

2020 SOAP Virtual Meeting Series



Raising the Standard For Each Woman Everywhere

SYLLABUS



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Abstract #: GM-01

Calcium chloride for the prevention of uterine atony during high risk cesarean delivery: A randomized clinical efficacy and safety study

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Presenting Author's Institution: Swedish Medical Center

Co-Authors: Jessica R. Ansari, MD - Stanford University
 Brendan Carvalho - Stanford University School of Medicine
 Edward Riley - Stanford University School of Medicine

BACKGROUND: Postpartum hemorrhage (PPH) is a leading cause of maternal mortality, and uterine atony (UA) causes 70-80% of PPH [1]. Current therapies for treatment of UA are limited by poor efficacy, adverse side effects, and expense. As such, a research priority is to develop new preventive approaches to reduce the incidence of UA and the need for a second line uterotonic medication. Extracellular calcium can significantly affect uterine contractility, and the efficacy of oxytocin diminishes in the setting of low calcium [2]. The aim of this study was to assess the efficacy and safety of intravenous calcium chloride (CaCl₂) in addition to standard oxytocin therapy to reduce UA.

METHODS: Single-center, blinded, randomized clinical pilot trial of women undergoing cesarean delivery with at least 2 risk factors for UA. Patients randomly received either 1 gram CaCl₂ (16.7mg/mL x 60mL) or placebo (60mL normal saline) as a 10 minute infusion started after umbilical cord clamping. The institution's standard oxytocin initial bolus (2 IU) and infusion (7.5-15 IU/h) as well as secondary uterotonic protocols were unaltered.

The primary outcome was incidence of UA, defined as any of the following: requirement for a second-line uterotonic, Bakri balloon, B-lynch, hysterectomy, or estimated blood loss (EBL) >1000 ml. Blood levels were established by measuring serial ionized calcium (iCa) levels in a subset of patients. A P value < 0.2 was considered a positive pilot study to justify a follow-up definitive evaluation study. Secondary outcomes included efficacy metrics (EBL, uterine tone score: 0-100% with 100% defined as optimal uterine tone as determined by the blinded obstetrician, and transfusion), side effects (IV site discomfort, nausea, vomiting, and changes in heart rate or blood pressure >20%) and safety (peak iCa levels, hemodynamic changes, complications).

RESULTS: Forty parturients (n=24 for iCa levels) were enrolled and analyzed. The incidence of UA was lower in women receiving CaCl₂ versus placebo (20% vs. 50%; p=0.09; Figure 1). There was a trend toward improved uterine tone score (median 89% vs 80%; p=0.14) and no difference in EBL (median 750 ml vs 850 ml; p=0.61). The CaCl₂ infusion was well tolerated with no difference in any side effects (30% in both groups; p=1.0) or any reported complications. The iCa level rose from a baseline of 1.18 mmol/L (95% CI 1.16-1.19) to a peak level in the 1.5-1.6 mmol/L range.

CONCLUSIONS: A CaCl₂ infusion given to women undergoing cesarean delivery was found to be effective with a large effect size decrease in incidence of UA from 50% to 20%. The infusion was well-tolerated and did not increase side effects compared to the placebo group. The results of this pilot study justify a definitive larger study to confirm the valuable contribution CaCl₂ could make as an effective, inexpensive, and well-tolerated intervention for the prevention of UA and PPH.

References:

1. Obstet Gynecol 2017; 130: e168-186
2. AJOG 1999;181(6):1445-51

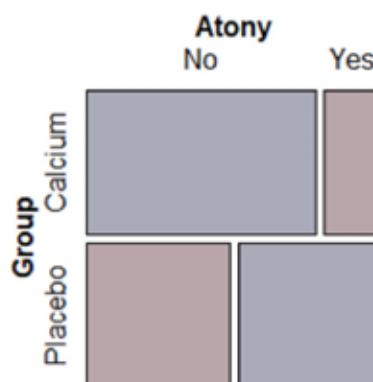


Figure 1: Effect of Calcium Infusion on Incidence of Uterine Atony.
 In the placebo + oxytocin arm (n=20), 50% of patients experienced uterine atony. In the calcium + oxytocin arm (n=20), 20% of patients experienced uterine atony. (p=0.09). Atony was defined *a priori* as any of the following: requirement for a second line uterotonic, Bakri balloon, B-lynch suture, hysterectomy, or blood loss greater than 1000mL.

Abstract #: GM-02

Ultrasound Measurement of the Optic Nerve Sheath Diameter in the Parturient

Presenting Author: Merry Colella, MD

Presenting Author's Institution: Beth Israel Deaconess Medical Center

Co-Authors: Philip Hess

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Introduction: The optic nerve sheath (ONS) is a flexible tube contiguous with the sclera and the dura mater. The diameter of the ONS widens with increases in intracranial pressure (ICP), due to transmission of ICP to the perineural subarachnoid space (1). The ONS diameter (ONSD) may be measured on ultrasound (Fig. 1a) and has been shown to correlate with direct measurements of ICP by invasive monitoring (2) and with head computer tomography findings of increased ICP (3). Thus, ONSD ultrasound is a convenient, noninvasive tool for identifying patients with elevated ICP in the emergency or neurocritical care units. Prior studies have identified an ONSD of >5 mm as a sensitive threshold value for detecting elevated ICP, defined as an ICP >20 mmHg. Critical changes in ICP can occur during the peripartum period due to a variety of causes, and ONS ultrasound may be useful for detecting and monitoring these changes. However, normal values in pregnancy are unknown. In this study, we aimed to establish normal values for both antepartum and postpartum ONSD on ultrasound in healthy term parturients.

Methods: 31 women undergoing scheduled cesarean delivery with neuraxial anesthesia who met inclusion criteria gave informed consent. A small linear array transducer was placed over the closed eyelid of each eye, the ONS was identified, and the best possible images were stored for measurement. For each participant, a total of 12 antepartum ONSD measurements were taken (3 measurements of each eye in both the seated and supine positions). These measurements were repeated at least 24 hours postpartum. The Shapiro Wilk test was used to confirm the normality of the data. Measurements were compared at each point using ANOVA, and between points using paired t-tests.

Results: Chronbach's alpha (0.89) showed a high level of inpatient consistency within each set of 3 measurements. All mean values were above 5.1 ± 0.7 mm. No significance was found when comparing Pre-Delivery Supine to Sitting ($p=0.73$), or Post-Delivery Supine to Sitting ($p=0.53$). No significant change was found when comparing Pre-Delivery and Post-Delivery measurements (Fig 1b) in either the Supine (Left: $p=0.42$; Right: $p=0.63$) or Sitting position (Left: $p=0.56$; Right: $p=0.77$).

Conclusions: Measurement of ONSD by ultrasound can be used with high levels of inpatient reliability. There is no statistically significant difference in ONSD from pre- to post-partum in our analysis, which suggests it may be possible to establish a single range of normal for the entire peripartum period. Mean values of greater than 5.1 ± 0.7 mm for healthy parturients appear to exceed the previously established threshold for elevated ICP in non-pregnant patients. Caution should be used when applying the normal values of non-pregnant ONSD to the parturient.

References:

1. *Surg Radiol Anat* 1996; 18(4):323-8.
2. *Acad Emerg Med* 2008; 15:201-204.
3. *Ann Emerg Med* 2007; 49:508-14.

Abstract #: GM-02

Fig. 1a: The optic nerve sheath as seen on ultrasound, with calipers denoting diameter for measurement.



Fig. 1b: Mean ONSD measurements obtained before and after delivery, in both the supine and sitting positions.

	Pre-Delivery			Post-Delivery	p values*
Supine (mm)			Supine (mm)		
Left Eye	5.2±0.5		Left Eye	5.1±0.7	0.42
Right Eye	5.3±0.6		Right Eye	5.2±0.7	0.63
Sitting (mm)			Sitting (mm)		
Left Eye	5.2±0.6		Left Eye	5.1±0.7	0.56
Right Eye	5.2±0.5		Right Eye	5.2±0.8	0.77
p values**	0.73			0.53	

*Comparison between Pre-Delivery and Post-Delivery measurements

**Comparison between Supine and Sitting measurements

Abstract #: GM-03

Identification of fetal genetic variants associated with *FLT1* transcription and preeclampsia

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Introduction: Preeclampsia (PE) affects 2-8% of pregnancies and accounts for significant maternal and neonatal morbidity and mortality. 55% of PE risk is heritable with both the maternal and fetal genomes contributing risk¹. A fetal genome-wide association study (GWAS) of PE demonstrated that genetic loci near the *FLT1* gene are associated with PE². *FLT1* encodes sFlt1, a soluble form of the VEGF receptor produced primarily in the placenta and strongly implicated in PE pathogenesis. As genetic loci from GWAS denote trait-associated regions, but are usually not themselves the causal genetic variants, we undertook a multiple parallel reporter assay (MPRA) approach to identify genetic variants near *FLT1* casually-associated with PE³.

Methods: Fetal genomes from PE (n=200) and normotensive (N=2000) pregnancies were used to select PE-associated genetic variants in a region from 25kb downstream to 200 kb upstream of the *FLT1* locus. Variants in this same region were identified in gnomAD, and the total collection of variants were annotated and prioritized based on bioinformatic features predicted to impact gene expression, with 100 variants selected for evaluation with the MPRA as an initial proof-of-concept. A plasmid library containing multiple variant representations tagged with a unique oligonucleotide barcode was synthesized and sequenced. A placental trophoblast cell line (HTR8) and a neuroendocrine cell line (PC-12) were transfected with the MPRA library. Total RNA was isolated, MPRA library RNA was purified and converted to cDNA, and then barcode counts were quantified with RNAseq.

Results: Of the 100 *FLT1*-associated variants evaluated, 9 demonstrated statistically significant effects on transcription in the MPRA (see Table 1). These 9 variants were all rare variants with strong predicted transcriptional effects; more common variants, including those from the fetal GWAS, did not show an effect on expression in the MPRA. Each variant was represented in a three ways in the library to account for positional effects of flanking nucleotide sequence; of the 9 total variants, 3 had more than one of these representations impact transcription. Three of the 9 variants, including all of those with multiple active representations, lie in candidate cis-regulatory elements (cCREs) described in ENCODE. These CREs show strong DNase-seq and ChIP-seq signals from placental tissues, consistent with a role for these regions as distal enhancers.

Conclusion: MPRA is a high-throughput method for following up GWAS results and identifying causal genetic variants with effects on gene transcription. Ongoing work aims to validate and further characterize these significant *FLT1*-associated variants and to construct a second expanded variant library in order to determine which fetal genetic variants most influence sFlt1 expression and PE pathogenesis.

References:

1. Gray KJ et al *Am J Obstet Gynecol* 2018
2. McGinnis R et al *Nat Genet* 2017

Table: Variants with statistically significant impact on expression in MPRA

Variant	Chr. 13 position (hg38)	Ref/alt allele	Alt allele freq	Active Oligos	LogSkew	ENCODE cCRE designation
rs182125072	28505702	G/C	0.0002	2	-0.188	Distal Enhancer
rs923589501	28505705	G/T	0.000097	2	-0.350	Distal Enhancer
rs1160085455	28532784	C/A	0.000033	1	-0.378	Distal Enhancer
rs1172975466	28533164	G/C	0.000032	1	1.226	NA
rs772548014	28540081	G/T	0.000032	1	0.652	NA
rs953355019	28540634	C/A	0.000097	1	-0.338	NA
rs1404379650	28540713	G/C	0.000032	1	0.158	NA
rs9506009	28547707	G/C	0.99	1	-0.329	NA
rs1264400849	28569774	C/T	0.000032	3	-0.767	Distal Enhancer

Abstract #: GM-04

Serial Serum Interleukin Assessment in Labouring Women receiving Epidural Analgesia: A prospective observational study

Presenting Author: Richard Katz

Presenting Author's Institution: The Rotunda Hospital, Dublin. John Radcliff Hospital, Oxford

Co-Authors: Fionnuala Breathnach - RCSI, Rotunda Hospital

Anne Doherty - RCSI, Rotunda Hospital

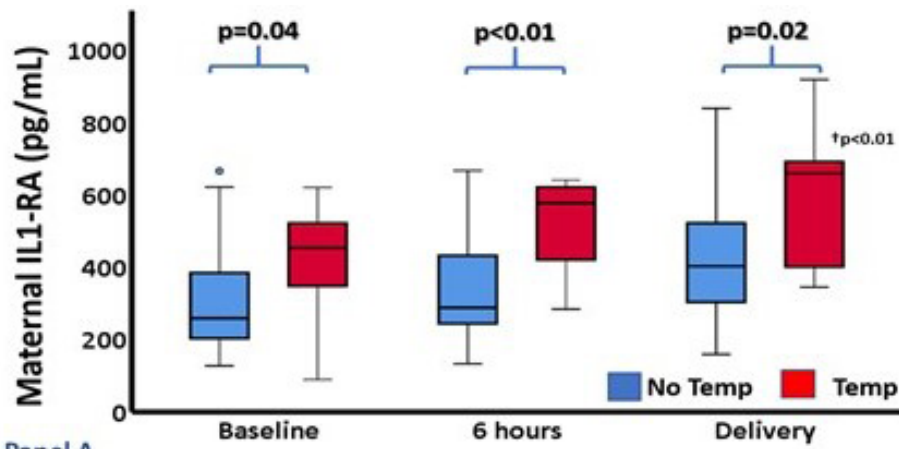
Emma Doyle - Rotunda Hospital

Richard Drew - Rotunda Hospital

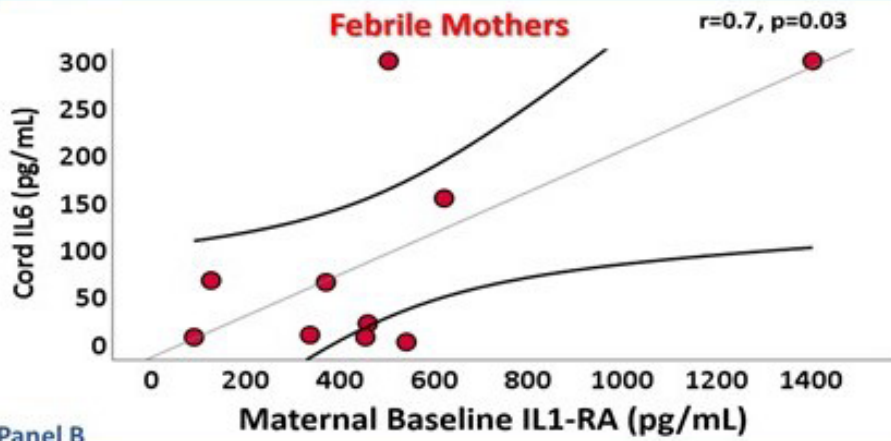
Afif EL Khuffash, MD - RCSI, Rotunda Hospital

Epidural related fever occurs in 20% of labouring women receiving epidural analgesia. The causative mechanism is unclear. It is regarded as a sterile phenomenon triggered by epidural local anaesthetics in labour. We examined serum maternal interleukin 6 (IL6), interleukin 1 β (IL1B) and interleukin 1 receptor antagonist (IL1-RA) before and after epidural analgesia in labouring women at term and correlated our findings with cord blood analysis. We hypothesized that changes in maternal circulating interleukins would be associated with maternal fever in labour. Methods: This was a prospective observational study of healthy primiparous women presenting for term induction of labour. Patients who had received immunomodulating agents (steroids or magnesium), those who subsequently had prolonged rupture of membranes prior to commencing the study protocol, and patients who delivered or developed fever earlier than four hours after epidural placement were excluded. Maternal serum samples were obtained prior to epidural insertion, six hours after commencing labour epidural analgesia, and upon delivery. Maternal fever was defined as a maternal temperature of 38°C (100.4°F). Cord blood samples were obtained upon delivery of the placenta. Results: Fifty-seven mothers with a median [IQR] age and gestation of 32 [29 – 36] years and 40 [39 – 41] weeks respectively were included. Twelve patients developed fever >4 hours after the epidural was sited (21%). There was no difference in age or gestation at delivery between febrile and non-febrile mothers ($p > 0.05$). In addition, there was no difference in the duration of induction between the two groups (28 [17-34] vs. 25 [18-36] hours, $p=0.9$). Maternal serum IL6 levels increased significantly throughout labour ($p < 0.01$) in the entire cohort with no difference between febrile and non-febrile mothers at any timepoint. IL1B levels did not increase in either group over time, however IL1B was higher in the febrile group at 6 hours (2.9 [2.6-3.8] vs. 2.3 [1.9-3.4] pg/mL, $p=0.04$). There was a significant difference between the groups in IL1-RA levels at all time points (Figure 1, Panel A). IL1-RA also increased significantly during labour in both groups ($p=0.01$). Maternal baseline IL1-RA correlated with cord blood IL6 in those women who developed fever (Figure 1, Panel B and C). Maternal baseline IL1-RA was predictive for fever in labour (AUC 0.7, 95%CI 0.5 – 0.9, $p=0.048$; cut-off of 330 pg/ml, sensitivity 82%, specificity 70%). Conclusion: Our study suggests that some patients in pregnancy have an elevated IL1-RA at the onset of labour which could identify an increased risk of developing maternal related epidural fever and increased cord blood IL6. Although IL1-RA is an anti-pyretic, elevated levels in women prior to initiation of epidural analgesia could indicate a pre-disposition to an auto-inflammatory reaction in labour, triggered by systemic absorption of local anaesthetic and its action on the maternal immune system.

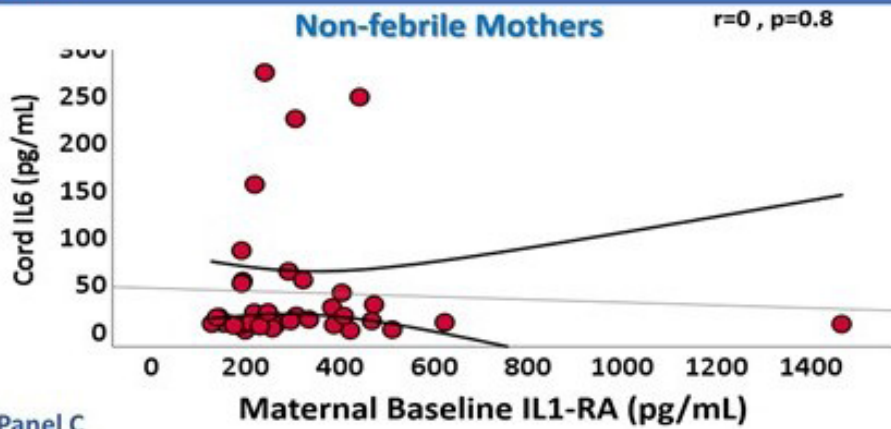
Abstract #: GM-04



Panel A



Panel B



Panel C

Figure 1. Panel A: Serial Maternal IL1-RA over the three time points. Box plot represents median and interquartile range, whiskers represent 5th and 95th percentiles. † represents p value for change over time in the entire cohort. Panels B and C: Correlation between maternal baseline IL1-RA and cord blood IL6 in febrile (panel B) and non-febrile (panel C) mothers.

Abstract #: GM-05

Rural and Urban Disparities in Severe Maternal Morbidity and Mortality in the United States

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Introduction: Rural and urban disparities in chronic health conditions and outcomes are well documented in many areas of medicine but are less defined in obstetrics patients compared to the general population. Limited data suggests an increased risk of severe maternal morbidity (SMM) and mortality associated with rural residence (1), however, this association is not well characterized. Women in rural areas may experience disproportionate challenges accessing high quality health services due hospital or obstetric unit closures, provider shortages, and other socioeconomic determinants of health. We evaluate potential disparities in SMM and mortality in parturients living in rural vs. urban locations.

Methods: Hospital admissions data for obstetric deliveries, 2012 -2015, were extracted from the National Inpatient Sample. SMM and the obstetric comorbidity index (OB-CMI) were defined based on diagnosis and procedure codes of the International Classification of Diseases, 9th Revision, Clinical Modification (2). Patients with an OB-CMI ≥ 5 were classified as high risk. Rural residency was determined based on the National Center for Health Statistics definition of nonmetropolitan counties. SMM and mortality were compared between rural vs. urban-dwelling patients using survey-weighted multivariable logistic regression.

Results: 2,836,008 delivery hospitalizations were identified. 14.21% of parturients lived in a rural location. The frequency of SMM excluding transfusion was 3,078/401,817 (0.77%) among rural vs. 20,268/2,426,413 (0.84%) among urban parturients; SMM including transfusion was 7,522/401,817 (1.87%) and 44,849/2,426,413 (1.85%) in rural vs. urban women, respectively. After adjusting for comorbidity and socioeconomic factors, rural residence was associated with an increased risk of a composite outcome of mortality and SMM including transfusion (OR 1.10 [95% CI 1.06, 1.14]); however, when transfusion was excluded from the composite outcome, the difference was no longer present (OR 1.00 [0.95, 1.05]). Transfusion risk among rural-based parturients was increased (OR 1.15 [1.10, 1.20]). Analysis restricted to high risk patients showed no difference in transfusion risk (OR 0.94 [0.84-1.05]), while a significant difference in low risk patients was found (OR 1.17 [1.12, 1.22]).

Conclusion: After adjustment for maternal comorbidities, the risk of SMM independent of transfusion does not appear to be increased in rural populations, for either low or high risk patients, suggesting that the health care system is adequately optimizing risk-appropriate care and outcomes for many maternal conditions. Higher rates of obstetric hemorrhage, as evidenced by increased transfusion rates, was identified in parturients from rural residence, particularly in low risk patients. Rural hospitals may benefit from quality improvement initiatives that emphasize hemorrhage detection and management.

References:

1. Kozhimannil et al. *Health Aff.* 2019
2. Bateman et al. *Obstet Gynecol.* 2013

Abstract #: GM-05

Likelihood of Severe Maternal Morbidity and Mortality in the United States, 2012-2015				
Selected Characteristics	Risk of Severe Morbidity, Including Transfusion, and Mortality		Risk of Severe Morbidity, Excluding Transfusion, and Mortality	
	Adjusted Odds Ratio	95% CI	Adjusted Odds Ratio	95% CI
Rural residence (ref: urban residence)	1.10	1.06, 1.14	1.00	0.95, 1.05
OB-CMI (continuous)	1.54	1.53, 1.55	1.60	1.59, 1.61
Age (continuous)	0.99	0.98, 0.99	1.00	1.00, 1.00
Race/Ethnicity (ref: non-Hispanic White)				
Non-Hispanic Black	1.56	1.50, 1.61	1.38	1.32, 1.44
Hispanic	1.25	1.21, 1.29	1.08	1.03, 1.13
Asian or Pacific Islander	1.28	1.20, 1.35	1.22	1.14, 1.30
American Indian or Alaska Native	1.36	1.20, 1.54	1.14	0.97, 1.34
Other	1.39	1.32, 1.47	1.28	1.19, 1.38
Unknown	0.99	0.93, 1.05	1.06	0.98, 1.14
Primary Payer Type (ref: private insurance)				
Medicare	1.63	1.50, 1.79	1.69	1.52, 1.89
Medicaid	1.12	1.09, 1.15	1.03	0.99, 1.06
Self-pay	1.20	1.13, 1.28	1.05	0.96, 1.15
No charge/other	1.08	1.00, 1.15	1.03	0.95, 1.13
Median Income of Zip Code (ref: top quartile, 66,000+)				
Quartile 1 (1-39,999)	1.10	1.05, 1.14	1.08	1.03, 1.13
Quartile 2 (40,000-50,999)	1.04	1.00, 1.09	1.05	1.01, 1.10
Quartile 3 (51,000-65,999)	1.02	0.98, 1.06	1.02	0.98, 1.07
Year (continuous)	1.01	0.98, 1.03	0.99	0.97, 1.01

Abstract #: GM-06

Oxytocin at Elective Cesarean Deliveries: A Dose-finding Study in Women with Obesity

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Background: Prophylactic oxytocin usage at third stage of labor reduces blood loss and the need for additional uterotonics (1). Obesity has been associated with increased risk of uterine atony and postpartum hemorrhage (PPH) (2). It is unknown whether women with obesity need higher doses of oxytocin for uterine contraction. The purpose of this study was to establish the bolus dose of oxytocin for producing effective uterine contraction in 90% of women (ED90) at elective cesarean delivery (CD). Our hypothesis was that the ED90 of oxytocin would be $>0.5\text{IU}$ but $<5\text{IU}$.

Methods: We conducted a double-blind dose finding study using the biased coin up-down design (BCD) method. Term pregnant women with BMI $>40\text{ kg/m}^2$ undergoing elective CD under regional anesthesia (spinal, combined spinal-epidural or epidural anesthesia) were included. Those with conditions predisposing to PPH were excluded. Oxytocin was administered IV as a bolus over 1 minute upon delivery of the fetus in a blinded manner. Starting with 0.5IU , oxytocin doses $0.5, 1, 2, 3, 4, 5\text{ IU}$ were determined according to the BCD allocation targeting ED90. The primary outcome, defined as the satisfactory/adequacy of uterine tone was assessed by the obstetrician at 2 minutes after the administration of the oxytocin bolus. Secondary outcomes included need for rescue uterotonics, adverse effects, and estimated blood loss. The ED90 was estimated using the Dixon-Mood and the Isotonic Regression methods.

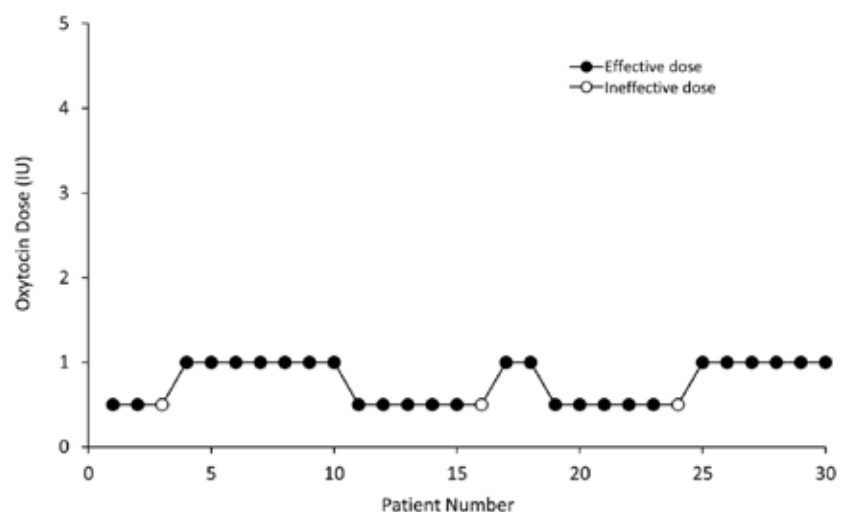
Results: We studied 30 women with BMI ranging from 40.5 to 66.9 [mean (SD)= 52.3 (7.5)] kg/m^2 . The estimated ED90 (95% CI) of oxytocin was 0.78 IU ($0.68\text{--}0.88$) and 0.75 IU ($0.5\text{--}0.93$) by the Dixon-Mood and Isotonic Regression methods, respectively (Figure 1). The overall incidence of hypotension after oxytocin administration was 47%, nausea 33% and vomiting 10%. Mean (SD) estimated blood loss was 1277 (801)mL.

Discussion: Our results suggest that women with BMI $>40\text{ kg/m}^2$ require approximately twice as much oxytocin as compared to those with BMI $<40\text{ kg/m}^2$ (ED90 0.35 IU ; 95% CI $0.18\text{--}0.52\text{ IU}$) (3). It is reassuring that the required bolus dose of oxytocin for these women is within the currently published recommendations of 1IU for women at elective CD (4) and far less than the traditional use of $5\text{--}10\text{IU}$ boluses.

References:

1. Cochrane Database of Systematic Reviews 2019;4;
2. BJOG 2013; 120:853–862;
3. Obstet Gynecol 2004; 104:1005-10;
4. Anaesthesia 2019; 74:1305-1319.

Figure 1: Sequence of oxytocin dose allocation



Abstract #: GM-07

Low-Dose Intravenous Dexmedetomidine Reduces Shivering Following Cesarean Delivery

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Philip Hess

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Margaret O'Donoghue, MD - Albany Medical Center

Sichao Xu, MD - BIDMC/HMS

Background: Intravenous dexmedetomidine at doses higher than presented here reduces shivering and nausea after cesarean delivery, but can result in sedation and other side effects (1-3). We hypothesized that prophylactic administration of low-dose intravenous dexmedetomidine (DEX) would reduce the incidence of shivering after cesarean delivery without increased incidence of side effects.

Methods: IRB approval was obtained prior to enrollment of subjects. Women undergoing scheduled cesarean delivery with spinal anesthesia were randomized to receive either normal saline or DEX 10 mcg IV immediately after delivery. Randomization and drug preparation was performed by the investigational pharmacy to ensure blinding. Our primary outcome was subjective shivering score by VAS scale at 30 and 60 minutes after arrival in the PACU. Secondary outcomes included subjective scores for pain, nausea, itching, dry mouth, and sedation, as well as 24-hour medication administration and investigator-rated observations of vomiting, shivering, pruritis, and sedation. Repeated-measures Tukey-Kramer statistical analysis was applied.

Results: Results reported as percentages or as median (IQR) where appropriate. 100 patients were enrolled, and 85 were included in analysis. 15 patients met predefined intraoperative exclusion criteria of postpartum hemorrhage and did not receive the study medication. There was no difference in baseline characteristics. The VAS shivering scores were lower in the DEX group over the first 60 minutes ($p=0.0002$). Presence of shivering was more common in both groups at 30 minutes versus baseline and the 60-minute timepoint, and intensity of shivering in the DEX group was significantly lower than among controls at 30 minutes (placebo 0.2 (0-2.6) vs. DEX 0 (0-0.5), $p=0.044$, **Figure 1**). Patient-reported and observer-rated side effects did not differ between groups. Postoperative medication administered for pain, nausea, and GI symptoms within 24 hours were similar between groups, with the exception of naloxone for pruritus (placebo 34% vs. DEX 14%, $p=0.04$).

Conclusions: Prophylactic administration of dexmedetomidine 10 mcg IV after delivery reduces shivering without notable side effects.

References:

1. *Drug Res.* 2015; 65: 468-472.
2. *Anesth Essays Res.* 2013; 7(2): 168-172.
3. *Can J Anesth.* 2019; 66: 762-771.

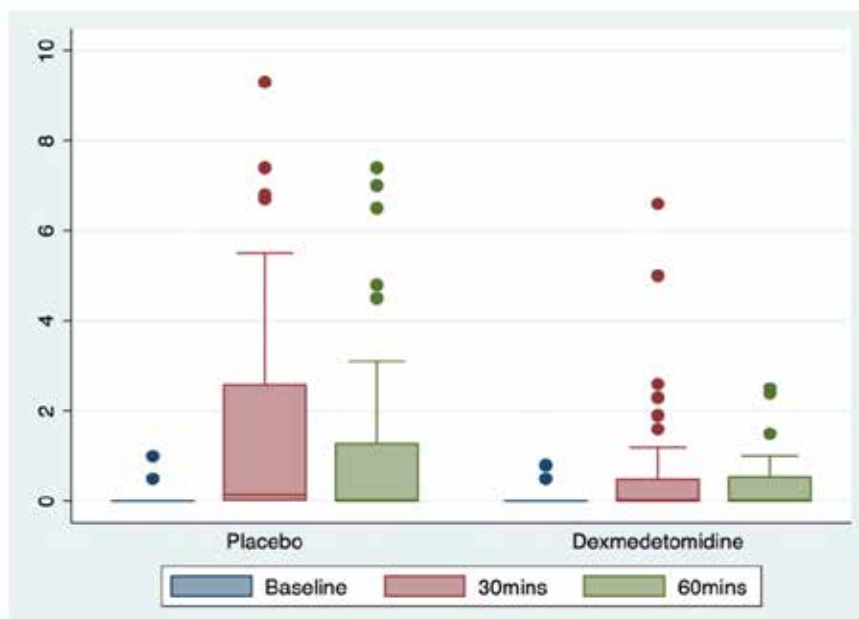


Figure 1. Intensity of shivering at baseline, 30min, and 60min.

Abstract #: GM-08

The Dural Puncture Epidural Technique: An Investigation with Porcine Epidural and Spinal Spaces

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Background: The dural puncture epidural (DPE) technique involves placing a 17G Weiss needle in the epidural space, introducing a 25G Whitacre needle via the Weiss needle to puncture the dural sac, and threading a catheter into the epidural space. All medications are dosed through the epidural catheter.¹ Compared to a conventional epidural (EPL) technique, the DPE has faster onset, greater bilateral and sacral coverage, fewer top-up requests, with no difference in rates of maternal hypotension, fetal bradycardia, high sensory block, or post-dural puncture headache.¹⁻⁴ As radiographic evaluation of neuraxial techniques is limited to EPL techniques,^{5,6} we conducted a fluoroscopy and necropsy porcine study to elucidate the mechanism, spread and distribution of EPL, DPE, and combined-spinal epidural (CSE) techniques.

Methods: Following approval by our Animal Care and Use Committee, four 60 kg Yorkshire female pigs were sedated, intubated, and maintained with isoflurane in oxygen. Placed in the left lateral decubitus position, each pig had an attempted EPL, DPE, or CSE technique by a single operator at lumbar, low thoracic, or mid thoracic levels using a loss-of-resistance to air technique and fluoroscopy. Radio-opaque contrast (1 mL) was administered via the EPL catheter at 0, 45, 90, 135, and 180 min. Spread was assessed with fluoroscopy during injections. Dye (1 mL) was administered via the EPL catheter at 3 or 6 hrs, the animals euthanized, and necropsy performed to assess dye distribution.

Results: Ten experiments were conducted—consisting of EPL, DPE and CSE techniques, an inadvertent 17G dural puncture and a subcutaneous catheter placement. Fluoroscopic images demonstrated greatest to least segmental spread with CSE > DPE > EPL techniques throughout the 3-hr study period. Dye distribution was distinct to each technique (Table 1): With an EPL, dye was visualized only in the epidural space; DPE dye was visualized in both the epidural and subarachnoid spaces, though less than with a CSE at both 3 and 6 hrs.

Conclusion: Our findings explain the clinical characteristics of the DPE technique: Dural sac puncture allows medication translocation from epidural to subarachnoid spaces for at least 6 hrs. This mechanistic understanding of the DPE, CSE, and EPL techniques offers insight into the procedural elements that ultimately contribute to the ideal neuraxial technique: one that provides rapid onset, reliable spread and quality, and titratable depth and duration, while balancing the risks of less desirable maternal and fetal outcomes.

References:

1. *Anesth Analg* 2008;107,1646-51
2. *Anesth Analg* 2017;124,560-69
3. *IJOA* 2019;40,24-31
4. *Anesth Analg* 2018;126,545-51
5. *Br J Anaesth* 2016;116,277-81
6. *Int J Obstet Anesth* 2017;32,88-89

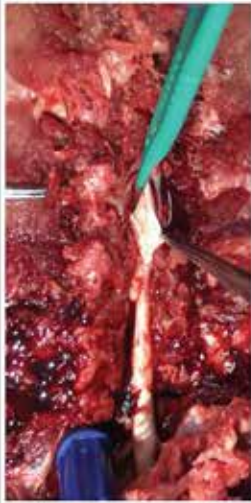
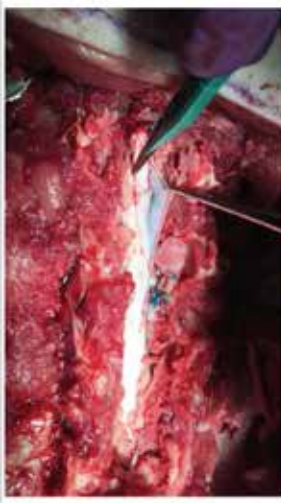


	EPL	DPE	CSE	Inadvertent Dural Puncture
Necropsy				
Dye Epidural	+	+	+	+
Dye Intrathecal	-	+	++	++

Table 1. Necropsy dye distribution, spread, and magnitude for epidural (EPL), dural puncture epidural (DPE), combined spinal epidural (CSE), and inadvertent dural puncture epidural techniques.

Abstract #: ET1-01

Association of First Trimester Opioid Use with Congenital Malformations in the Offspring

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Background: Nationwide estimates from the United States report approximately 22% of Medicaid beneficiaries and 14% of commercial insurance beneficiaries are dispensed a prescription opioid during pregnancy. Prior studies suggest an association between in-utero opioid exposure and certain congenital malformations, but data are few and conflicting.

Objective: To evaluate the risk of 1st trimester in-utero opioid exposure with respect to congenital malformations previously suggested to be associated with opioid exposure including major malformations overall, cardiac malformations overall, ventricular septal defects (VSD), secundum atrial septal defects/patent foramen ovale (ASD/PFO), neural tube defects (NTD), club foot, and oral clefts.

Methods: The study used pregnancy cohorts nested in the Medicaid Analytic eXtract (MAX), which includes healthcare utilization data for Medicaid beneficiaries from 2000 to 2014 and the IBM Health MarketScan Research Database, which includes data for commercial insurance beneficiaries from 2003 to 2015. Exposure was defined based on ≥ 2 dispensings for any opioid during the 1st trimester. Validated claims-based algorithms were used to define the malformations of interest in the offspring. Relative risks (RR) and 95% confidence intervals (CI) were estimated using propensity-score stratification to adjust for potential confounders including demographics, pain conditions, concomitant drug exposures, and comorbidities. Estimates from each database were combined using random effects meta-analysis.

Results: The study cohort consisted in 1,602,580 pregnancies in the MAX cohort of which 70,447 (4.4%) were exposed to opioids during the 1st trimester and 1,177,676 pregnancies in the MarketScan cohort of which 12,454 (1.1%) were exposed to opioids during the 1st trimester.

The pooled unadjusted relative risk (RR) estimates were elevated for all primary study outcomes but shifted substantially toward the null after adjustment. Adjusted pooled estimates did not suggest a meaningfully elevated risk for congenital malformations overall (RR 1.06, 95% CI 1.01 to 1.11), cardiovascular malformations overall (RR 1.09, 95% CI 1.00 to 1.18), VSD (RR 1.07, 95% CI 0.95 to 1.21), ASD/ PFO (RR 1.04, 95% CI 0.88 to 1.24), NTD (RR 0.82, 95% CI 0.53 to 1.27), or club foot (RR 1.06, 95% CI 0.88 to 1.28). In contrast, the pooled estimate for oral clefts remained elevated after adjustment (RR 1.31, 95% CI 0.84 to 2.04). This association was explained by a higher relative risk of cleft palate (RR 1.77, 95% CI 0.96 to 3.27); estimates were close to the null for cleft lip and cleft palate with cleft lip. These findings were consistent across multiple sensitivity analyses.

Conclusions: After adjusting for relevant confounders, opioid exposure was not associated with a substantial increase in risk for malformations overall, cardiac malformations overall, VSD, ASD/PFO, NTD, or club foot, but was associated with a 30% increase in the risk of oral clefts.

Abstract #: ET1-02

Gabapentin does not affect post-cesarean opioid consumption or pain scores in women taking buprenorphine and receiving neuraxial morphine: a 10-year retrospective cohort study

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Intro: Buprenorphine (BPR) used to treat opioid use disorder (OUD) during pregnancy impedes effective post-cesarean analgesia due to its high affinity and low intrinsic activity at mu receptors.¹ Gabapentin (GPN) is not generally utilized for post-cesarean analgesia in patients without OUD given conflicting data on analgesic benefit^{2,3,4} and concern for sedating side effects. Analgesic benefits of GPN in women taking BPR who have received neuraxial morphine for cesarean delivery (CD) remain unknown. We sought to determine effects of GPN on post-CD opioid consumption and pain scores in women taking BPR and receiving neuraxial morphine.

Methods: We performed a database search for all records of women taking BPR who underwent CD, 2007-2017. The multimodal post-CD regimen was standard during that period (ketorolac, ibuprofen, acetaminophen, hydro-/oxycodone). Data were collected via manual chart review and entered into a study spreadsheet. Opioid consumption (morphine milligram equivalents, MME) and mean verbal numerical pain scale scores (0-10) were calculated at POD0, POD1 and POD2 for all patients. Pearson Chi-square and Wilcoxon tests were then used as appropriate to compare outcomes between those who received ≥ 1 dose GPN within 24 hours of CD (GPN group) and those who received none (control, CTL). Linear regression was used to examine association between study groups and outcomes (MME and pain score on POD0, POD1 and POD2) while adjusting for pre-specified potential confounders (anesthesia type, incision type, repeat CD, operation time, dose of buprenorphine, gabapentin, ketorolac, ibuprofen, and acetaminophen).

Results: 220 records were identified and analyzed—48 (22%) GPN vs 172 (78%) CTL. Mean daily GPN dose was 630mg. There were no differences in baseline characteristics or post-CD multimodal analgesics between groups (table), except that GPN patients were less likely than CTL patients to have undergone neuraxial anesthetic (83% v 94%, $p=0.025$) and more likely to have received acetaminophen (94% v 83%, $p<0.001$). Post-CD opioid consumption and pain scores were not different between groups (table).

Discussion: In women receiving BPR, we observed no benefit of GPN in decreasing opioid consumption or reducing pain scores after CD. This is despite higher acetaminophen use in that group. Average pain scores exceeded 6/10 in both groups at all measured time periods, highlighting the difficulty in achieving effective analgesia in these patients, even with high utilization (nearly 90%) of a multimodal analgesic regimen. Given lack of analgesic benefit, inclusion of GPN is unsupported as of yet in this population. Future prospective studies will help to confirm these findings, and to determine more effective strategies (e.g, thoracic epidural or fascial plane blocks) to better treat post-CD pain in parturients taking buprenorphine.

References:

1. PMID: 26580836
2. PMID: 21081764
3. PMID: 23011560
4. PMID: 26200182

Abstract #: ET1-02

		Post-CD Gabapentin Given (N=48)	No Post-CD Gabapentin Given (N=172)	P value
Baseline Characteristics				
Age (years)		29 ± 5	29 ± 5	0.94
Gravida		4 ± 2	4 ± 2	0.73
Paragravida		2 ± 2	2 ± 1	0.54
BMI (kg/m ²)		32 ± 6	30 ± 7	0.11
Number of prior CD	0	19 (40%)	72 (42%)	0.38
	1	17 (35%)	53 (32%)	
	2	9 (19%)	27 (16%)	
	3	2 (4%)	15 (9%)	
	≥4	1 (2%)	1 (1%)	
Smoking status	Current	42 (88%)	154 (91%)	0.48
	Former	4 (8%)	7 (4%)	
	Never	2 (4%)	9 (5%)	
Operative time (min)		56 ± 22	56 ± 28	0.79
Anesthesia type	Neuraxial	40 (83%)	161 (94%)	0.025
	General	8 (17%)	11 (6%)	
Incision type	Transverse	48 (100%)	169 (98%)	0.36
	Vertical	0 (0%)	3 (2%)	
Multimodal Analgesics				
Ketorolac	Yes	41 (85%)	147 (85%)	
	No	7 (15%)	25 (15%)	
Dose (mg)	POD 0	35 ± 31	37 ± 29	0.55
	POD 1	36 ± 34	30 ± 31	0.29
	POD 2	0.6 ± 4	3 ± 15	0.36
Ibuprofen	Yes	43 (90%)	158 (92%)	
	No	5 (10%)	14 (8%)	
Dose (mg)	POD 0	112 ± 319	157 ± 347	0.31
	POD 1	1150 ± 771	1301 ± 803	0.22
	POD 2	1685 ± 807	1853 ± 715	0.12
Acetaminophen	Yes	45 (94%)	143 (83%)	
	No	3 (6%)	29 (17%)	
Dose (mg)	POD 0	1136 ± 864	356 ± 597	<0.001
	POD 1	2358 ± 1287	1114 ± 946	<0.001
	POD 2	2155 ± 1145	996 ± 986	<0.001
Buprenorphine dose (mg)	POD 0	12 ± 9	10 ± 8	0.08
	POD 1	17 ± 7	16 ± 7	0.17
	POD 2	17 ± 6	15 ± 7	0.24
Opioid and Pain Outcomes				
Opioid Consumption (MME)	POD 0	43 ± 110	35 ± 67	0.42
	POD 1	77 ± 72	80 ± 73	0.94
	POD 2	25 ± 9	23 ± 9	0.20
Average Pain Score (NRS)	POD 0	6.7 ± 1.6	6.3 ± 1.9	0.36
	POD 1	6.5 ± 1.2	6.3 ± 1.6	0.45
	POD 2	6.5 ± 1.1	6.1 ± 1.5	0.17

Data presented: n (%) or mean ± SD.

Abbreviations: BMI- body mass index, CD- cesarean delivery, POD- Postoperative day, min- minutes, mg- milligrams, MME- morphine milligram equivalents, NRS- numeric rating scale

Abstract #: ET1-03

Individual in-hospital opioid trajectories after cesarean delivery: An observational cohort study.

Presenting Author: Ruth Landau

Presenting Author's Institution:

Co-Authors: Janice J. Aubey, M.D. MPH - Columbia University

Bahaa E. Daoud, M.D. - Columbia University

Jean Guglielminotti

Background: Guidelines for opioid use after cesarean delivery (CD) recommend avoiding unnecessary maternal opioid exposure,¹ and reducing discharge opioid prescriptions to limit the risk of persistent use and potential misuse.² Opioid prescribers are now encouraged to individualize discharge opioid prescriptions with a recommended range between 0-20 pills.³ Prescribers have raised concern that pain and opioid use might actually increase at discharge, as women become more active. We evaluated individual trajectories of daily opioid use from CD until discharge, hypothesizing that opioid use would be highest on 1st post-CD day, with a reduction on 2nd day, which may help guide discharge opioid prescription.

Methods: Data for all CD cases in 2018 were abstracted from an EMR and an institutional QA/QI Opioid Dashboard that records in-hospital opioid use. The study sample was limited to cases with a postoperative stay of 3 days (excluding cases with severe co-morbidities or surgery). Number of oxycodone pills used on CD day (POD0) and 2 following days (POD1 & POD2) was recorded for each case. Anesthesia protocol includes neuraxial morphine (150mcg IT or 3mg epidural), IV ketorolac 30mg at end of case (unless CI), followed by multimodal opioid-sparing analgesia (standard PO acetaminophen & ibuprofen q6h, oxycodone 5mg for breakthrough pain only with max daily dose of 6 pills). Proportion of oxycodone users and mean daily number of oxycodone pills were calculated and compared across the 3 days. Individual trajectories between POD1 and POD2 were analyzed with a change ≥ 2 pills deemed clinically relevant.

Results: There were 1421 CD included in the analysis (Table). The proportion of oxycodone users increased significantly from POD0 (33.8%) to POD1 (47.1%) and then decreased from POD1 to POD2 (40.4%; $P < 0.001$). Similarly, the mean daily number of oxycodone pills increased from POD0 (0.6 pill) to POD1 (1.1 pills) and then decreased from POD1 to POD2 (0.9 pill; $P < 0.001$). However, inter-individual variations were observed for changes between POD1 and POD (Figure): 161 (11.3%) had a decrease ≥ 2 pills from POD1 to POD2, 81 (5.7%) had an increase ≥ 2 pills, and 1179 (82.9%) a change < 2 pills.

Conclusions: As expected, the proportion of women using any opioid on the day of CD was relatively low (1:3 women), as a result of the long-acting analgesic effect of neuraxial morphine, which was then followed by an increase on POD1. The mean daily use of opioids was in the order of 0-2 pills, which highlights that opioid use is low when opioid-sparing strategies are employed.

Overall, we observed a reduction in opioid use between POD1 and POD2, with some variation in opioid trajectories. Our data supports recommending individualized opioid prescriptions at discharge with a proposed range between 0-10 pills for 5 days of use.

References:

1. Postpartum Pain Management *Obstet Gynecol* 2018
2. Bateman, *Obstet Gynecol* 2017;130:29-35
3. Overton, *J Am Coll Surg* 2018;227:411-18

Abstract #: ET1-03

Table. In-hospital oxycodone use after cesarean delivery (N=1421 in 2018).

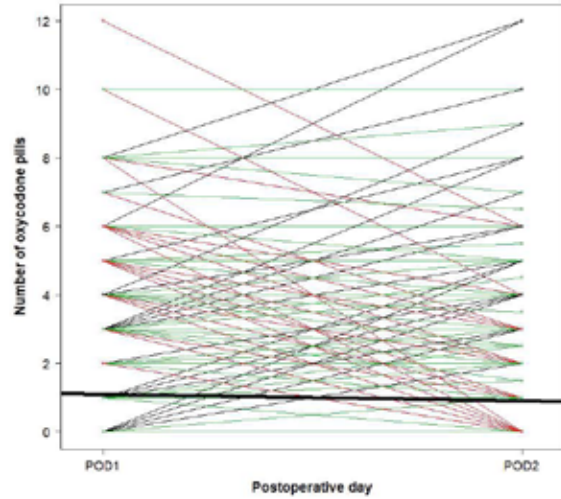
	On CD day (POD0)	On post-CD day 1 (POD1)	On post-CD day 2 (POD2)	P-value	POD0 versus POD1	POD0 versus POD2	POD1 versus POD2
Number of women using oxycodone	481 (33.8%)	670 (47.1%)	574 (40.4%)	< 0.001	< 0.001	< 0.001	< 0.001
Number of oxycodone pills (median)	0 (0-1)	0 (0-2)	0 (0-1)	**	**	**	**
	Mean = 0.59	Mean = 1.11	Mean = 0.91	< 0.001	< 0.001	< 0.001	< 0.001

Results expressed as count (%), median (interquartile range), or mean.
 Abbreviations: CD: cesarean delivery; POD: postoperative day.

Figure. Spaghetti plot of daily oxycodone use (number of oxycodone 5mg pills) for each patient (N=1421) on POD1 and POD2 .

The thin black lines indicate an increase ≥ 2 pills between POD1 and POD2 (81 patients or 5.7%) The red lines indicate a decrease ≥ 2 pills (11.3%). The green lines indicate a change < 2 pills (82.9%). The thick black line is the regression line from a linear regression.

On POD1, there were 14 women who used more than 6 pills (the maximum recommended dose); these were 'outliers' requiring an increase in opioid prescription (from 1 pill q4h to 2 pills q4h).



Abstract #: ET1-04

The use of neuraxial labor analgesia is associated with higher postpartum pain score and larger analgesic consumption.

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Tokujiro Uchida, MD PhD - Tokyo Medical and Dental University

Background: No previous studies have revealed any differences in postpartum pain burden between women who used neuraxial labor analgesia and those who did not. Moreover, few data are available on the intensity of pain that women experience during the first five days after delivery.

Methods: We performed a retrospective cohort study based on chart review of all women who delivered vaginally at an urban teaching hospital between April 2017 and September 2019. The primary outcome was the area under the curve of pain score on numeric rating scale (NRS) documented in electric medical records for five days postpartum (NRS-AUC_{5days}), which we calculated using the equation demonstrated in Figure 1. Secondary outcomes included peak NRS score, doses of oral and intravenous analgesics consumed during the first five days postpartum, and length of postpartum hospital stay. Chi-square test and non-parametric Mann-Whitney U test were used to assess categorical and continuous variables, respectively. Logistic regression was used to examine the association between the use of neuraxial labor analgesia and NRS-AUC_{5days} adjusting for relevant confounders.

Results: During the study period, 1057 women (42.4%) underwent vaginal delivery with neuraxial analgesia (NA) and 1437 (57.6%) without. NRS-AUC_{5days} of women who delivered with NA was bigger than that of those without (median 0.17 [interquartile range (IQR) 0.12-0.25] vs. 0.13 [0.08-0.19], $p < 0.001$, respectively). Peak NRS score of women who delivered with NA was higher than that of those without (median 4 [IQR 3-5] vs. 3 [2-4], $p < 0.001$, respectively). Women who delivered with NA consumed more oral analgesics than those without during the first five days postpartum; acetaminophen (median 500mg [IQR 0-4500] vs. 0mg [0-500], $p < 0.001$, respectively), diclofenac (median 225mg [IQR 75-325] vs. 100mg [0-250], $p < 0.001$, respectively). Doses of intravenous acetaminophen, flurbiprofen axetil (NSAIDs) and pentazocine were not different between the two groups. Length of postpartum hospital stay was slightly longer among women who delivered with NA than those without (median 5.0 days [IQR 4.6-5.6] vs. 4.9 days [4.1-5.6], $p < 0.001$, respectively). The use of NA was independently associated with increased odds of having NRS-AUC_{5days} in the top 20 % (adjusted odds ratio [aOR] 2.17; 95% confidence interval [CI] 1.72-2.74) and peak NRS ≥ 4 (aOR 1.60; 95% CI 1.33-1.93) after adjusting for age, pre-delivery BMI, parity, gestational age, baby's weight, blood loss, length of labor and delivery, the presence of psychiatric diseases, oxytocin use for induction and/or augmentation of labor, instrumental delivery, episiotomy and the degree of perineal tear.

Conclusion: The use of neuraxial labor analgesia is associated with higher postpartum pain score and larger analgesic consumption. Women who undergo vaginal delivery with neuraxial analgesia may benefit from further interventions to improve postpartum pain management.

Figure 1: Calculation of NRS-AUC

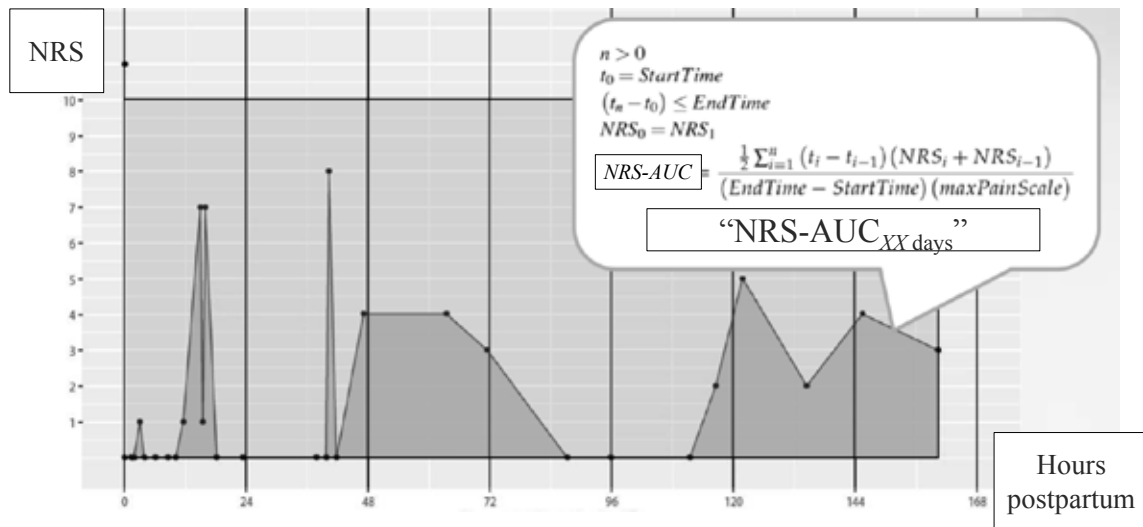


Table 4:
Logistic Regression
Analysis

Peak NRS ≥ 4

* P < 0.05

	OR	95% CI	P value
Age	0.99	0.97 – 1.01	0.26
Augmentation	1.06	0.88 – 1.28	0.54
Baby's weight	1.00	1.00 – 1.00	0.11
Blood loss	1.00	1.00 – 1.00	0.43
BMI pre-delivery	1.02	0.99 – 1.06	0.25
Episiotomy	2.00	1.64 – 2.44	<0.001*
Forceps	1.32	0.75 – 2.34	0.33
GA weeks	1.00	0.93 – 1.09	0.91
GDM	0.88	0.65 – 1.21	0.44
HDP	1.13	0.64 – 1.99	0.68
Induction	0.89	0.68 – 1.18	0.49
Labor analgesia	1.60	1.33 – 1.93	<0.001*
Tear degree	1.09	0.99 – 1.20	0.052
Multiparous	0.52	0.42 – 0.65	<0.001*
Non Japanese	1.29	0.91 – 1.84	0.15
Psych prepartum	2.09	1.15 – 3.81	0.02*
Suction	1.20	0.84 – 1.72	0.32
Total labor time	1.00	1.00 – 1.00	0.34

Table 1: Background Characteristics

	Without Neuraxial Analgesia N=1437 (57.6%)	With Neuraxial Analgesia N=1057 (42.4%)	p value
Age, mean (SD) years	34.0 (±4.3)	34.6 (4.6)	<0.001
Pre-delivery BMI, mean (SD)	24.0 (±2.6)	24.3 (±2.6)	<0.01
Nulliparous, n (%)	711 (49.5%)	753 (71.2%)	<0.001
Psychiatric history, n (%)	21 (1.5%)	29 (2.7%)	0.03
Baby's weight, mean (SD) g	3032 (±374)	3087 (±383)	<0.001
Induction/Augmentation, n (%)	843 (58.7%)	838 (79.3%)	<0.001

Table 2: Obstetric Outcomes

	Without Neuraxial Analgesia N=1437 (57.6%)	With Neuraxial Analgesia N=1057 (42.4%)	p value
Blood loss, median (IQR), g	397 (275-526)	476 (335-685)	<0.001
Instrumental delivery, n (%)	55 (3.8%)	160 (15.1%)	<0.001
Episiotomy, n (%)	583 (40.6%)	642 (60.7%)	<0.001
Perineal tear, n (%)	433 (30.1%)	432 (40.9%)	<0.001
Perineal tear degree (0-4), median (IQR)	2 (0-2)	2 (0-2)	0.3

Figure 2:
NRS-AUC_{5days}

Median (IQR)
P < 0.001

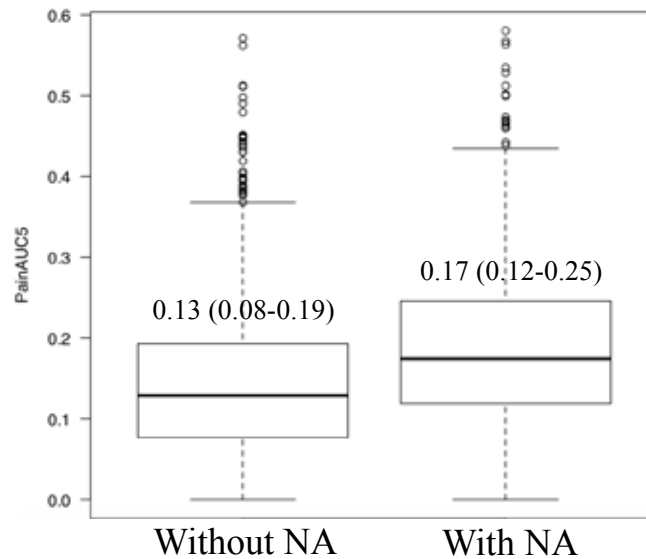


Figure 3:
Peak NRS - 5 days

Median (IQR)
P < 0.001

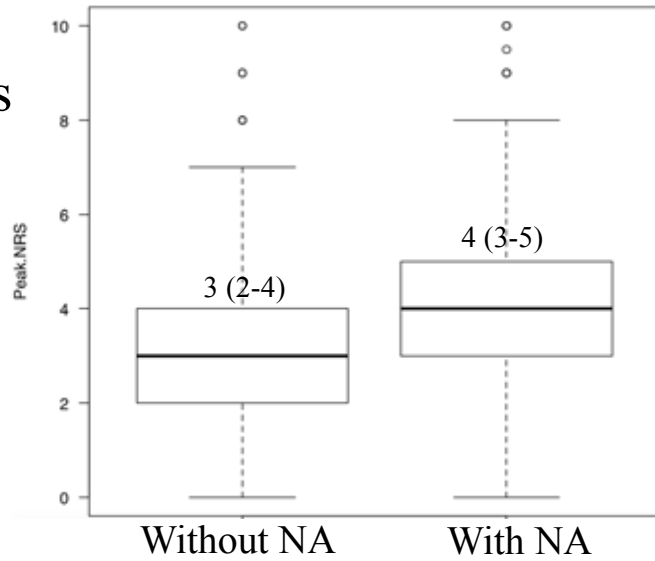


Figure 4:
Oral acetaminophen
(mg) – 5 days

Median (IQR)
P < 0.001

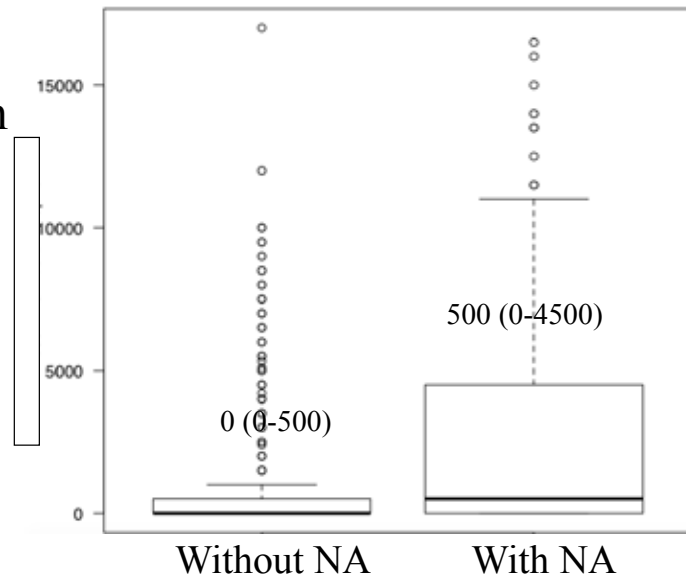


Figure 5:
Oral diclofenac
(mg) – 5 days

Median (IQR)
P < 0.001

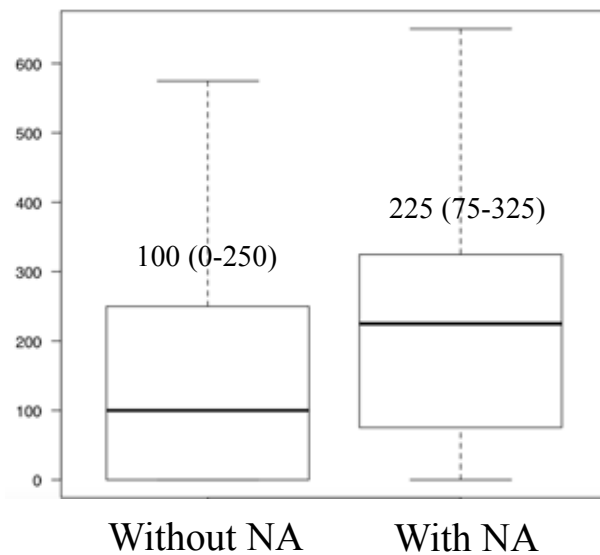
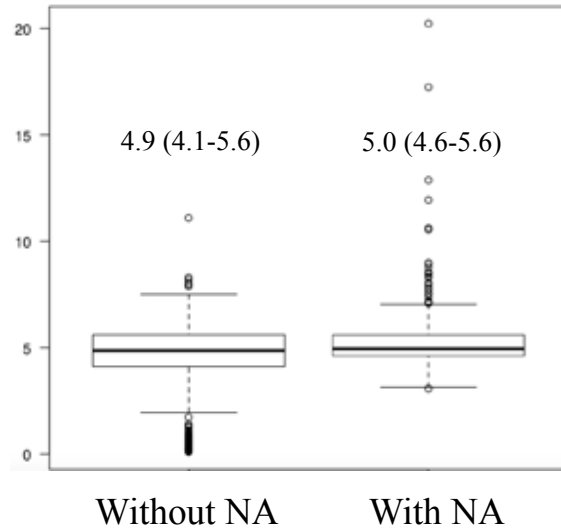


Figure 6:
Postpartum
length of stay (days)



Median (IQR)
P < 0.001

Table 3:
Logistic Regression
Analysis

NRS-AUC_{5days}
Top 20 percent

	OR	95% CI	p value
Age	0.98	0.96 – 1.01	0.19
Augmentation	1.19	0.93 – 1.51	0.17
Baby's weight	1.00	1.00 – 1.00	0.32
Blood loss	1.00	0.99 – 1.00	0.03*
BMI pre-delivery	1.01	0.97 – 1.06	0.53
Episiotomy	2.31	1.79 – 2.99	<0.001*
Fprceps	1.28	0.73 – 2.24	0.38
GA weeks	1.12	1.02 – 1.24	0.02*
GDM	1.24	0.85 – 1.79	0.26
HDP	0.23	0.08 – 0.64	<0.01*
Induction	0.86	0.61 – 1.22	0.40
Labor analgesia	2.17	1.72 – 2.74	<0.001*
Tear degree	1.12	1.00 – 1.25	0.04*
Multiparous	0.58	0.44 – 0.77	<0.001*
Non Japanese	0.76	0.48 – 1.18	0.22
Psych prepartum	2.11	1.10 – 4.03	0.02*
Suction	1.10	0.76 – 1.61	0.62
Total labor time	1.00	1.00 – 1.00	0.04*

* P < 0.05

Abstract #: ET1-05

Impact of Postsurgical Opioid Prescription After Cesarean Delivery and Hysterectomy in a US Managed Care Population: A Two-Year Real-World Study

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Presenting Author's Institution: HealthCore

Co-Authors: Chia-Chen Teng - HealthCore
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Background: Opioids have been a mainstay of pain management for the 1.8 million US women undergo cesarean delivery or hysterectomy each year, leading to risk of persistent postsurgical opioid use. Objective: The study aims to assess the impact of surgery-initiated postsurgical opioid use for cesarean delivery or hysterectomy in a managed care population.

Methods: This retrospective, observational cohort study involved commercially-insured patients who underwent cesarean delivery between 07/01/2015-03/31/2016 and hysterectomy between 04/01/2015-03/31/2016 using the HealthCore Integrated Research Database (HIRD®). The date of surgery was the index date. Patients (age ≥18 years) were opioid-naïve during 1 to 5 months pre-index, with complete medical/pharmacy claims in the 6-month pre and 24-month follow-up periods after surgery. Patients were excluded if ≥1 surgery, ≥2 cancer diagnosis, or surgery stay ≥30 days. The high-intensity opioid (case) cohort was comprised of patients in the highest quartile of year-1 post discharge opioid use among patients who initiated opioid peri-surgically (from 30 days pre-index to surgery discharge). Patients in the opioid-free (reference) cohort did not initiate opioid for the surgery, regardless of post-surgical opioid use. The study endpoints, including total healthcare cost, utilization, and overuse-related conditions in year 2 after surgery, were compared between the case (C) and reference (R) cohorts. Propensity-score matching weights (MW) were applied to adjust for confounding factors.

Results: A total of 3,768 cesarean delivery (high-intensity =1,199, opioid-free=2,569) and 1,793 hysterectomy (high-intensity =1,178, opioid-free=615) patients met selection criteria with an average age of 31.8 and 46.8 years. High-intensity cohort had filled >10 days of opioid supply for cesarean delivery (C=10.3;R=0.7 days) and hysterectomy (C=12.6;R=0.9 days) in year 1 post discharge. For cesarean delivery, after MW-adjustment, high-intensity cohort is associated with significantly higher costs (C=\$7,753, R=\$5,762; diff=\$1,991), resource utilization (emergency room (C=0.38, R=0.25; Relative Risk(RR)=1.72), outpatient visits(C=14.95, R=12.22; RR=1.23)), and opioid-related conditions (anxiety(C=19.3%, R=12.3%; Odds Ratio(OR)=1.70), depression(C=13.7%, R=7.9%; OR=1.84), opioid use disorder(C=1.0%, R=0.1%; OR=8.03)) in year 2 post discharge (p< 0.05). Similarly, for hysterectomy, the high-intensity cohort was associated with higher costs (C=\$9,826, R=\$5,811 diff=\$4,014), emergency room (C=0.30, R=0.20; RR=1.64), inpatient(C=0.08, R=0.03; RR=2.61), outpatient visits(C=18.43, R=14.95; RR=1.24), and higher rates of anxiety(C=20.2%, R=13.3%; OR=1.64). All p< 0.05.

Conclusions: Increased reliance on postsurgical opioid use for cesarean delivery or hysterectomy is associated with higher rates of adverse outcomes and costs, emphasizing the need for opioid minimizing analgesic regimens and robust post-discharge patient education.

Post-surgery Year 2 Outcomes	C-Section				Hysterectomy			
	Opioid-Free	High-Intensity	RR ¹	p-value	Opioid-Free	High-Intensity	RR ¹	p-value
Healthcare Resource Utilization	Mean	Mean	RR ¹	p-value	Mean	Mean	RR ¹	p-value
Number of ER Visits	0.25	0.38	1.72	<.0001	0.20	0.30	1.64	<.0001
Number of Inpatient Stays	0.12	0.12	1.12	0.28	0.03	0.08	2.61	<.01
Number of Outpatient Visits	12.22	14.95	1.23	<.0001	14.95	18.43	1.24	<.0001
Annual Cost (\$USD)	Mean	Mean	Diff. ²	p-value	Mean	Mean	Diff. ²	p-value
Medical	\$5,222	\$6,240	\$1,019	<.01	\$4,450	\$7,568	\$3,119	<.0001
Rx	\$540	\$1,512	\$972	<.0001	\$1,362	\$2,257	\$896	<.0001
Total	\$5,762	\$7,753	\$1,991	<.0001	\$5,811	\$9,826	\$4,014	<.0001
Overuse-related conditions	Rate	Rate	OR ³	p-value	Rate	Rate	OR ³	p-value
Anxiety	12.3%	19.3%	1.70	<.0001	13.3%	20.2%	1.64	0.01
Depression	7.9%	13.7%	1.84	<.0001	11.3%	12.9%	1.16	0.45
Opioid use disorder	0.1%	1.0%	8.03	0.02	0.4%	0.7%	1.54	0.64

1. Risk ratio (RR) and p-values were calculated using GLM negative binomial distribution with log link function.
2. Cost difference (Diff.) and p-values were calculated using GLM gamma distribution with log link function.
3. Odds ratio (OR) and p-values were calculated using GLM binomial distribution with logit link function.

Abstract #: ET1-06

Correlation Between Postsurgical Opioid Consumption and Pain Scores in a Multicenter, Randomized, Double-Blind, Controlled Study of Transversus Abdominis Plane Block With LB for C-Section Delivery

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Introduction: A randomized double-blind clinical study (NCT0317649) recently demonstrated that the use of transversus abdominis plane (TAP) block with liposomal bupivacaine (LB) significantly decreased opioid consumption in women undergoing cesarean delivery (CD).¹ However, the relationship between postsurgical opioid consumption and pain scores has not been evaluated. This post hoc analysis assessed the correlation between postsurgical opioid consumption and pain scores.

Methods: Women with non-high-risk term pregnancies scheduled to undergo elective CD with spinal anesthesia were randomized 1:1 to TAP block with LB 266 mg plus bupivacaine hydrochloride (HCl) 50 mg or TAP block with bupivacaine HCl 50 mg alone as part of a multimodal pain management protocol. The primary end point (postsurgical opioid consumption in morphine equivalent dosing through 72 h) was assessed in a modified intent-to-treat (mITT) population and was significantly lower in the LB group in the original analysis.¹ Pain intensity was measured as the area under the curve for pain scores on a 10-cm visual analog scale from 6 to 72 h after surgery. Distribution of total opioid consumption in the mITT population was highly skewed (58 of 135 patients were opioid free [43%]). Shapiro-Wilk normality test determined that opioid consumption among non-opioid-free patients across both treatment arms (n=77) had a non-normal distribution; therefore, nonparametric tests for correlation (Kendall tau and Spearman rho) were used in this analysis. We also performed multiple linear regression to assess pain scores according to opioid-free status.

Results: In patients who consumed opioids (ie, non-opioid-free patients), a moderate to strong positive correlation between opioid consumption and pain scores was observed by both Kendall ($\tau=0.47$) and Spearman ($\rho=0.64$) nonparametric tests ($P < 0.0001$ for both). These results were consistent across treatment arms, given the similar correlation coefficients within each arm as assessed by Kendall ($\tau=0.53$ vs 0.44 for the LB + bupivacaine HCl arm vs bupivacaine HCl arm) and Spearman ($\rho=0.70$ vs 0.61) tests. In opioid-free patients, the least squares mean (LSM) pain scores, adjusted for age and site, were significantly lower than those in non-opioid-free patients (LSM, 70.1 vs 217.0; LSM ratio, 3.02; $P < 0.0001$). Discussion: The correlation between opioid consumption and pain intensity scores, with opioid consumption more likely to be higher as pain scores increased, reflects within-study consistency in titration of opioid consumption for patients with pain after CD. Opioid-free patients experienced ~3-fold lower pain than patients who consumed opioids. These data suggest opioid consumption is a reliable metric of postsurgical pain after CD.

References:

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Abstract #: ET1-07

Persistent Opioid Use After Cesarean Delivery in the United States: A Narrative Review of the Literature

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Presenting Author's Institution:

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Mary digiorgi, MD - Pacira BioSciences, Inc.

Background: Current recommendations for pain management after cesarean delivery (CD) involve opioid-sparing strategies to reduce postsurgical opioid exposure and associated risks such as development of persistent opioid use.^{1,2} As few as 5 days of prescription opioid use increases the probability of acute treatment developing into long-term use.³ We performed a narrative review of the literature to assess the incidence of persistent opioid use after CD.

Methods: A PubMed search was performed to identify all articles published reporting on persistent opioid use after CD between January 2000 and September 2019. Search terms and inclusion/exclusion criteria are reported in the Table footnotes. Data were qualitatively analyzed.

Results: Twenty published studies were identified; 4 studies met inclusion criteria (Table). Persistent opioid use after CD was generally defined as ≥ 2 opioid prescriptions filled within the first year of delivery among opioid-naive women, although definitions varied. Rates of persistent opioid use after CD were reported from 2 claims databases and 1 Medicaid query and ranged from 0.12% to 2.2%, with the highest reported rate observed in claims from 2008–2016 evaluating privately insured women.²

Conclusions: The rates identified from our narrative review of the literature suggest that a substantial number of women are at risk (from 1:1000 to 1:50) for persistent postpartum opioid use. Of the 1.2 million women undergoing CD each year,⁴ we can estimate that up to 26,400 women may still be using opioids >3 months after their CD. Our findings emphasize the importance of opioid-sparing analgesic approaches and individualized opioid prescriptions to reduce the risk for persistent postpartum opioid use among opioid-naive women. The different definitions reported in the literature underscore the importance of a standardized definition to accurately assess the risk, rate, and trends for persistent opioid use, particularly while interventions aiming to reduce opioid exposure in the obstetric population are undertaken.

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Abstract #: ET1-07
Table. Literature Review^a

Publication	Study design	Data source (years analyzed)	Cohort (N)	Definitions of opioid-naive patient	Definitions of persistent opioid use	Rates of persistent postsurgical opioid use
Peahl et al 2017 ²	Retrospective	Private payer claims from Clinformatics Data Mart (2008–2016)	113,213 (CD) 195,013 (VD)	No opioid prescription filled in the 12 months prior to CD	1 claim 4–90 days after discharge and 1 claim 91–365 days after discharge	2.2% after CD 1.7% after VD
Osmundson et al 2019 ⁵	Retrospective	Filled prescriptions through Tennessee Medicaid ^b (2007–2015)	102,541 women who gave birth ^b	Opioid-naive for ≥6 months prior to delivery ^b	1 filled prescription in each 45-day period from postpartum days 43–365	0.84% after CD 0.59% after VD
Bateman et al 2016 ⁶	Retrospective, trajectory model	Commercial claims from Clinformatics Data Mart (2003–2011)	80,127 (CD)	No opioid prescription filled in the 12 months prior to CD or diagnosis of opioid dependence or abuse	Trajectory model based on pattern of filling prescriptions each month 1 year after delivery	0.36% after CD
Sun et al 2016 ⁷	Retrospective	Administrative private insurance health claims from MarketScan (2001–2013)	201,662 (CD)	No opioid prescription filled in the 12 months prior to CD	≥10 prescriptions or >120 days' supply during postoperative days 91–365	0.12% after CD

CD, cesarean delivery; VD, vaginal delivery.

^aKeywords included in the PubMed search string were related to

- Study drug (eg, opioid, opiate, narcotic)
- Surgery (eg, cesarean, C-section)
- Onset of exposure (eg, surgical, postsurgical, postoperative)
- Duration of exposure (eg, chronic, persistent, recurrent)
- Persistent use concerns (eg, abuse, misuse, chronic opioid after surgery, persistent opioid after surgery)
- Years of publication (2000:3000), and language (English).

Twenty studies were identified from the initial PubMed search, and 1 additional study was identified from the references of an included study. Studies were excluded if primary data were unavailable, <10 patients were evaluated, or no report of opioid consumption or prescription ≥7 days was present. Seventeen studies were not included: 4 studies did not report primary data, 3 studies were case reports, 8 studies did not assess opioid exposure ≥7 days, and 2 studies did not report rate of persistent opioid use after CD.

^bAdditional methodologic details are unavailable.

Abstract #: ET1-08

The Effect of Neuraxial Morphine (Duramorph) on Postpartum Pain after a Severe Perineal Laceration

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Objective: Postpartum pain has negative consequences on maternal-infant bonding, future narcotic abuse, and development of chronic pain. With the rise of the opioid epidemic, it is important to find novel approaches in managing this pain. This pilot study investigates the use of neuraxial morphine (Duramorph) in postpartum pain control after a severe perineal laceration.

Study design: A single-blind randomized controlled trial (NCT03926559) was conducted on parturients admitted to our obstetric service. Patients were enrolled if they had an epidural and if they had a severe perineal laceration defined as second, third, or fourth degree laceration that was identified immediately postpartum. Participants were randomized to receive either 2mg of neuraxial morphine (Duramorph) or sham injection of no drug within 30 minutes after their perineal laceration repair, prior to the removal of their epidural. Primary outcomes were perineal pain at 24 and 48 hours postpartum as measured on a 11-point Numerical Rating Scale (NRS-11). Secondary outcomes were amount of additional oral narcotics used in morphine milliequivalents (MME) over 24 and 48 hours postpartum, and maternal satisfaction as measured on a Likert (1-10) scale.

Results: Between 04/2019 to 08/2019, 154 patients were consented, of which 78 patients had a severe perineal tear and were eligible for the study. 58, 13, and 7 patients had second, third, and fourth degree perineal tears respectively. Baseline demographic characteristics between the two groups were comparable. As seen in Table 1, there was a statistically significant reduction in pain scores at 24 hours in women who received Duramorph compared to sham for all perineal tears. There was also a statistically significant decrease in narcotic use at 24 hours, as well as an increase in maternal satisfaction for all perineal tear groups in the Duramorph group compared to sham.

Conclusion: With the onset of the opioid crisis, it is important for obstetricians and anesthesiologists to find novel ways in mitigating postpartum pain after vaginal deliveries. The use of Duramorph in the immediate postpartum setting may alleviate pain in the first 24 hours and may also decrease the number of oral narcotics consumed during the early postpartum period.

Type of Perineal Laceration	Intervention Utilized	Mean Pain Scores (24hrs)	Mean Pain Scores (48hrs)	Narcotics used at 24hrs	Narcotics used at 48hrs	Maternal Satisfaction
2nd degree (N total= 58)	Sham Injection (n=29)	5.20± 1.47	2.64 ± 1.47	7.86 ±8.44	2.31 ± 4.08	6.16 ± 1.25
	Duramorph (n=29)	2.26 ±1.73	2.00± 1.54	1.24 ± 4.11	1.04 ± 3.57	9.05 ± 1.10
	P-Value	< 0.0001**	0.3633	< 0.0001**	0.0765	0.0365*
3rd degree (N total= 13)	Sham Injection (n=7)	7.00± 1.00	8.67 ± 0.58	56.50 ± 15.20	24.50 ± 17.77	2.00± 1.00
	Duramorph (n=6)	3.50 ±1.29	2.75 ± 1.00	13.75± 5.20	7.50 ± 3.66	8.75 ± 0.50
	P-Value	< 0.0117**	0.0371*	0.0286*	0.0356*	0.0413*
4th degree (N total= 7)	Sham Injection (n=4)	7.80 ± 1.20	8.80 ± 1.20	60.45 ± 23.40	45.45 ± 18.89	3.12 ± 1.04
	Duramorph (n=3)	3.45 ±1.34	3.65 ± 1.34	30.02 ± 10.50	25.56 ± 10.87	7.73 ± 1.30
	P-Value	< 0.015**	< 0.0195*	< 0.0136*	< 0.0256*	< 0.0343*

Table 1: Mean pain scores, amount of additional narcotic medications used in morphine milli-equivalents (MME) at 24hrs and 48hrs, and maternal satisfaction at 48hrs for Sham Injection vs. Duramorph

** denotes statistical significance (p < 0.01).

* denotes statistical significance (p < 0.05)

Abstract #: ET1-09

Predictors of Severe Acute Post-Surgical Pain and Opioid Use after Cesarean Delivery.

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Introduction: Approximately 20% of women who undergo cesarean delivery experience severe acute postoperative pain; severe pain on postpartum day 1 increases risk of depression and persistent pain 2.5-3 fold.¹⁻³ Women with severe pain after cesarean delivery are typically discharged with prescriptions for opioid analgesics and of these, 1 in 300 become persistent opioid users.⁴ Identifying those at high risk for developing severe acute post-cesarean pain will be important to improve pain management and decrease risk of persistent opioid use. In this study, we evaluated whether anxiety, depression, catastrophizing, pre-operative pain, poor sleep quality, fibromyalgias and pain with local anesthetic injection, predict severe acute pain and/or opioid consumption after cesarean delivery.

Methods: 447 patients who underwent elective cesarean delivery under spinal anesthesia at Brigham and Women's Hospital were enrolled and completed the following questionnaires prior to surgery: Pain Catastrophizing Scale (PCS), Brief Pain Inventory (BPI), Edinburgh Postnatal Depression Scale (EPDS), Fibromyalgias Scale, the PROMIS anxiety, PROMIS depression and PROMIS sleep disturbance. Study participants rated pain experienced with the local anesthetic injection (LAI) prior to spinal anesthesia using a numeric rating scale (NRS), with 0 = no pain and 10 = worst pain. The primary outcome was severe pain (NRS ≥ 7) and/or opioid consumption between 18-24 hours after cesarean delivery. Data were analyzed using simple and multivariable logistic regression.

Results: A total of 414 patients completed the study. Simple logistic regression identified PCS, BPI, EPDS, fibromyalgias, and PROMIS depression scores to be associated with increased odds of severe pain and/or opioid consumption between 18-24 hours after cesarean delivery. The associations of PCS and BPI with post-delivery severe pain and/or opioid consumption persisted after adjustment for all other questionnaires and pain score with LAI using multivariable regression. Specifically, each 1-point increase in baseline BPI score increased odds by 29% (95% CI: 9-53%; $p=0.003$), and each 1-point increase in baseline PCS increased odds by 4% (95% CI: 1-7%; $p=0.016$).

Discussion: Women with pre-existing pain and higher baseline pain catastrophizing scores had a greater risk of experiencing more severe acute pain and requiring additional opioids after cesarean delivery. Currently, most women after cesarean delivery receive a one-size-fits-all approach for postoperative pain management. Using tools such as BPI and PCS to identify high risk patients will guide physicians to develop individually targeted approaches including maximizing non-opioid analgesic interventions to improve patient outcomes, decrease postpartum opioid use and improve mother-infant interaction.

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Abstract #: ET2-01

Opioid Prescription and Persistent Opioid Use after Ectopic Pregnancy

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Importance: Women diagnosed with an ectopic pregnancy can experience severe pain, especially after surgical treatment. However, little is known regarding outpatient opioid dispensing and the incidence of persistent opioid use among opioid naïve women after ectopic pregnancy.

Objective: To determine outpatient opioid dispensing and the incidence of persistent opioid use after ectopic pregnancy.

Design, Setting, and Participants: This cohort study used American employer-based claims data for 15,332 women who had an ectopic pregnancy from a single private payer between November 1, 2008 and September 30, 2015. Participants included reproductive age, opioid-naïve women with one year of continuous enrollment before and after diagnosis of an ectopic pregnancy. Treatment for ectopic pregnancy was categorized as surgical, medical, and unknown. For patients who filled a new opioid prescription, we calculated the incidence and predictors of persistent opioid use.

Main Outcomes and Measures: New opioid prescription (one week before treatment to one week after treatment) was assessed by number of days' supply of opioids and oral morphine-equivalent daily dose. Persistent opioid use was defined as at least one opioid prescription fulfilment between 8 and 90 days after treatment and at least one opioid prescription between 91 and 365 days after treatment.

Results: Of the 15,332 individuals who had an ectopic pregnancy and were opioid naïve, 7,042 (45.9%) filled an opioid prescription at the time of treatment for their ectopic pregnancy. The rate of new opioid use varied by treatment type, from 17.5% among women treated medically to 68.7% among women treated surgically. Among women with new opioid use, 4.0% continued to use opioids persistently. Persistent opioid use was highest among women treated medically (6.8%) and lowest among women treated surgically (3.5%). Risk factors most strongly associated with persistent opioid use were: pre-treatment antidepressant use (aOR = 1.59, 95% CI 1.09, 2.31), pre-treatment benzodiazepine use (aOR = 1.57, 95% CI 1.05, 2.23), and having a pre-existing pain disorder (aOR = 1.48, 95% CI = 1.16, 1.90).

Conclusions and Relevance: New opioid use and persistent opioid use after treatment for an ectopic pregnancy is common. Persistent opioid use is associated with mood and pain disorders. Persistent pain after an ectopic pregnancy is an underappreciated maternal health problem requiring new guidelines and policies for increased awareness and refined analgesia prescribing.

Table 1. Frequency of post-ectopic pregnancy opioid use and persistent opioid use among opioid-naïve women

	All Opioid Naïve	New Opioid Use		Persistent Opioid Use	
		N	% of All Opioid Naïve	N	% of New Opioid Use
All	15,332	7,042	45.93	279	3.96
By Treatment Type					
Surgical	7,410	5,168	68.74	183	3.54
Medical	2,850	498	17.47	34	6.83
Unknown ^a	5,072	1,376	27.13	62	4.51

^a Could be managed expectantly or have received inpatient methotrexate treatment

Abstract #: ET2-02

Impact of False Alarms in Capnography in the Detection of Postoperative Respiratory Depression

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Intrathecal morphine (ITM) is considered to be the “gold standard” for postoperative analgesia after Caesarean delivery (CD)¹⁻². Multiple studies have examined the use of capnography [(Capno), EtCO₂, and respiratory rate (RR)] in the detection of postoperative respiratory depression (RD) in high-risk patients after receiving ITM.³ Respiratory Volume Monitoring (RVM) is a novel monitor that provides a direct quantitative measure of ventilation in non-intubated patients. This monitor has been validated against ventilators in the operating room delineating the accuracy of its measurements⁴. This study aims to compare the ability of Capno against RVM to detect RD and the number of false alarms rates.

With IRB approval, we recruited 77 high-risk parturients receiving ITM for scheduled CD. Inclusion criteria were BMI of ≥ 35 kg/m² and at least one of the following: pre-eclampsia, hypertension, diabetes, OSA, or snoring. Participants were encouraged to wear a nasal cannula (NC) for 24 hours postoperatively. Capno was measured by the LifeSense monitor (Nonin Medical Inc), with alarms set at EtCO₂ < 15 and > 45 mmHg and RRcap < 8 and > 30. We compared the Capno values against RVM (ExSpirom1Xi, Respiratory Motion Inc), which calculates % of predicted Minute Ventilation (MV_{PRED}) along with Tidal Volume and RR based on a body surface area formula. RD was defined as MV < 40% MV_{PRED} for ≥ 2 min or apnea for ≥ 30 seconds. The false alarm rate was calculated using an ANOVA test, $p < 0.05$ was considered statistically significant.

77 patients (BMI: 45.9 ± 7.5 kg/m², range: 33.5-69.1 kg/m²) were monitored with RVM for 17.7 ± 4.8 hours (range: 1.7-25.4 hrs) and Capno 4.6 ± 3.7 hours (range: 0-14.6 hrs). 37.6% of patients (29) had true RVM alarms due to RD, all of which were resolved by the alarm sound or the nurse stimulating the patient. Only one patient had true high EtCO₂ alarms. RVM had five false alarms due to pad set misplacement across all patients. The false alarm rate (false alarms/h) was noted to be 0.0037 versus 23.48 ($p < 0.001$) for the RVM and Capno, respectively. EtCO₂ monitoring was often discontinued due to false alarms or patient non-compliance; 33 patients refused capnography after initial attempts to place NC.

Most Capno alarms were false; see Figure 1. RVM had a greater number of patients (48/77) with no alarms compared to Capno (0/44), as seen in Figure 2. High Capno false alarm rates reduce its clinical utility as an RD monitor. Alarm fatigue can lead to patient and staff non-compliance. Additionally, Capno was not well tolerated with thirty-three patients refusing it due to discomfort, itchiness, and overall inconvenience.

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Figure 1: Capnography alarms are further separated into each alarm category. Number of alarms and percentage of total alarms are presented.

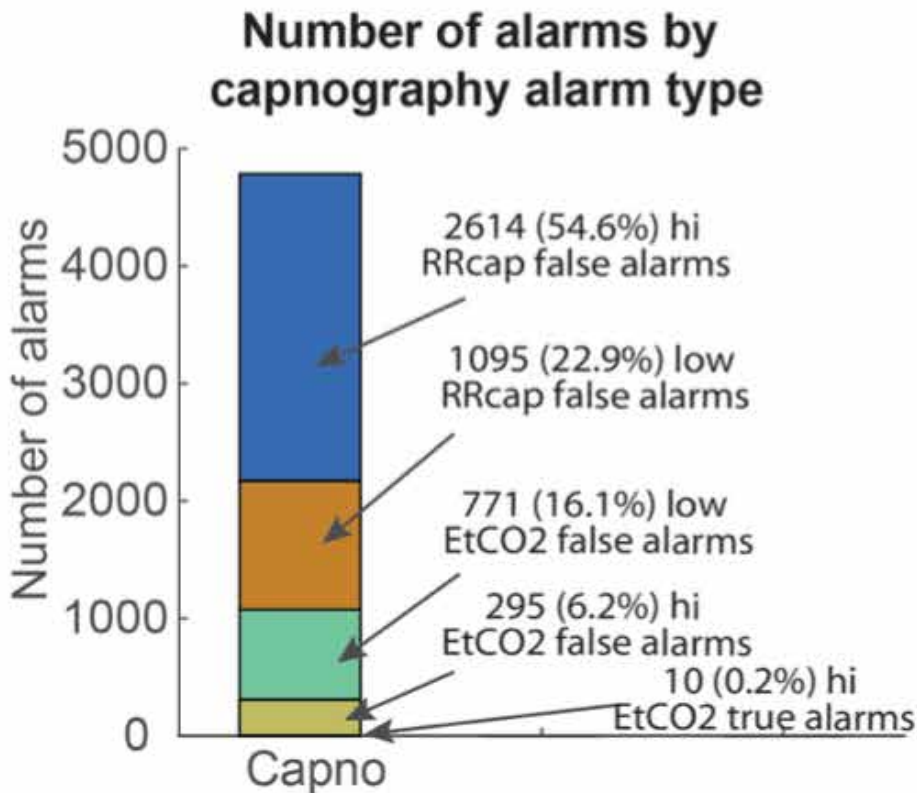
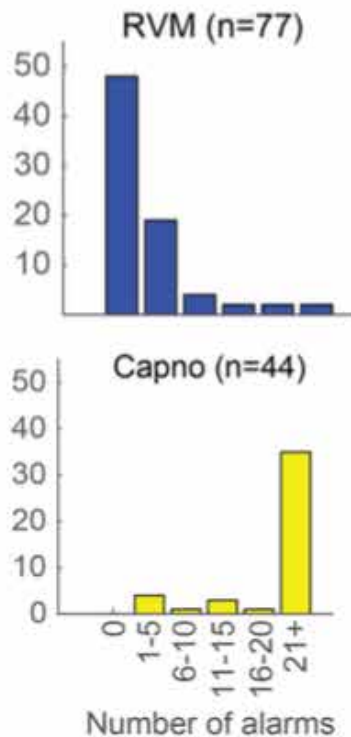


Figure 2: Distribution of Patients with Specific Number of Alarms for each Monitoring Device

Alarm distribution for monitored patients



Abstract #: ET2-03

Opioid-induced respiratory depression detection. Which monitor should we use? Pulse oximeter or RVM

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Introduction: Respiratory depression (RD) is the leading cause of rescue calls, ICU admissions, and code blues in hospitals (1,2,3). Pulse Oximetry is the most used monitor to detect respiratory depression in hospitals. Setting the alarm threshold too high might result in a high false alarm rate and setting it too low might result in a reduced threshold of detecting respiratory depression events. On the other hand, Respiratory Volume Monitoring (RVM) provides direct measures of ventilation by detecting changes in electrical conductance of the chest obtained with surface electrodes to estimate respiratory rate (RR), minute ventilation (MV), tidal volume (TV), and apnea events. This study aims to monitor postoperative RD in high-risk obstetric patients using the RVM and Pulse Oximetry.

Methods: Under IRB approval, 77 (Age: 30.3 ± 6.6 yrs. BMI: 47.0 ± 8.7) high-risk parturient scheduled for cesarean delivery (CD) receiving neuraxial anesthesia with opioids were monitored with RVM and oxygen saturation (SpO₂) for 24 hours postoperatively. Inclusion criteria were BMI ≥ 35 kg/m², with any following risk factors [pre-eclampsia, gestational hypertension, diabetes & obstructive sleep apnea]. (MV)/ (TV)/ (RR) were measured by RVM (ExSpiron1Xi, Respiratory Motion Inc, Watertown, MA). MV was presented as a % of predicted MV (MVPRED) based on body surface area. RVM true alarm was defined as MV < 40% MVPRED for ≥ 2 min. Low MV resulted in an audible alarm as an indication of RD. SpO₂ was measured continuously (LifeSense, Nonin Medical Inc) with defined true alarm threshold SpO₂ < 90% for ≥ 5 min.

Results: RVM reported metrics 87% of the time, with the remaining 13% due primarily to patient disconnection for ambulation. Alarm free hours (the numbers of monitored hours between each alarm) were reported to be 91.8 % of the total monitored hours. SpO₂ reported data 62% of the time, with alarm free hours reported to be 42.6 % of total monitored hours (figure 1). We recorded 1364 RVM hours vs. 965 hours for pulse oximetry. Pulse oximetry missing data was primarily due to patient non-compliance or sensor dislodgement (figure 2). True alarms were 201 and 24 in RVM and pulse oximetry respectively (figure 3).

Discussion: Our data showed that RVM was a better monitor for early detection of RD postoperatively in high-risk parturients who received neuraxial narcotics post CD. Thus choosing the proper device can help in early detection and intervention of RD before a catastrophic outcome occurs.

References:

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Abstract #: ET2-03

Fig 1

	RVM	Pulse Oximetry
Patients	77	77
Monitored Hours/ Study Hours (%)	1364/1567 (87%)	965/1567 (62%)
Alarm-free hours (% of Monitored Hours)	1251 (92%)	431 (44.7%)
Average time between false alarms	271 hrs	12.5 min

Fig 2

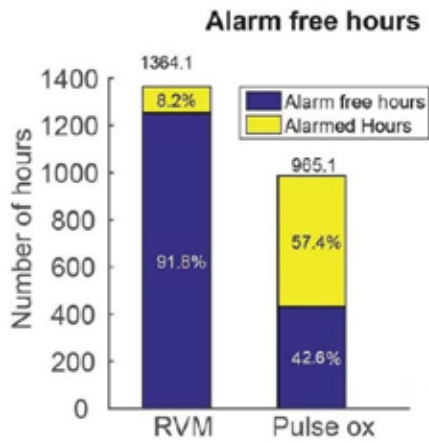


Fig 3

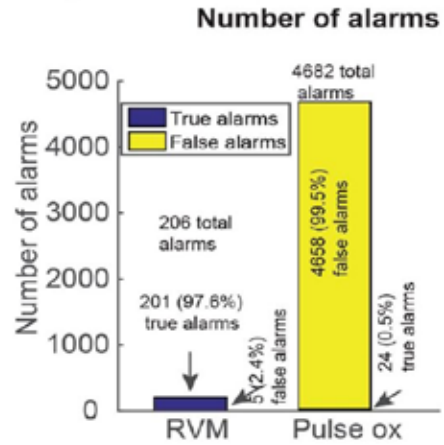


Fig1: Table of monitoring times for RVM and pulse oximetry. “Study hours” is the total duration that any of the two physiologic study modalities were in use. “Monitored hours” is the fraction of the study time that the device was acquiring physiological values. **Fig2:** Alarm free hours are the number of monitored hours between each alarm. **Fig 3:** Number of alarms for each monitoring technology.

Abstract #: ET2-04

Effects of State Law Limiting Discharge Post-Operative Opioid Prescriptions on Patients After Cesarean Delivery: An Interrupted Time-Series Analysis

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OBJECTIVE: The state of Florida passed House Bill 21 (HB 21) on July 1st 2018, a state law restricting the duration of opioid prescriptions for acute pain to 3 days. The aim of this study is to evaluate the impact of Florida HB 21 on patients after cesarean delivery (CD).

METHODS: This was a retrospective cohort study conducted at a large, public hospital. The two cohorts represented the period before implementation of the law (July 2017 to February 2018) and after implementation of the law (July 2018 to February 2019). Patients who received general anesthesia for CD were excluded from the study. Using an interrupted time-series analysis, we evaluated the impact of the law on trends in the proportions of patients receiving opioids on discharge, duration of opioid prescriptions, total opioid dose prescribed, and daily opioid dose prescribed. All opioid doses were converted to morphine milligram equivalents (MME). We also compared the need for additional opioid prescriptions within 30 days of discharge and the rates of emergency department visits or readmissions within 7 days after discharge.

RESULTS: During the study period, 1855 patients were included in our analysis; 913 pre-law and 942 post-law implementation. There were no differences with respect to age, race, insurance, nulliparity, ASA, surgery duration, urgency of CD, or length of stay. Eight months after implementation, there were significant decreases in the mean duration of opioid prescriptions (5.8 vs. 2.9; $P=0.016$) and the mean total opioid dose (119.5 vs. 99.4 MME; $P=0.015$). However, there was no change in the proportion of patients receiving discharge opioids (99.9% vs. 99.9%; $P=0.66$) or the mean daily opioid dose (33.5 vs 28.2 MME; $P=0.18$). After implementation of the law, there were no changes in the proportion of patients who required additional opioid prescriptions (2.1% vs 2.2%; $P=0.80$) or emergency department visits or readmissions (2.4% vs. 2.2%; $P=0.72$).

CONCLUSION: Implementation of Florida HB 21 was associated with a lower total dose and shorter duration of opioid prescriptions on hospital discharge after CD. These reductions were not associated with the need for additional opioid prescriptions, emergency department visits, or readmissions.

Abstract #: ET2-05

Investigation of the pharmacokinetics and pharmacodynamics of epidural methadone in healthy volunteers

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Background: Treating postoperative pain requires balancing analgesia and safety. Neuraxial hydrophilic opioids such as morphine are long lasting but cause adverse effects secondary to rostral spread. Lipophilic opioids work more segmentally but are of short duration. Methadone is lipophilic but highly polar and thus may provide prolonged segmental analgesia with fewer adverse effects. This study compared the pharmacokinetics and pharmacodynamics of bolus dose epidural methadone to those of epidural morphine in healthy volunteers.

Participants: Thirteen volunteers age 18-65 with BMI 18.5-30.0 in good general health.

Methods: Using a randomized, double-blind, crossover design, participants received a 4mL bolus containing 4mg methadone or 4mg morphine through an epidural catheter at the L3-L4 interspace. At baseline and at 10 intervals from 0-24hr after administration, we measured heat pain tolerance (HPT) and pressure pain threshold (PPT) measurements at the dermatome of injection (L3) and the face (V2 dermatome), pupillometry, respiratory rate, capnography, and blood draw for plasma drug concentration assessment. Patients also reported subjective adverse effects.

Results: Analgesia was quantified as the area under the curve for the change in HPT versus time, from 0-12 hours (AUC_{HPT}). The primary outcome was ΔAUC_{HPT} , the difference in AUC_{HPT} at L3 versus V2, for methadone vs morphine via paired t-test. ΔAUC_{HPT} for morphine vs methadone did not reach statistical significance ($10.2^{\circ}\text{C}\cdot\text{hr}$ vs $1.04^{\circ}\text{C}\cdot\text{hr}$; $p = 0.09$; see Figure 1). There was a significantly greater AUC_{HPT} at L3 for morphine vs methadone ($13.4^{\circ}\text{C}\cdot\text{hr}$ vs $2.5^{\circ}\text{C}\cdot\text{hr}$; $p = 0.008$) but comparable AUC_{HPT} for both medications at V2 ($3.2^{\circ}\text{C}\cdot\text{hr}$ vs $1.5^{\circ}\text{C}\cdot\text{hr}$, $p = 0.80$). Neither medication induced meaningful respiratory depression. Morphine caused more miosis than did methadone ($6.2\text{mm}\cdot\text{hr}$ vs $2.9\text{mm}\cdot\text{hr}$; $p = 0.009$). With morphine, 8/13 (62%) of patients reported nausea/vomiting, pruritus, and/or urinary retention. In contrast, no patients had these adverse effects from methadone ($p < 0.01$ by Fisher exact test). Blood samples have been collected, and pharmacokinetic analysis will be complete by the time of the conference.

Conclusions: There was no significant difference in segmental versus supraspinal/systemic analgesia between bolus epidural morphine versus epidural methadone. There were significantly more miosis and opioid mediated adverse effects with morphine than with methadone, though this is confounded by relatively stronger analgesia from morphine than methadone.

References:

Ginosar Y, et al. The site of action of epidural fentanyl in humans: the difference between infusion and bolus administration. *Anesth Analg*. 2003 Nov;97(5):1428-38.

Haroutianian S, et al. Enhanced antinociceptive efficacy of epidural compared with i.v. methadone in a rat model of thermal nociception. *Br J Anaesth*. 2014 Jan;112(1):150-8.

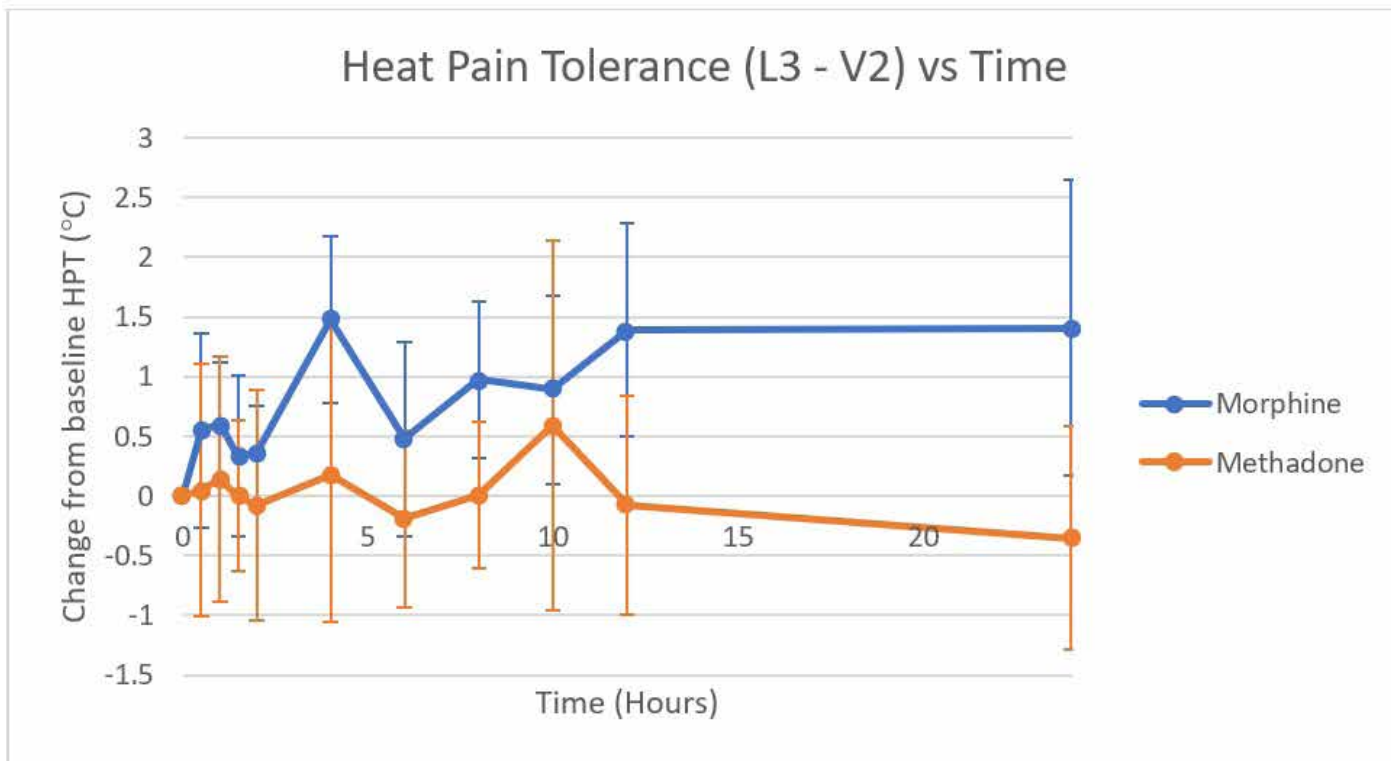


Figure Legend: Figure 1 – HPT (difference between L3 and V2 dermatomes) versus time. Error bars represent CI95%.

Abstract #: ET2-06

The Association of Maternal BMI and Fetal Cord Blood Gases in Parturients Receiving Phenylephrine during Cesarean Delivery

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Introduction

Previous studies have shown an inverse relationship between maternal obesity and fetal cord pH in women having cesarean delivery (CD) under spinal anesthesia. However, in these studies, the management of spinal anesthesia-induced hypotension was not standardized, and the majority of cases were managed with ephedrine, which has been associated with fetal acidemia. Phenylephrine, which is now more commonly used, has been shown to be associated with better fetal outcomes compared to ephedrine. The purpose of this study was to examine the relationship between maternal body mass index (BMI) and fetal cord pH in a cohort that received only phenylephrine for spinal anesthesia-induced hypotension. We hypothesized that obese women having CD under spinal anesthesia are not at an increased risk of neonatal acidemia.

Methods and Materials: This was a retrospective cohort study of all scheduled CD between January 2012 to March 2019 in non-laboring parturients with non-anomalous singleton ≥ 37 weeks gestational age. Women with birth weight $< 2,500$ g, hypertension, preeclampsia, gestational hypertension, or maternal cardiac disease were excluded.

Multivariate linear regression was used to assess whether BMI, race, maximal drop in systolic blood pressure (SBP) before delivery, time from anesthesia induction-to-delivery, baseline systolic blood pressure, and total dose of phenylephrine received predicted fetal cord arterial pH. The Akaike information criterion (AIC) was used to compare model fits for a large number of predictor sets. Time from spinal anesthesia induction-to-delivery, maximal drop in systolic blood pressure, race and maternal BMI were selected by AIC for the final model.

Results: Seven hundred and sixty-one patients were included in the analysis. Maternal BMI was not a significant predictor for fetal cord arterial pH ($p = 0.36$). However, as maximum drop in SBP increased by 1 unit, fetal cord arterial pH decreased by 0.001 unit ($p < 0.01$, table 1). Increased maximum drop in SBP had no correlation with BMI ($R = 0.16$). There was also an inverse correlation between time from spinal anesthesia induction-to-delivery and fetal cord pH ($p = 0.01$).

Conclusion: Our study demonstrated that an increased drop in maternal systolic blood pressure is associated with lower fetal arterial cord pH and fetal acidemia. Maternal BMI was not a predictor maximum drop in SBP. Also, as the time from anesthesia induction-to-delivery increased there was decrease in fetal pH. Maintaining intraoperative blood pressure close to preoperative baseline values and shortening the spinal anesthesia induction to delivery time may improve neonatal outcomes.

References:

1. Edwards RK, Cantu J, Cliver S et al. The association of maternal obesity with fetal pH and base deficit at cesarean delivery. *Obstet gynecol* 2013;122:262-7.
2. Powell MF, Morgan CJ, Cantu JA et al. Obesity and Neonatal Cord Blood Gas Results at Cesarean: Effect of Intraoperative Blood Pressure. *Am J Perinat* 2017;34:716-21.

Table 1. Regression results for fetal cord arterial pH

	continuous			Categorical (pH ≤ 7.21 vs pH > 7.21)			
	B	se	p	B	odds ratio	SE	p
Intercept	7.324	0.01	$<.01$	-3.30	0.04	0.65	$<.01$
BMI (kg/m ²) ref= < 25							
25-29.99	-0.002	0.01	0.81	-0.65	0.52	0.62	0.29
30-34.99	-0.003	0.01	0.78	-0.21	0.81	0.58	0.71
35-39.99	-0.002	0.01	0.82	-0.60	0.55	0.64	0.35
≥ 40	-0.013	0.01	0.19	0.23	1.26	0.59	0.70
SATDT	-0.001	0	0.01	0.02	1.02	0.01	0.29
Maximum drop in SBP	-0.001	0	$<.01$	0.03	1.03	0.01	$<.01$

BMI = body mass index, SATDT = spinal anesthesia to delivery time, SBP = systolic blood pressure

Abstract #: ET2-07

Increase in the persistent opioid prescription and resource utilization associated with opioid exposure during inpatient admission for cesarean delivery or hysterectomy

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Co-Authors: Jennifer Babin - University of Utah

Joseph Biskupiak - University of Utah

Mary Helen Tran - Pacira Pharmaceutical Inc.

Background: Despite the implementation of guidance for limited opioid use, a sizable number of patients are still at risk of long-term opioid use after cesarean delivery (CD) or hysterectomy.[1-3] The purpose of our study was to assess the influence of opioid use during C-section or hysterectomy on post-surgery opioid prescription and medical resource utilization.

Methods: A retrospective cohort analysis was performed using deidentified administrative data and electronic healthcare records from the University of Utah Health system (UHealth). The target population included patients who received a CD or hysterectomy between January 2015 and June 2018 in the inpatient setting (index admission). Eligible patients were cancer-free and were followed within UHealth at least 6 months after the index event. Each surgery cohort was grouped into two, High and Low, categorized by the median morphine milligram equivalent (MME) dose administered during the inpatient stay for the index surgery. Post-surgery persistent opioid use defined by opioid prescription(s) in both periods, 1-90 days and 91 – 180 days after the index discharge, was compared between the High and Low MME groups using descriptive statistics and logistic regressions. Healthcare resource utilization such as the number of hospital readmissions during the 180-day post-discharge period was also compared using descriptive statistics.

Results: The study cohorts consisted of 2309 C-section and 310 hysterectomy patients. Among the CD cohort, the median (IQR) high and low MME were 97 (79 – 121) mg and 38 (22 – 52) mg. The respective percentages of being a persistent opioid user were 4.5% and 2.0%, which calculate the odds ratio of 1.76 [1.05 - 2.95] after adjusting for baseline characteristics. In the hysterectomy group, the median (IQR) high and low MME during the index stay were 311 (245 – 444) mg and 79 (41 – 132) mg. The respective percentage of being a persistent opioid user were 9.0% and 7.7%, which calculates the adjusted odds ratio of 1.76 [1.05 - 2.95] In general, the High MME patients utilized more healthcare resources than the Low MME patients. The respective (High MME vs. Low MME, Mean±SD) numbers of hospital readmissions over the 180-day post-discharge period were 0.12 ± 0.45 vs. 0.11 ± 0.43 in the hysterectomy patients ($p=0.80$) and 0.05 ± 0.25 vs. 0.02 ± 0.15 in the CD patients ($p < 0.01$).

Conclusion: An increase in opioid use during inpatient admission for cesarean delivery or hysterectomy is associated with a higher rate of persistent opioid use and greater healthcare resource utilization after patient discharge.

References:

1. Badreldin N, et al. American journal of obstetrics and gynecology. 2018;219(1):103.e101-103.e108.
2. Larach DB, et al. Annals of surgery. 2019.
3. Donohue JM, et al. Annals of internal medicine. 2019;171(2):81-90.

Abstract #: ET2-08

Echocardiogram Findings in Super Morbidly Obese Pregnant Women and the Association with Obstetric Outcomes

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Maternal obesity is increasing exponentially over the years. Maternal obesity is associated with labor and delivery complications including cardiovascular and respiratory failure.¹ Therefore, morbidly obese pregnant women at our Institution routinely undergo echocardiograms to establish cardiovascular function during pregnancy. The diagnostic yield of this screening program is unknown, and the association between abnormal echocardiograms, treatment decisions, and complications is not well established. Based on the current belief, morbidly obese pregnant women, with abnormal echocardiograms may have more complications during labor and delivery compared to morbidly obese pregnant women with normal echocardiograms. This retrospective study evaluates antepartum echo findings and labor and delivery outcomes in morbidly obese pregnant women, particularly BMI > 50. Methods: Following IRB approval, retrospective chart review of obese patients who delivered between 11/01/2015 to 03/31/2019 were evaluated to determine pre delivery echo findings. Details of age, gestational age, parity, preoperative symptoms, mode of delivery, regional versus general anesthesia, arterial and central line cannulation, blood loss and transfusions, and ICU admissions were obtained from EPIC and Metavison. The parturients were divided into three groups, Abnormal Echo, Normal Echo and No Echo. Data analysis was performed using R and Python. Chi-squared test and Fisher's exact test were used for bivariate analysis. Results: Out of the 216 patients (BMI >50, 50-78.3), 73 had abnormal echocardiograms, 46 had normal echocardiograms, and 97 did not receive an echocardiogram for various reasons. Among abnormal echos, 68% had Left ventricular hypertrophy (68%), LV dilatation (15%), LV systolic dysfunction (23%), LV diastolic dysfunction (12%), RV dilatation (5%), and Tricuspid valve regurgitation (10%). There was no difference in age, race, ethnicity, BMI, parity, and gestational age. There was no statistically significant differences between patients who had abnormal echocardiogram findings and those who had normal echocardiogram findings, or no echo in terms of type of anesthesia received (general vs. regional, p=0.283), delivery method (Cesarean vs. vaginal, p=0.807), and occurrence of ICU admission (no ICU vs. ICU, p=0.158). There were also no differences in invasive line placements, blood loss and blood products transfusions. Conclusion: Contrary to the popular belief, morbidly obese pregnant women with abnormal echocardiograms did not have differences in labor and delivery management and outcomes compared to those with normal echocardiograms, or no echocardiograms. Further analysis of the data may reveal subtle differences between patients with abnormal echocardiograms from patients with normal echocardiograms in duration of labor, postpartum infection, and neonatal outcome.

References:

1. Womens Health (Lond Engl). 2016;12(6):523-32
2. Anesth Analg 2019;129(2):444-9.

Labor and Delivery Outcomes	Normal Echo (n=46)	Abnormal Echo (n=73)	No Echo (n=97)
BMI (Mean, range)	58.7(50.5-70)	57.2(50-78)	54.3(50-70)
Delivery via C-section	30 (65.2%)	46 (63.0%)	52 (53.6%)
General Endotracheal Anesthesia (GETA)	9 (19.6%)	9 (12.3%)	14 (14.4%)
IV Epinephrine	1 (2.2%)	0 (0.0%)	1 (1.0%)
Arterial line	3 (6.5%)	3 (4.1%)	3 (3.1%)
Central line	0 (0.0%)	1 (1.4%)	2 (2.1%)
Blood products transfused	3 (6.5%)	4 (5.5%)	3 (3.1%)
EBL (mL), median (IQR)	800 (600)	700 (750)	650 (650)
ICU admission	0 (0.0%)	3 (4.1%)	1 (1.0%)

Abstract #: ET2-09

Postoperative pain and opioid use following cesarean delivery in women maintained on methadone versus buprenorphine during pregnancy

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Francesca Garofalo - Larner College of Medicine, University of Vermont

Carole McBride - Larner College of Medicine, University of Vermont

Rebecca Parad, MD - University of Vermont Medical Center

Background: Pain control for patients on buprenorphine for medication assisted treatment (MAT) for opioid use disorder (OUD) is challenging. It has been hypothesized that the partial agonist pharmacology of buprenorphine contributes to suboptimal pain control and that transition to a full agonist pre-operatively will improve the ability to control postoperative pain. The goal of this study was to determine whether women treated with buprenorphine reported increased post-cesarean pain scores and required higher doses of opioid analgesia when compared with women maintained on methadone, a full opioid agonist.

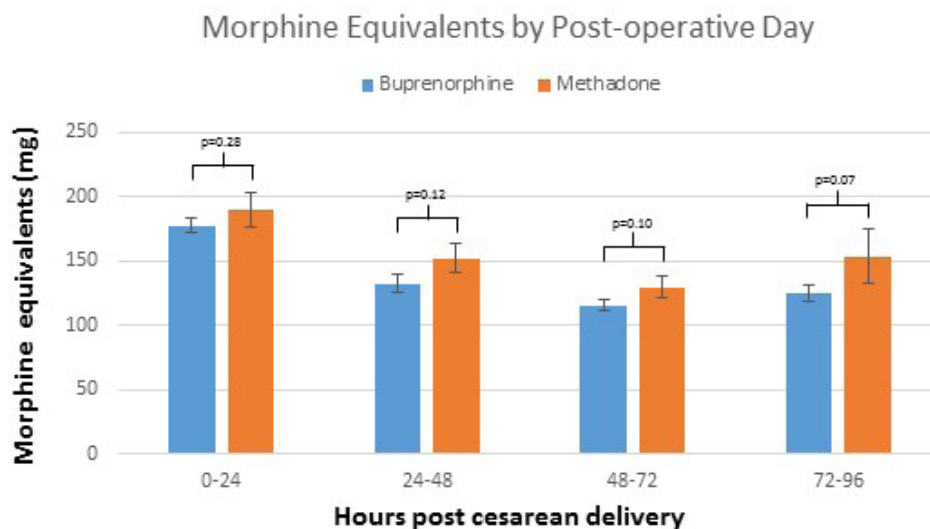
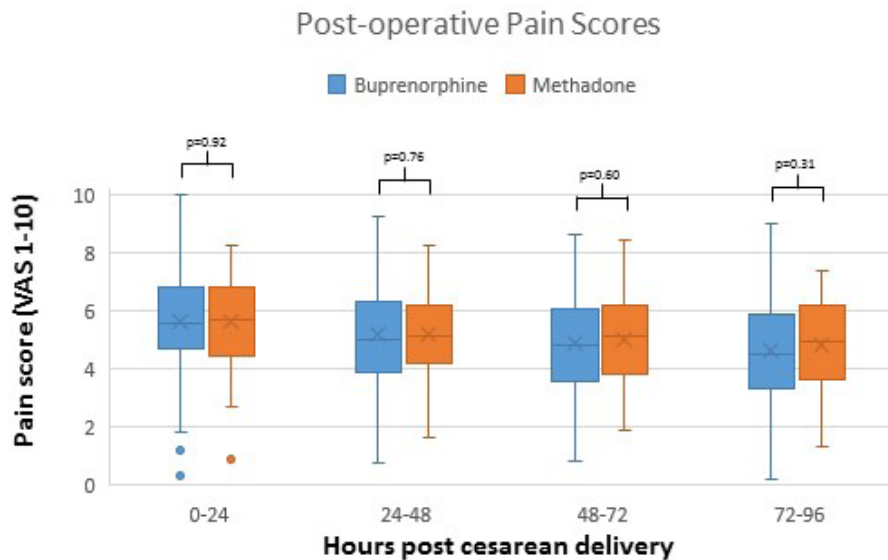
Methods: Approval from the IRB was obtained. Women treated with MAT (methadone (n=53) or buprenorphine (n=196)) during pregnancy and delivered by cesarean at a single institution from 2009-2018 were identified and data reviewed retrospectively. Women that required general anesthesia were excluded. Postoperative pain scores and opioid use (in morphine milligram equivalents, MME) were extracted by the medical record and compared in 24 hour increments from the time of delivery. Data were analyzed by Fishers exact test, t-test (MME) and Mann Whitney U test (pain scores).

Results: Demographics and Intraoperative anesthesia modality were similar.

	Methadone N=53	Buprenorphine N=196	p value
Age (years)	27.9	28.3	0.53
Nulliparous (%)	7 (13.2)	48 (24.5)	0.09
BMI (kg/m ²)	27.1±6.5	27.1±6.8	0.99
Smoker (%)	34 (64.1)	125 (63.8)	1.00
GA (weeks)	37.5±2.8	38.2±2.5	0.08
TOL (%)	9 (17.0)	58 (29.6)	0.08
Primary cesarean	34 (64.2%)	114 (58.2%)	0.53
MAT dose (mg)	100.5±48.3	13.2±6.2	NA
Surgical Anesthesia			
Epidural (%)	5 (9.4)	39 (19.9)	0.200
Spinal (%)	38 (71.7)	127 (64.8)	
Combined spinal epidural (%)	10 (18.9)	30 (15.3)	
Neuraxial long acting opioid (%) (meperidine or hydromorphone)	11 (20.7)	40 (20.4)	1.0
Ketorolac (%)	24 (45.3)	118 (60.2)	0.06
Ketamine (%)	0	18 (9.2)	0.02
Birthweight (grams)*	2852±676	3060±642	0.044
Birthweight z-score*	-0.74±0.99	-0.55±7.07	0.27

Pain scores and opioid use (MME) were similar in women on buprenorphine and methadone within each 24 hour postoperative increment to 96 hours (Figure 1). In the 51 patients received neuraxial meperidine or hydromorphone there was no effect on pain scores (24 hours: buprenorphine 5.1 (4.1, 6.3); methadone 5.6 (4.3, 6.9); or MME requirement (24 hours: buprenorphine 208±95; methadone 211±62) in this limited subset. Ibuprofen and acetaminophen use were similar.

Conclusions: Numeric pain scale ratings and opioid requirements following cesarean delivery are similar in women with OUD treated buprenorphine versus methadone. Transition to full opioid agonists from buprenorphine will not likely improve pain control. Alternative mechanisms such as opioid tolerance and hyperalgesia may contribute to suboptimal pain control in this population regardless of maintenance therapy. Future studies should focus on ERAS protocols and non-opioid adjuncts for postoperative pain control.



Abstract #: ET3-01

Reduced Post-Cesarean Opioid Consumption following a Quality Improvement Initiative

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Introduction: The United States' opioid epidemic is responsible for almost 400,000 overdose deaths between 1999-2017 and an estimated 130 overdose deaths daily¹. Obstetrical delivery is the most common cause for hospitalization; in many centers, opioids are still the mainstay for post-cesarean pain management both during hospitalization and upon discharge². Evidence demonstrates that post-cesarean delivery opioid exposure can lead to persistent use³.

Methods: We conducted a pre/post-implementation quality improvement study at two campuses in our hospital system. In October 2017, the change consisted of: 1) decreasing the amount of opioids prescribed after cesarean delivery, 2) scheduled PO acetaminophen (975 mg every 6 hours) and ibuprofen (600 mg every 6 hours), and 3) providing education to patients, nurses, and obstetricians about pain management by way of email and brief oral presentations. Data was collected from the electronic medical record (EMR) for four months prior to the intervention from January 2017 – April 2017 and four months after the intervention from January 2018 – April 2018. The primary outcome was to report the amount of opioids prescribed to women 72 hours post-cesarean delivery. Wilcoxon rank-sum and Chi-square tests were performed to compare continuous variables and categorical variables, respectively. The Institutional Review Board approved all study activities.

Results: A total of 1535 patients were included in the study: 836 pre- and 699 post- intervention. In the pre-intervention group, 82.2% of women (687/836) received oxycodone, whereas in the post-intervention group, 59.2% of women (414/699) received oxycodone (23% reduction, $p < 0.001$). The total amount of oxycodone taken in the 72 hours after cesarean delivery was significantly reduced. Median oxycodone consumption decreased from 38 mg to 6 mg ($p < 0.001$).

Discussion: A standardized multimodal perioperative pain management order set for cesarean delivery reduced both the number of women given opioids post-delivery and the total amount of oxycodone consumed per patient in the 72 hours after cesarean delivery. We believe that scheduled acetaminophen and ibuprofen combined with education efforts geared towards patients and providers allowed for a reduction in opioid intake following cesarean delivery. This study has limitations. We did not collect pain or satisfaction scores due to the retrospective design, and it is possible that despite a significant decrease in opioid consumption patients experienced suboptimal pain control. We also did not study discharge-prescribing information for opioids, and we do not have data for neonatal outcomes. Our findings suggest that a change in practice, accompanied by provider education, leads to a decrease in opioid intake during post-cesarean hospitalization.

References:

1. Scholl L et al. *Morb Mortal Wkly Rep* 2019; 67:119-27
2. Rogers R et al. *Obstet Gynecol* 2019; 134:932-40
3. Bateman et al. *Am J obs Gyn* 2016; 353

Abstract #: ET3-02

Quadratus lumborum block versus transversus abdominis plane block for cesarean delivery analgesia: a network meta-analysis

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Introduction Many studies have compared quadratus lumborum block (QLB) or transversus abdominis plane (TAP) block to control following cesarean delivery (CD). However, only two studies have directly compared QLB to TAP block in this context (1,2). In view of this, we conducted a network meta-analysis to determine which technique, QLB or TAP block, provided better analgesia subsequent to CD.

Methods We performed a literature search of four databases (CINAHL, EMBASE, Pubmed and Web of Science) for randomised controlled trials comparing: (1) control to either QLB or TAP block, or (2) QLB to TAP block; for elective or emergency CD, under neuraxial or general anaesthesia, with or without neuraxial morphine (or equivalent long-acting opioid). The primary outcome was 24-hour (h) morphine consumption. Secondary outcomes included pain score at rest and on movement at 12-h and 24-h and postoperative nausea and vomiting (PONV), pruritus and sedation.

Results Thirty-one trials comprising 2418 women were included. In the absence or presence of neuraxial morphine, no differences were demonstrated between control, QLB and TAP block in 24-h morphine consumption. In the absence of neuraxial morphine, QLB and TAP block were found to be favourable to control for pain score at rest at 12-h. TAP block was revealed to be superior to control for pain score at rest and on movement at 24-h. No differences were shown between QLB and TAP block, with or without neuraxial morphine, for pain score at rest or on movement at 12- or 24-h. TAP block resulted in less PONV and sedation compared to control with neuraxial morphine, but no other differences were demonstrated across all intervention groups for either PONV, pruritus or sedation at 24-h.

Conclusion In the absence of neuraxial morphine, QLB and TAP block reduced the pain score at rest at 12-h, with analgesic benefits similar between the two regional techniques. Neither QLB nor TAP block seem to add analgesic benefit when neuraxial morphine was concomitantly administered.

References:

1. Reg Anaesth Pain Med. 2016;41(6):757-762.
2. Indian J Anaesth. 2019; 63(10):820-826.

Table 1. Network league table for cumulative morphine consumption at 24-h.

No ITM

Control		
15.34 (-2.83 to 33.51)	QLB	
15.12 (-0.04 to 30.29)	-0.22 (-21.39 to 20.96)	TAP

ITM

Control and ITM		
6.50 (-3.28 to 16.28)	QLB and ITM	
-2.10 (-10.21 to 6.01)	-8.60 (-21.30 to 4.10)	TAP and ITM

ITM, intrathecal morphine; QLB, quadratus lumborum block; TAP, transversus abdominis plane.

Estimates are presented as mean differences with 95% confidence interval in parentheses. Mean differences below 0 favour the column intervention and mean differences above 0 favour the row intervention. Interventions in bold are significantly different since the 95% confidence interval does not include 0.

Abstract #: ET3-03

The Use of Liposomal Bupivacaine in Transversus Abdominis Plane Blocks in Reducing Postoperative Narcotic Use

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The search for the ideal postoperative analgesia has become crucial given the current opioid epidemic in the United States. Adequate analgesia has the potential benefits of increased mobility, and hence early recovery. The use of transversus abdominis plane (TAP) blocks has proven to decrease the use of opioids in the first few hours after surgery. This study evaluates the impact of the introduction of TAP blocks as part of our institutional multimodal strategy. The primary aim of this retrospective study was to assess opioid consumption during the first 72 hours after cesarean delivery (CD) and the time to first narcotic.

We conducted a single-center retrospective chart review

of all CD at our institution from March 1st to May 31st,

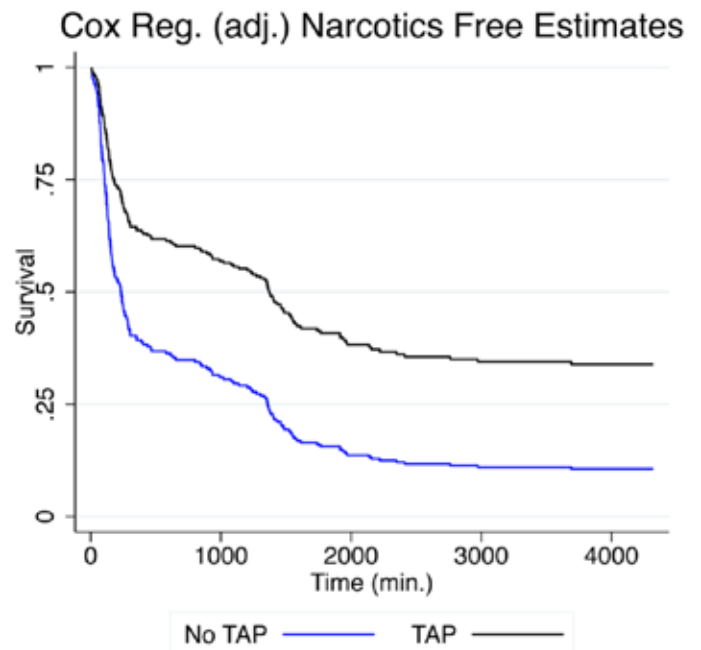
2019, using electronic medical records. A total of 379 cases

were identified during the study period, and 222 cases were analyzed for study purposes. All patients received a spinal anesthetic with 100 mcg of intrathecal morphine (ITM) and postoperative multimodal analgesia including acetaminophen and non-steroidal anti-inflammatory drugs. Patients with chronic pain and preoperative opioid use were excluded. A total of 82 patients received a TAP block utilizing bupivacaine 0.25% 20 ml combined with 133 mg of liposomal bupivacaine (LB) bilaterally and 140 patients either refused the procedure or the provider did not offer it to the patient. We summarize baseline patient characteristics using mean and standard deviations (SD) by TAP groups for quantitative characteristics and frequencies, with percentages, for categorical characteristics. The analyses adjusted for BMI and the number of CD. We tested the adjusted hazards using Cox regression. All analyses were conducted using the Stata (version 16.0) statistical package.

There was no difference between the two groups in terms of mean BMI and the frequency distributions for number of CD. The estimated mean time to first opioid request in the TAP versus no TAP was ~ 30 h and 15 h ($p = 0.002$). A Cox regression analysis comparing patients with the same BMI and number of CD, estimated the risk of receiving a first narcotic in the TAP block group to be one-half of those who did not receive a TAP block (HR = 0.48, 95% CI=[0.36, 0.65], p -value < 0.001). Figure 1 presents the two TAP block groups' respective "survival" curves over time. Patients who did not receive a TAP block had their first narcotic sooner.

Our study demonstrated that patients who received TAP block were more likely to abstain from opioid use during the first 72 h with a mean opioid-sparing effect of > 24 h (30 h) for those patients receiving a TAP block. This is in contrast to previous studies that demonstrated little to no benefit when comparing ITM + TAP versus ITM + no TAP. This difference may be explained by the use of LB in our TAP blocks which confers a prolonged bupivacaine release and may play a role in longer narcotic free intervals and decreased total postoperative narcotic consumption.

Figure 1: Cox Regression of First Narcotic between TAP Groups



Abstract #: ET3-04

Reducing Healthcare Disparities using Enhanced Recovery After Cesarean

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Objective: Enhanced recovery after surgery programs aim to achieve impartial surgical healthcare through the utilization of standardized protocols. Our objective was to compare disparities in hospital length of stay (LOS) by race-ethnicity before and after the implementation of an enhanced recovery after cesarean (ERAC) program.

Study Design: An ERAC program was implemented at our institution in October 2018. Using a healthcare analytics platform, we compared disparities in LOS after delivery (calculated from time of delivery to discharge) and 30-day readmission rates (defined as any inpatient hospitalization within 30 days of delivery) based on race-ethnicity before (October 2017 – September 2018) and after (November 2018 – October 2019) ERAC implementation. We excluded any outliers, defined as a LOS >25 days using the Academic Medical Center model, as well as any patients without reported race-ethnicity. Student’s T test and Chi square were used for statistical comparison with $p < 0.05$ considered statistically significant. Continuous data are expressed as mean +/- standard deviation.

Results: 1729 patients underwent cesarean delivery in the pre-ERAC group; 284 (16.4%) identified as Asian, 124 (7.2%) as Black, 128 (7.4%) as Hispanic, 122 (7.1%) as other, and 862 (49.9%) as White. 209 (12.1%) patients did not have a reported race-ethnicity in the pre-ERAC group. In the post-ERAC group, 1753 patients had a cesarean delivery; 277 (15.8%) identified as Asian, 97 (5.5%) as Black, 107 (6.1%) as Hispanic, 99 (5.6%) as other, and 942 (53.7%) as White. 231 (13.2%) patients did not have a reported race-ethnicity in the post-ERAC group. Before ERAC implementation, Asian, Black, Hispanic and patients of other race-ethnicity all had a significantly longer mean LOS after cesarean delivery as compared to White patients. After ERAC implementation, this disparity was no longer seen (Table 1). 30-day re-admission rates were similar pre- and post-ERAC in patients of all race-ethnicities; 0.7% vs 0.7%, $p=0.99$ for Asians, 7.3% vs 8.2%, $p=0.80$ for Blacks, 3.9% vs 2.8%, $p=0.64$ for Hispanics, 1.6% vs 1.0%, $p=0.75$ for other and 1.6% vs 2.1%, $p=0.43$ for Whites.

Conclusions: After the implementation of an ERAC program, we saw a reduction in healthcare disparity as it relates to hospital LOS among patients of various race-ethnicities, without an increase in re-admission rates. We believe that consistent patient education and multidisciplinary standardized guidelines contributed to this effect. Although our findings show promise in addressing known healthcare disparities, one must equally practice cultural competency and patient-centered care so as to achieve truly impartial surgical healthcare.

References:

Bateman BT & Carvalho B. Obstet Gynecol 2019.
 Kleiman AM et al. Int J Obstet Anesth 2019.
 Wilson RD et al. Am J Obstet Gynecol 2018.

Table 1. Length of stay after cesarean delivery before and after ERAC implementation, by race-ethnicity.

	LOS after Delivery (days)	p value
Pre-ERAC Implementation		
Asian	4.12 +/- 15.11	0.04
Black	3.54 +/- 1.33	0.0001
Hispanic	3.29 +/- 0.93	0.007
Other	3.29 +/- 0.96	0.009
White*	3.07 +/- 0.85	--
Post-ERAC Implementation		
Asian	2.73 +/- 0.76	0.67
Black	3.00 +/- 0.79	0.93
Hispanic	2.75 +/- 0.84	0.81
Other	2.78 +/- 1.00	0.85
White*	2.93 +/- 7.89	--

*Reference population

Abstract #: ET3-05

Addressing the Opioid Epidemic using Enhanced Recovery After Cesarean

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Objective: Enhanced recovery after surgery programs utilize standardized protocols and guidelines to improve patient recovery. However, the effect of these initiatives on the current opioid epidemic has not been well studied in the obstetric population. Our objective was to compare opioid prescription practices before and after the implementation of an enhanced recovery after cesarean (ERAC) program.

Study Design: An ERAC program was implemented at our institution in October 2018. Using a healthcare analytics platform, we compared the proportion of patients who received an opioid prescription upon discharge before (October 2017 – September 2018) and after (November 2018 – October 2019) ERAC implementation. For patients who received a prescription, we further compared the average number of pills, amount in milligrams (mg), and morphine milligram equivalents (MME) prescribed per patient. Student’s T test and Chi square were used for comparison with $p < 0.05$ considered statistically significant. Continuous data are expressed as mean +/- standard deviation.

Results: 1729 patients underwent cesarean delivery in the pre-ERAC group, 1113 (64.4%) of whom received an oxycodone prescription upon discharge. In the post-ERAC group, 1753 women had a cesarean delivery and 712 (40.6%) received an oxycodone prescription, a statistically significant reduction from the pre-ERAC group ($p < 0.0001$). Table 1 shows opioid metrics pre- and post-ERAC implementation. Post-ERAC, opioid prescription rates declined significantly for patients with both Medicaid (87.6% vs 76.8%, $p = 0.003$) and private insurance (60.7% vs 36.0%, $p < 0.0001$). However, patients with Medicaid were more likely to receive an oxycodone prescription compared to privately insured patients both pre- and post-ERAC (87.6% vs 60.7%, $p < 0.0001$; 76.8% vs 36.0%, $p < 0.0001$).

Conclusions: With the implementation of an ERAC program, we observed a decline in the amount of oxycodone prescribed to patients undergoing cesarean delivery. Although the observed reduction is likely multifactorial, enhanced recovery after surgery programs may serve a promising role in addressing the current opioid epidemic. Additionally, the consistent use of standardized ERAC pathways may be viewed as an opportunity to reduce disparities in perioperative healthcare.

Table 1. Opioid metrics for patients receiving an oxycodone prescription after cesarean delivery pre- and post-ERAC implementation.

	Pre-ERAC (n = 1113)	Post-ERAC (n = 712)	p value
Overall number of oxycodone pills prescribed	28,147	11,920	--
Average number of oxycodone pills prescribed per patient	25.3 +/- 13.7	16.7 +/- 8.7	<0.0001
Overall amount of oxycodone prescribed (mg)	141,610	59,600	--
Average amount of oxycodone prescribed per patient (mg)	127.2 +/- 71.0	83.7 +/- 43.3	<0.0001
Overall morphine milligram equivalents prescribed (mg)	88,586	51,230	--
Average morphine milligram equivalents prescribed per patient (mg)	70.9 +/- 72.7	45.7 +/- 48.0	<0.0001

References:

Bateman BT & Carvalho B. *Obstet Gynecol* 2019.
 Hedderson M et al. *Obstet Gynecol* 2019.
 Lester SA et al. *Int J Obstet Anesth* 2020.
 Peahl AF et al. *Am J Obstet Gynecol* 2019.
 Peahl AF et al. *JAMA Network Open* 2019.

Abstract #: ET3-06

Subgroup Analysis of Postsurgical Opioid Consumption After LB Transversus Abdominis Plane Block for Cesarean Delivery: Results From a Multicenter, Randomized, Double-Blind, Controlled Trial

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Introduction: The use of transversus abdominis plane (TAP) block with long-acting liposomal bupivacaine (LB) after cesarean delivery (CD) was shown to decrease opioid consumption in the primary analysis of a randomized, double-blind study (NCT03176459).¹ Here, we present an analysis across subgroups to assess whether opioid-reducing benefits would differ in patients based on baseline characteristics.

Methods: Women with low-risk term pregnancies and no concurrent painful condition scheduled to undergo elective CD using spinal anesthesia were randomized 1:1 to TAP with LB 266 mg plus bupivacaine hydrochloride (BUPI HCl) 50 mg or BUPI HCl 50 mg alone as part of a multimodal pain management protocol. Primary efficacy endpoint was postsurgical opioid consumption (morphine equivalent dosing [MED]) through 72 h. Analysis was conducted for subgroups based on age, race, body mass index (BMI), prior CD, discharge time, and medical anxiety history. The difference between groups using least squares mean (LSM) was determined using an analysis of covariance model, with treatment as main effect and age and height as covariates, and presented as the difference between the LB plus BUPI HCl and BUPI HCl only groups.

Results: Demographics were similar across treatment groups (LB, n=71; BUPI HCl, n=65). Total opioid consumption was significantly lower with LB plus BUPI HCl overall (LSM, 15.5 vs 32.0 mg; P=0.01) and numerically lower across all subgroups except BMI < 25 kg/m². The LSM treatment differences (95% CI) in mg MED across subgroups were < 35 years: -18.0 (38.1, 2.2), ≥35 years: -2.3 (-22.1, 17.5); white: -8.3 (-24.5, 7.9), non-white: -23.3 (-54.2, 7.5); BMI < 25 kg/m²: 13.2 (-7.5, 33.8), BMI 25 to < 30 kg/m²: -16.8 (-42.4, 8.8), BMI ≥30 kg/m²: -9.7 (28.8, 9.5); prior CD: -17.3 (-35.4, 0.7), no prior CD: -4.6 (25.8, 16.7); discharged on or before day 3: -10.5 (29.1, 8.1), discharged on or after day 4: 14.3 (-36.2, 7.7); and anxiety history: -32.9 (-77.1, 11.2), no anxiety history: -8.8 (-23.8, 6.3). In a post hoc analysis, there were numerical trends toward increased opioid consumption in patients with higher risk for increased opioid consumption (ie, younger patients, history of CD, or anxiety), particularly in the BUPI HCl arm: age < 35 years vs ≥35 years (LSM difference [95% CI], 0.2 [-26.8, 27.3] for LB, 20.3 [-20.6, 61.2] for BUPI HCl); no prior CD vs prior CD (-6.9 [-25.0, 11.2] for LB, -19.1 [-42.5, 4.4] for BUPI HCl); and no anxiety history vs anxiety history (-4.4 [-30.8, 21.9] for LB, -32.2 [-72.1, 7.8] for BUPI HCl).

Discussion: This analysis suggests that the opioid-reducing benefits of TAP block using LB plus BUPI HCl as part of a multimodal analgesia protocol after CD may not be specific to any subgroups based on age, race, prior CD, BMI, duration of hospitalization, and anxiety history.

References:

1. Nedeljkovic SS et al. Presented at the Society for Obstetric Anesthesia and Perinatology 51st Annual Meeting; May 1-5, 2019; Phoenix, AZ.

Abstract #: ET3-07

Quadratus lumborum block for postoperative analgesia after cesarean delivery – A systematic review and meta-analysis.

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Background: The quadratus lumborum (QL) block may improve local anesthetic (LA) spread into the paravertebral space, visceral nerve blockade, and postoperative analgesia compared to transversus abdominis plane (TAP) blocks. However, the analgesic efficacy of QL blocks in women undergoing cesarean delivery is unclear. This meta-analysis assesses the efficacy of QL blocks for postoperative analgesia after cesarean delivery.

Methods: We searched MEDLINE, PubMed, and Embase for randomized controlled trials that evaluated the efficacy of QL block following cesarean delivery. Articles meeting inclusion criteria were assessed separately by two reviewers (THS and CT). Discrepancies were resolved by the third reviewer (AH). The primary outcome was opioid consumption at 24 hours. Secondary outcomes included opioid consumption at 6 h and 12 h, pain scores (rest/movement) at 6h, 12h and 24 h, and opioid-related side effects (pruritus and nausea). We performed the following comparisons: QL block vs inactive control in patients who did not receive and those who received neuraxial morphine; QL block vs neuraxial morphine; and QL block vs TAP block. A random effects model was used for analysis.

Results: 715 studies were initially identified, 704 excluded, and 11 were analyzed. Six studies compared QL blocks against controls in women who did not receive neuraxial morphine, two had the same comparison in women who received neuraxial morphine, three compared QL block vs neuraxial morphine, two compared QL blocks with TAP blocks. The results are summarized in Table 1. QL blocks reduced 24 h opioid consumption in patients who did not receive neuraxial morphine but not in those who received neuraxial morphine. There was no difference in 24 h opioid consumption between QL block and neuraxial morphine or TAP blocks. With regards to secondary outcomes in women who did not receive neuraxial morphine, QL blocks decreased opioid consumption (6, 12 hrs), pain at rest (6, 12 hrs), and pain on movement (6 hrs), with no difference in pruritus or nausea. In women who received neuraxial morphine, there was no difference between QL blocks or controls in any of the outcomes. When compared to neuraxial morphine, QL blocks did not reduce opioid consumption or pain at rest, but was associated with higher pain scores on movement at 6 hrs, and lower risk of pruritus (6 hrs), and nausea (6, 12, 24 hrs). When compared to TAP blocks, QL blocks were associated with lower opioid consumption at 6 and 12 hrs, as well as lower pain at rest and on movement.

Conclusions: QL blocks improved post-cesarean analgesia compared to TAP blocks and inactive controls in the absence of neuraxial morphine. Although there was no analgesic improvement when compared to neuraxial morphine, QL blocks were associated with less nausea and pruritus. The addition of QL block to patients receiving neuraxial morphine did not confer any analgesic benefit.

Abstract #: ET3-07

Study	Control	Comparison	6 hours	12 hours	24 hours
QL block (no neuraxial morphine)	Inactive control/sham (no neuraxial morphine)	Cumulative opioid consumption	-6.37 [-8.53, -4.21] 3 studies (n=156)	-8.83 [-12.80, -4.87] 2 studies (n=88)	-10.64 [-16.01, -5.27] 3 studies (n=156)
		Pain at rest	-16.44 [-27.65, -5.22] 5 studies (n=290)	-17.07 [-32.77, -1.37] 5 studies (n=274)	-5.18 [-13.59, 3.23] 6 studies (n=348)
		Pain on movement	-16.86 [-30.39, -3.34] 5 studies (n=290)	-17.03 [-37.18, 3.12] 4 studies (n=216)	-6.12 [-17.39, 5.16] 5 studies (n=290)
		Pruritus	0.95 [0.44, 2.05] 3 studies (n=182)	1.02 [0.32, 3.22] 2 studies (n=108)	0.98 [0.46, 2.06] 3 studies (n=182)
		Nausea	0.66 [0.25, 1.73] 2 studies (n=108)	0.69 [0.25, 1.87] 2 studies (n=108)	0.64 [0.14, 3.04] 3 studies (n=176)
QL block (no neuraxial morphine)	Neuraxial morphine	Cumulative opioid consumption			-10.41 [-38.00, 17.17] 2 studies (n=149) ##
		Pain at rest	15.22 [-5.15, 35.60] 3 studies (n=223)	4.16 [-42.98, 51.31] 2 studies (n=149)	6.03 [-16.28, 28.34] 3 studies (n=223)
		Pain on movement	20.42 [2.15, 38.69] 3 studies (n=223)	8.03 [-61.58, 77.64] 2 studies (n=149)	11.88 [-11.25, 35.01] 3 studies (n=223)
		Pruritus	0.37 [0.17, 0.79] 2 studies (n=134)	0.71 [0.22, 2.25] 1 study (n=60)	0.65 [0.22, 1.93] 2 studies (n=134)
		Nausea	0.23 [0.07, 0.76] 1 study (n=60)	0.08 [0.02, 0.28] 1 study (n=60)	0.33 [0.11, 0.95] 1 study (n=60)
QL block (no neuraxial morphine)	TAP block (no neuraxial morphine)	Cumulative opioid consumption	-1.50 [-3.24, 0.24] 1 study (n=76)	-2.67 [-5.15, -0.19] 1 study (n=76)	-5.90 [-10.40, -1.40] 1 study (n=76)
		Pain at rest	-9.99 [-12.03, -7.95] 1 study (n=60)	-29.99 [-32.03, -27.95] 1 study (n=60)	-20.00 [-22.22, -17.78] 1 study (n=60)
		Pain on movement	-19.99 [-20.85, -19.13] 1 study (n=60)	-20.00 [-23.01, -16.99] 1 study (n=60)	0.00 [-2.10, 2.10] 1 study (n=60)
QL block with intrathecal morphine	Neuraxial morphine	Cumulative opioid consumption	-0.47 [-2.63, 1.69] 1 study (n=86)	-0.28 [-4.48, 3.92] 1 study (n=86)	-0.42 [-8.27, 7.43] 1 study (n=86)
		Pain at rest	-2.05 [-8.34, 4.23] 2 studies (n=158)	-2.33 [-10.09, 5.43] 1 study (n=86)	-1.31 [-5.62, 3.00] 2 study (n=158)
		Pain on movement	-5.33 [-16.47, 5.81] 2 studies (n=158)	-5.18 [-15.93, 5.57] 1 study (n=86)	-4.75 [-11.11, 1.62] 2 studies (n=158)
		Pruritus	1.10 [0.43, 2.78] 1 study (n=72)		0.82 [0.42, 1.60] 2 studies (n=158)
		Nausea			1.29 [0.43, 3.84] 1 study (n=86)

24-hour data not available, 48-hour data presented instead.

Table 1 Summary of results from meta-analysis. Data presented as Mean Difference [95% confidence intervals] or odds ratio [95% CI]. Abbreviations: QL – quadratus lumborum; TAP – transversus abdominis plane

Abstract #: ET3-08

Obstetric quality of recovery scoring tool: Assessment of validity, reliability and feasibility in an Israeli cesarean delivery population

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Background: An Obstetric quality of recovery scoring tool (ObsQoR-11) has been developed and validated in UK and US populations. (1,2) Based on patient feedback about question clarity, the ObsQoR-11 was modified to ObsQoR-10. We aimed to evaluate the validity, reliability and feasibility of a Hebrew version of the updated scoring tool, ObsQoR-10, following elective and non-elective cesarean delivery (CD).

Methods: The English version of ObsQoR-10, (a 10-item score, 0 to 100, where 0=best and 100=worst recovery) was translated (2 native bilingual Hebrew/English speakers) and back-translated (2 additional native bilingual English/Hebrew speakers). Following IRB approval, ObsQoR-10Heb was completed by postpartum women, day 1 after elective/non-elective CD in two large (>10,000 deliveries per annum) tertiary centers. Validity was assessed by: Convergent validity - correlation of ObsQoR-10Heb with the global health numerical reporting scale (NRS) (GHNRS) (0-100 mm); and discriminant validity - correlation with good vs. poor recovery (NRS of ≥ 70 vs. < 70 mm, respectively). Reliability was assessed by: Cronbach's alpha, inter-item correlation, split-half reliability, and floor and ceiling effects. Feasibility was tested by time for ObsQoR-10Heb completion, and recruitment rate.

Results: Ninety-two women completed ObsQoR-10Heb. ObsQoR-10Heb correlated well with GHNRS ($r = -0.53$ $P < 0.0001$); discriminated well between good vs. poor recovery (VAS ≥ 70 vs < 70 respectively; VAS < 70 , 46.7 (95% CI 41.1 to 52.3); VAS ≥ 70 , 26.3 (95% CI 21.2 to 31.5), difference 20.4 (95% CI 12.9 to 27.9, $p < 0.001$). Cronbach's alpha was 0.83 and inter-item correlation was > 0.29 indicating good internal consistency. Split half reliability using Spearman-Brown Prophecy Reliability Estimate was 0.91 (very good). No floor or ceiling effects were demonstrable. Median completion time was 120 seconds. Five women declined to respond.

Conclusions: ObsQoR-10Heb performed well in measures of validity, reliability and feasibility. ObsQoR-10Heb appears to be a tool that can assess quality of recovery following cesarean delivery in this population. Further work is needed to determine how ObsQOR-10Heb scores correlate with clinical parameters and out-patient recovery outcomes.

References:

1. Ciechanowicz S. Br J Anaesth 2019; 122: 69-78
2. Ciechanowicz S. Int J Obstet Anesth 2019; 39: 51-59

Abstract #: ET4-01

Sepsis in Pregnancy: Trends in Canada (SePTIC Study)

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Introduction: Maternal sepsis, characterized by dysregulated host response to infection during pregnancy, can lead to adverse outcomes in both mother and baby. There are no prior epidemiological data on maternal sepsis in Canada. The objective of this study was to evaluate the incidence, temporo-regional variation, risk factors, morbidity and mortality due to maternal sepsis in Canada.

Method: This was a population-based retrospective cohort study based on the nationwide Discharge Abstract Database compiled by the Canadian Institute for Health Information. All delivery records (≥ 20 weeks gestational age) in Canada (excluding Quebec) between April 1, 2004 and March 31, 2017 and associated hospitalization information (demographics, diagnoses, therapeutic procedures) were identified using International Classification of Diseases-10CA/Canadian Classification of Interventions codes. The primary outcome was incidence of sepsis. The secondary outcomes were risk factors, morbidity (organ failure, ICU admission) and mortality. Data were summarized using descriptive statistics. Associations between risk factors and sepsis were derived using unadjusted Odds Ratios (OR).

Results: There were 4,183 cases of sepsis in 3,653,783 hospitalizations for delivery during the study period, with an incidence of 114 (95% CI: 111, 118) per 100,000 hospitalizations and a mortality rate of 0.5%. There was a trend towards decreasing sepsis rates from 2004 [160 per 100,000 (95% CI: 146, 177)] to 2016 [104 (93, 117)] ($p < 0.001$). The highest sepsis rate was observed in the Territories [224 per 100,000 (95% CI: 167, 301)], while the lowest was in New Brunswick [77 (61, 98)]. Puerperal sepsis was the leading diagnostic code associated with sepsis [72%, (Table 1)]. Severe sepsis was seen in 14% ($n=568$) of all patients with sepsis, which we defined as patients with one or more of: septic shock (15%, $n=85$), organ failure (61%, $n=345$), ICU admission (78%, $n=443$) or mortality (3%, $n=19$). The leading systems involved in organ failure were cardiovascular (41%) and respiratory (22%). Among patients with organ failure, 30% ($n=105$) had multi-organ system failure. Extremes of maternal age [< 25 years, OR: 1.59 (95% CI: 1.48, 1.71); > 40 years, OR: 1.42 (1.22, 1.65)], multiple gestation [2.86 (2.46, 3.32)], stillbirths [8.79 (7.60, 10.17)], cesarean delivery [3.32 (3.10 to 3.54)], retained products of conception [2.13 (1.69 to 2.69)], postpartum hemorrhage [3.94 (3.65 to 4.24)] and hysterectomy [24.23 (18.16, 32.32)] were associated with maternal sepsis.

Discussion: Maternal sepsis rates have been decreasing in Canada but remain higher than those observed in the UK and US.^{1,2} Our study shows 1 in 8 women with sepsis develop severe sepsis-related morbidity, which warrants risk stratification, changes in practice guidelines and national preventive strategies.

References:

1. Acosta et al. *PLoS Med.* 2014;11:e1001672
2. Hensley et al. *JAMA.* 2019;322:890

Abstract #: ET4-01
Table 1: Morbidity and Mortality of Maternal Sepsis in Canada

Condition	N (%)	Incidence (95% CI) 100,000 hospitalizations	Organ failure N (%)	ICU Admissions N (%)	Mortality N (%)
Puerperal Sepsis	2990 (71.5)	81.8 (79.0 to 84.8)	165 (34.3)	249 (56.2)	9 (47.4)
Other Infection During Labor Includes Sepsis	683 (16.3)	18.7 (17.3 to 20.2)	43 (8.9)	48 (10.8)	2 (10.5)
Other Sepsis	441 (10.5)	12.1 (11.0 to 13.3)	139 (28.9)	154 (34.8)	10 (52.6)
Streptococcal Sepsis	136 (3.2)	3.7 (3.2 to 4.4)	21 (4.4)	23 (5.2)	0
Bacteremia	118 (2.8)	3.2 (2.7 to 3.9)	12 (2.5)	9 (2.0)	1 (5.3)
Septic Shock	85 (2.0)	2.3 (1.9 to 2.9)	85 (17.7)	69 (15.6)	4 (21.1)
Infection Following Transfusion, Infusion and Therapeutic Injection	29 (0.7)	0.8 (0.6 to 1.1)	2 (0.4)	6 (1.4)	0
Necrotizing Fascitis	23 (0.5)	0.6 (0.4 to 1.0)	6 (1.2)	16 (3.6)	1 (5.3)
Systemic Inflammatory Response with Organ Failure (Includes Severe Sepsis)	7 (0.2)	0.2 (<0.1 to 0.4)	5 (1.0)	5 (1.1)	2 (10.5)
Toxic Shock Syndrome	4 (0.1)	0.1 (<0.1 to 0.3)	3 (0.6)	2 (0.5)	0
Listerial Sepsis	4 (0.1)	0.1 (<0.1 to 0.3)	0	0	0
Infection from External Stroma of Urinary Tract	2 (<0.1)	<0.1 (<0.1 to 0.2)	0	0	0
Salmonella Sepsis	2 (<0.1)	<0.1 (<0.1 to 0.2)	0	1 (0.2)	0
Gas Gangrene	1 (<0.1)	<0.1 (0 to 0.2)	0	0	0
Hospitalizations having at least 1 Sepsis Condition	4183	114.5 (111.1 to 118.0)	345*	443	19
Hospitalization with more than 1 Sepsis Condition	308	8.4 (7.5 to 9.4)	107	115	7

*345 hospitalizations with at least 1 organ failure, 481 total organ failures as 105 hospitalizations were associated with 2 or more organ failures.#

Abstract #: ET4-02

US state-level variation in prevalences of chronic hypertension and hypertensive disorders of pregnancy

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Importance: Hypertensive disorders of pregnancy are important causes of maternal death, and maternal and perinatal morbidity.(1-3)

Objective: To examine the extent of state-wide variation in the prevalence of chronic hypertension, pregnancy-induced hypertension (PIH) or preeclampsia (hereafter referred to as gestational hypertension), and eclampsia in the United States.

Design, Setting, and Participants: Retrospective cohort study using US birth certificate data. Participants were 3,855,500 women who delivered livebirths in 2017.

Main Outcomes and Measures: State-specific prevalences of chronic hypertension, gestational hypertension, and eclampsia among women who delivered livebirths, assessed using multilevel multivariable logistic regression. The adjusted median odds ratio (MOR) and intraclass coefficient (ICC) were used to evaluate state-wide variation in the prevalence of each disorder.

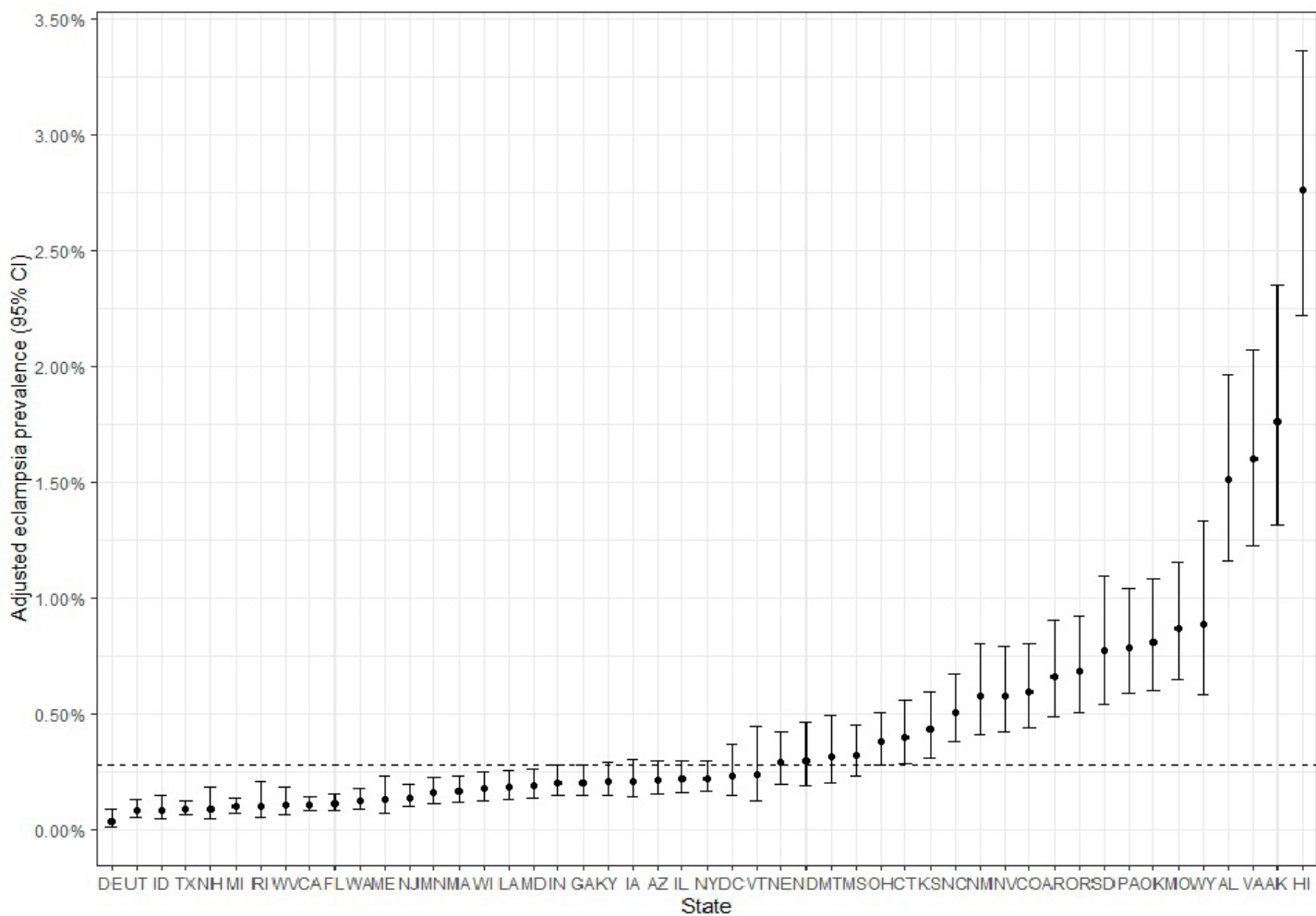
Results: The final analytic sample for the chronic hypertension, gestational hypertension, and eclampsia cohorts comprised 3,662,025 deliveries, 3,593,927 deliveries, and 3,462,909 deliveries, respectively. The overall US prevalences of chronic hypertension, gestational hypertension, and eclampsia were 1.9%, 6.5%, and 0.3%, respectively. The adjusted chronic hypertension prevalence ranged from 1.0% (95% CI 0.9-1.2%) in Hawaii to 3.4% (95% CI 3.0-3.9%) in Alaska. The adjusted gestational hypertension prevalence ranged from 4.3% (95% CI 4.1-4.6%) in Massachusetts to 9.3% (95% CI 8.9-9.8%) in Louisiana. The adjusted eclampsia prevalence ranged from 0.03% (95% CI 0.01-0.09%) in Delaware to 2.8% (95% CI 2.2-3.4%) in Hawaii (Figure). For chronic hypertension, gestational hypertension, and eclampsia, the adjusted MORs were 1.3 (1.2-1.3), 1.2 (1.1-1.2), and 2.4 (1.9-2.8), respectively and the ICCs were 1.9% (1.3%-2.9%), 0.8% (0.5%-1.3%), and 20.0% (13.9%-28.8%), respectively.

Conclusions and Relevance: Our findings indicate that US states explain a large portion of the variability in state-level prevalences of eclampsia and a much smaller portion for chronic hypertension and gestational hypertension. Detailed public-health inquiries are needed to identify reasons for the variability in eclampsia prevalence across US states.

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Abstract #: ET4-02



Abstract #: ET4-03

Modeling the aging placenta: Cobalt chloride induces senescence and mitochondrial dysfunction in placental trophoblasts in vitro

Presenting Author: Erin J. Ciampa, MD, PhD

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The majority of cases of pre-term labor (PTL) have an unknown etiology¹⁻². The burden of this problem is immense, given the implications of prematurity for neonatal and childhood health, and the fact that no effective treatment exists to halt PTL²⁻⁴. Placental aging is widely considered a key process that may drive the onset of parturition, but the underlying mechanisms remain elusive⁵⁻⁷. We hypothesize that effectors from dysfunctional mitochondria – originating from fetally-derived aging placental trophoblasts – may signal the normal and pathologic induction of parturition. In order to study this hypothesis, we needed to establish an *in vitro* model of aging trophoblasts, as none previously existed. We found that application of cobalt chloride to the culture medium of JAR choriocarcinoma cells induces senescence and mitochondrial dysfunction as evidenced by multiple hallmarks: 1) expression of senescence-associated beta-galactosidase, 2) dramatic slowing of cell proliferation, 3) loss of the nuclear envelope protein Lamin B1, 4) upregulation of candidate markers of a traditional SASP (senescence-associated secretory phenotype) at the mRNA level, and 5) upregulation of mitochondrial superoxide (detected by MitoSox Red, a highly selective fluorogenic dye). This novel *in vitro* model of trophoblast aging and metabolic stress will be valuable for a wide variety of applications, including for probing the putative pathways that connect mitochondrial dysfunction and the secretion of inflammatory mediators that signal the onset of labor.

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Abstract #: ET4-03

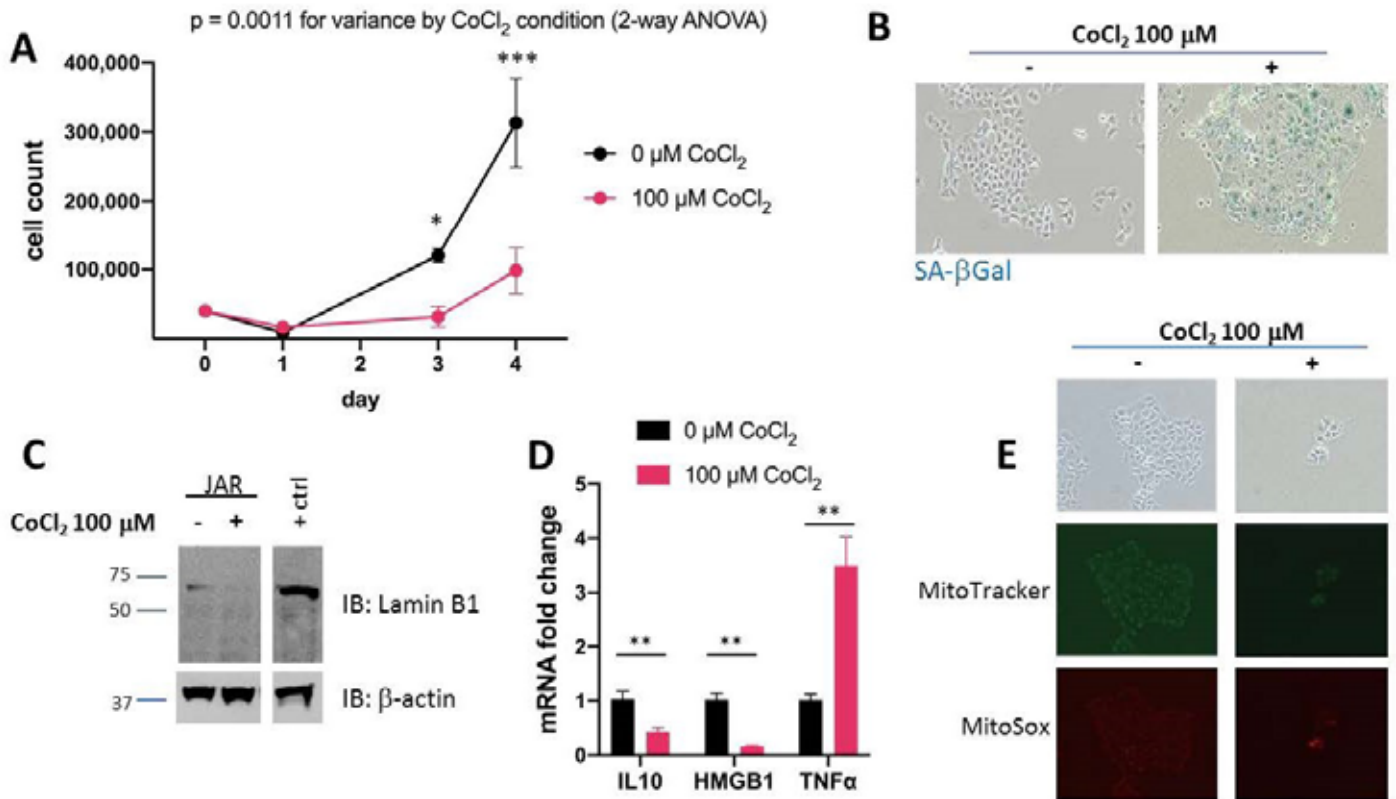


Figure 1. First-in-kind cell culture model of trophoblast senescence. **A**, Proliferation slows after four days of 100 μM CoCl_2 vs control media. *, $p < 0.05$ and ***, $p < 0.0001$ for post-hoc pairwise comparison with Fisher's LSD. **B**, SA- βGal expression (blue color) significantly increased after 4 days of CoCl_2 exposure. **C**, Decreased Lamin B1 protein after 2 days of CoCl_2 . **D**, Relative mRNA expression of candidate SASP genes after 4 days of CoCl_2 . **, $p < 0.01$ for student-t test each pairwise comparison. **E**, Increased mitochondrial superoxide expression detected with MitoSox Red probe in JAR cells after 4 days of CoCl_2 .

Abstract #: ET4-04

Core Outcome Set for Research on Critically Ill Obstetric Patients (COSCO): A Systematic Review

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Background: Critical illness during pregnancy is fortunately rare. The conduct of high-quality research in this area requires that outcomes reporting and measurement is standardized, to enable meta-analyses of results, which in turn will inform clinical practice and health policy. This study is the first step in an attempt to develop a Core Outcome Set for research on Critically ill Obstetric patients (COSCO study).

Methods: We conducted a systematic review by searching MEDLINE, EMBASE, CINAHL, Cochrane Library, and the Joanna-Briggs Institute Database of Systematic Reviews (from inception to November 2017). Randomized and non-randomized studies on women admitted to intensive care or high-dependency units during or immediately after pregnancy were included. Reported outcomes were categorized into four domains: (1) mortality, (2) physiological outcomes, (3) life-impact, and (4) resource-use, based on a previously published taxonomy. Variations in reporting of outcomes and their definitions, were documented.

Results: 12,581 citations were reviewed and 134 met inclusion criteria. The most commonly reported outcome was maternal all-cause mortality (n = 128, 95.5%), followed by resource-use (n = 116, 85.6%). Fetal/neonatal mortality was reported in 43 studies (32.1%). Maternal, fetal/neonatal, and obstetric physiological outcomes were reported in 35 (26.1%), 49 (35.6%), and 27 (20.1%) studies respectively. Life impact was only reported in two studies. There was considerable variation in outcome definitions.

Conclusions: There is considerable variation in the reporting and definition of outcomes in studies on critical illness during pregnancy. This review identifies a long-list of outcomes, which along with stakeholder interviews form an essential step towards development of COSCO.

Abstract #: ET4-05

Pulmonary Hypertension in Pregnancy: A Review of Peripartum Management of 21 cases

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OBJECTIVE: To identify whether mode of delivery or intrapartum management influenced maternal and neonatal outcomes in pregnancies complicated by pulmonary hypertension.

METHODS: A retrospective review of medical records at one academic institution from 2016-2018 identified pregnant women with pulmonary hypertension (resting mean pulmonary artery pressures >25 mmHg). Demographic, cardiopulmonary testing, intrapartum management, and maternal and fetal outcome data were collected. Women were classified according to the World Health Organization pulmonary hypertension classification groups 1-5. In accordance with prior similar studies, pulmonary hypertension was classified as mild (PAP 25-49mmHg) or severe (>50mmHg). Descriptive statistics were used to compare outcomes.

RESULTS: Eighteen women with twenty-one pregnancies were identified. Of these, 61% (11/18) were classified as WHO group I, 28% group 5 (5/18), 5.5% group 2 (1/18) and 5.5% group 4 (1/18). There were no maternal or neonatal deaths, although at delivery, three fetuses were pre-viable, and a fourth was an intrauterine fetal demise. Of seventeen viable pregnancies, thirteen were delivered at term, one was induced at < 37 weeks (preeclampsia with severe features), and the remaining three delivered at < 34 weeks (two with severe preeclampsia, and one precipitous). Mode of delivery was vaginal for twelve out of the twenty-one (57%), cesarean section for eight (38%) and D&C for one first trimester missed abortion. Of twelve vaginal deliveries, three were assisted in the second stage of labor. Two cesarean sections were performed urgently for preeclampsia, one for funic presentation, three women declined trials of labor after cesarean, and only one was elective. Neuraxial was performed for all cesarean sections and 8/12 vaginal deliveries, while remifentanyl PCA was used in one vaginal delivery. Only 3 patients delivered without analgesia. **CONCLUSION:** In this retrospective review of pulmonary hypertension in pregnancy, maternal and neonatal mortality were zero. The majority of patients delivered vaginally with neuraxial, while cesarean sections were performed for obstetric indications other than pulmonary hypertension. This review demonstrates that with multidisciplinary management, utilization of neuraxial anesthesia, and minimization of a prolonged second stage, it is possible to achieve low maternal and neonatal mortality rates in this high risk population.

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Abstract #: ET4-06

Posterior reversible encephalopathy syndrome (PRES) in parturients is associated with severe maternal morbidity

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Introduction: Posterior reversible leukoencephalopathy syndrome (PRES) is characterized by a constellation of symptoms including seizures and altered mentation. No large epidemiological studies have examined the association between PRES and maternal morbidity. Using a large national inpatient database we examined the incidence and outcomes of PRES in parturients. We hypothesized that women with a diagnosis of PRES would have associated higher rates of morbidity and mortality.

Methods: A retrospective cohort analysis was performed utilizing the National Inpatient Sample from 2002-2014. The primary exposure of interest was PRES during hospitalization for delivery and the primary outcome was rate of SMM, a composite outcome of twenty-one indicators defined by the CDC as unexpected outcomes of labor and delivery that result in short or long-term morbidity in the peripartum period.¹ Women with PRES were compared to those without using a chi-squared analysis with a $p < 0.01$ required to reject the null hypothesis.

Results: Among 57,980,328 weighted delivery discharges, 4617 patients had a diagnosis of PRES. Parturients with PRES experienced higher rates of SMM (Table) when compared to those without PRES. Similarly, a diagnosis of PRES was more often associated with eclampsia, heart failure, cardiac arrest and ventricular fibrillation, acute myocardial infarction, acute renal failure, ARDS, DIC, and sepsis.

Conclusion: PRES is associated with severe maternal morbidity. This association may be driven by underlying disorders of pregnancy-associated hypertension. Future studies are needed to determine the driving factors behind this association, and whether more aggressive treatment of either PRES or hypertension can prevent SMM during a delivery hospitalization.

References:

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	PRES (n=4617)	No PRES (n=57,975,712)	p
Severe maternal morbidity	3148 (68.2%)	1,149,331 (1.98%)	<0.001
Acute myocardial infarction	4 (0.4%)	1064 (0.01%)	0.050
Aneurysm	5 (0.1%)	1782 (0%)	0.333
Acute renal failure	307 (6.65%)	39466 (0.07%)	<0.001
Acute respiratory distress syndrome	839 (18.2%)	68975 (0.12%)	<0.001
Amniotic fluid embolism	15 (0.3%)	2635 (0%)	0.088
Cardiovascular arrest/ventricular fibrillation	62 (1.35%)	6654 (0.01%)	<0.001
Conversion of cardiac rhythm	38 (0.8%)	7382 (0.01%)	0.012
Diffuse intravascular coagulopathy	297 (6.4%)	142438 (0.25%)	<0.001
Eclampsia	1917(41.5%)	54954 (0.09%)	<0.001
Heart failure/arrest during surgery	59 (0.1%)	8046 (0.01%)	0.383
Periperal cerebrovascular disorders	668 (14.5%)	40295 (0.07%)	<0.001
Pulmonary edema/acute heart failure	135 (2.9%)	83595 (0.14%)	<0.001
Severe anesthetic complication	10 (0.2%)	10311 (0.02%)	0.195
Sepsis	228 (4.9%)	75175 (0.13%)	<0.001
Shock	158 (3.4%)	33098 (0.06%)	<0.001
Sickle cell disease with crisis	15 (0.3%)	32764 (0.06%)	0.156
Air and thrombotic embolism	49 (1.1%)	39676 (0.07%)	0.003
Blood transfusion	531 (11.5%)	664389 (1.15%)	<0.001
Hysterectomy	24 (0.5%)	60578 (0.1%)	0.072
Temporary tracheostomy	73 (1.6%)	3037 (0.01%)	<0.001
Ventilation	48 (1.0%)	24213 (0.04%)	0.002

Data expressed as n (%)

Abstract #: ET4-07

Incidence and Outcomes Across Obstetrical Patients Who Receive Extracorporeal Membrane Oxygenation: A Nationwide Inpatient Study in the United States

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Introduction: The use of extracorporeal membrane oxygenation (ECMO) has increased dramatically following successful use across patients with acute respiratory and cardiac failure.^{1,2} However, the literature reporting the experience with ECMO across the obstetrical population is sparse. Concerns unique to this population include maternal and fetal complications.³ The objectives of this study were to determine the incidence, characteristics and outcomes of pregnant patients who receive ECMO, and evaluate predictors associated with the need for ECMO.

Methods: We conducted a retrospective population-based cohort study using the Nationwide Inpatient Sample with weighted estimates of US hospitalizations of obstetrical patients requiring ECMO from 2010 to 2016. Patients treated with ECMO were identified using the diagnostic and procedural codes from the International Classification of Diseases 9th and 10th Edition. We evaluated demographic and obstetrical characteristics, etiologies necessitating ECMO and outcomes. Multivariate regression models were used to identify variables associated with in-hospital mortality.

Results: An estimated 5,346,517 pregnancy-based hospital discharges were identified, of which 59 discharges had an ICD-code associated with ECMO. The use of ECMO in pregnancy has increased over time, with the highest prevalence noted in 2015 (2.3 per 100,000 hospitalizations). The mean (Standard Error, SE) age of ECMO patients was 28.7 (1.3) years, with the majority being white (51%). Two thirds of patients had a Charlson Comorbidity Index of 0 (51%) or 1 (25%). Across ECMO recipients, 25% had pre-existing chronic kidney disease and 17% had pre-eclampsia. Fifty-four percent of patients receiving ECMO had concomitant acute kidney injury and 46% had sepsis (Table 1). The overall in-hospital mortality was 30.5% and the mean (SD) hospital length of stay was 23.8 (3.8) days. Mean (SE) total hospital charges were \$ 493,972 (77,013). In our exploratory, multivariable logistic regression analysis, there were no identified demographic characteristics, patient characteristics or complications that were associated with ECMO mortality with the exception of fetal death (Table 1).

Conclusions: Approximately 1.2 per 100,000 hospitalizations during pregnancy in a US-based nationally representative data was treated with ECMO. The mortality among these patients is 30.5%. The use of ECMO is uncommon in pregnancy and is mostly associated with acute cardiorespiratory complications (including ARDS and pneumonia). Future research should focus on evaluating factors associated with ECMO complications unique to the obstetrical population as well as ECMO outcomes.

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Abstract #: ET4-07

Table 1. Association between potential etiologies/complications with mortality in pregnant patients treated with ECMO.

	ECMO Prevalence N (%)	OR (95% CI)
Etiologies associated with ECMO utilization		
Acute respiratory distress syndrome	44 (74.6)	0.84 (0.24-2.94)
Acute kidney injury	32 (54.2)	1.50 (0.48-4.62)
Sepsis	27 (45.8)	0.93 (0.30-2.82)
Pneumonia	24 (40.7)	0.30 (0.08-1.07)
Cardiogenic shock	23 (39.0)	1.39 (0.45-4.28)
Cardiac arrest	19 (32.2)	3.1 (0.97-9.96)
Cardiomyopathy	17 (28.8)	1.97 (0.60-6.46)
Septic shock	15 (25.4)	0.78 (0.21-2.89)
Obstetric shock	15 (25.4)	1.19 (0.34-4.18)
Postpartum hemorrhage	9 (15.3)	1.17 (0.26-5.29)
Pulmonary embolism	3 (5.1)	1.15 (0.10-13.5)
Pulmonary hypertension	3 (5.1)	5.00 (0.42-59.1)
Status asthmaticus	2 (3.39)	
Amniotic embolism	1 (1.7)	
Pulmonary hemorrhage	1 (1.7)	
Potential Complications Associated with ECMO Utilization		
RBC transfusion	20 (33.9)	1.93 (0.61-6.09)
Fetal death	5 (8.5)	11.4 (1.18-111.1)
Intracerebral hemorrhage	2 (3.4)	2.35 (0.14-39.8)

Bold font denotes a statistically significant result.

Abbreviations: ECMO = extracorporeal membrane oxygenation, N=number of patients, OR=Odds Ratio, CI= confidence interval.

Abstract #: ET4-08

The pregnancy outcomes in patients with chronic kidney disease - A Retrospective Study

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Introduction: Approximately 3% women of the childbearing age have CKD. There are limited studies on adverse pregnancy outcomes in CKD patients. In this study, we retrospectively analyzed the pregnancy outcomes in patients with CKD at different stages.

Methods: Clinical data of pregnant women with CKD at Partners Healthcare System from January 2015 to December 2019 were retrospectively analysed. Patient age, blood pressure, delivery methods, prenatal and postnatal serum creatinine, glomerular filtration rate, gestational age and fetal preterm delivery were collected. Fetal and maternal outcomes were analyzed in patients with CKD in different stages. Statistical analysis using SPSS 25.0.

Result: A total of 90 pregnancy CKD female were included. Fetal Outcomes: Compared with the control group, the incidence of preterm birth increased in the CKD Stage 1 group (CKD1) ($P < 0.05$). Compared with the CKD1 group, there was no significant change in the incidence of preterm birth, small for gestational age infant or cesarean delivery rate in the CKD2 (CKD stage 2) group. Compared with the CKD1 stage group, the incidence of preterm birth was increased in the CKD Stage 3-4 group ($P < 0.05$). Maternal Outcomes: Compared with the control group, the incidence of preeclampsia and new-onset hypertension in the CKD group increased compared with the control group ($P < 0.05$). Compared with the control group, the incidence of new-onset hypertension was increased in the CKD1 stage group ($P < 0.05$). No significant change compared to stage CKD2. Compared with CKD1, urinary protein increased in CKD2 stage ($P < 0.05$), and the incidence of preeclampsia and new-onset hypertension was increased in the CKD3-4 stage group ($P < 0.05$). Compared with CKD1, there was no significant change in the increase of urinary protein in CKD2 and CKD3-4. In patients with stage CKD1-2, postpartum serum creatinine and eGFR did not change significantly compared with pregnancy, but in patients with stage CKD3-4, serum creatinine increased ($P < 0.05$) and eGFR decreased ($P < 0.05$). Urine protein was increased in the postpartum patients of CKD group.

Discussion: In this study, most patients with CKD had normal and mildly impaired renal function (CKD1 stage and CKD2 stage), while fewer patients had CKD3 stage and CKD4 stage. Compared with non-CKD women, the incidence of preterm births has increased, and the incidence of preterm births has increased significantly with the severity of renal impairment. The incidence of preeclampsia and emerging hypertension in CKD pregnant patients has increased significantly. In summary, CKD patients have an increased risk of adverse fetal and maternal outcomes compared to women without CKD.

References:

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Abstract #: ET5-01

Hereditary Hemorrhagic Telangiectasia and Hemoptysis: Implications for Delivery and Airway Management

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Presenting Author's Institution: Massachusetts General Hospital

Co-Authors: Xiaodong Bao, MD, PhD - Massachusetts General Hospital

Erin E. Haggerty, MD - Massachusetts General Hospital

Introduction: Hereditary hemorrhagic telangiectasia (HHT) is a disease of arteriovenous malformations (AVMs) predominantly in the lungs and gastrointestinal tract with significant implications in pregnancy. HHT has a variety of clinical presentations from epistaxis to bleeding secondary to ruptured AVMs. Data to guide management of HHT in pregnancy is limited. As such, our case of a parturient with recurrent hemoptysis secondary to a pulmonary AVM presents unique implications for anesthetic and obstetric management.

Case Presentation: A 32 yo G1P0 with known HHT and pulmonary AVMs, presented at 35w1d with recurrent and worsening hemoptysis. 13 days prior she underwent embolization for a left upper lobe vascular malformation for similar symptoms. She was admitted to the surgical intensive care unit (SICU) for airway observation and received inhaled tranexamic acid. Interventional radiology declined to intervene given the risk of fetal radiation exposure. Awake bronchoscopy revealed fresh clot formation in the left superior segmental bronchus.

Given her potentially unstable airway and worsening peripartum course, the decision was made to proceed with cesarean delivery. Prior MRI was negative for spinal AVMs, thus it was deemed safe to proceed with neuraxial anesthesia. Equipment for lung isolation and cardiopulmonary bypass were on standby should her course deteriorate rapidly. A combined spinal-epidural (CSE) was placed and blood pressure was maintained with a phenylephrine infusion. Following delivery, the patient returned to the SICU for airway monitoring with gradual improvement of symptoms.

Discussion: While most parturients with HHT have uneventful deliveries, hemoptysis complicates critical airway management. Neuraxial anesthesia has been demonstrated to be superior to general anesthesia (GA) to avoid worsening of the shunt associated with AVMs¹. Preserving inherent protective airway reflexes with an awake parturient was the safest course of action this patient. Postpartum hemorrhage requiring surgical intervention is among the most common complications of HHT, therefore a CSE is recommended after exclusion of spinal AVMs^{2,3}. Paradoxical embolism via pulmonary AVMs has been implicated in maternal mortality,³ therefore preemptive air filters were applied to all IV access in this case.

As a result of the successful management of this patient, we propose that cesarean delivery with neuraxial anesthesia, in the absence of spinal AVMs, is the appropriate management of the parturient with HHT in the setting of large volume hemoptysis.

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Abstract #: ET5-02

Cardiac Tamponade in Pregnancy from Multiple Stab Wounds: A Case Report

Presenting Author: Morganne Beard

Presenting Author's Institution: Loyola University Medical Center

Co-Authors: Michael Fox - Loyola University Medical Center

Dung Pham - Loyola University Medical Center

Introduction: Traumatic events complicate 1 in 12 pregnancies, and although the majority of trauma-related injuries in pregnancy are minor, trauma is the leading non-obstetric cause of death in pregnant women [1]. Treatment involves prioritizing maternal resuscitation, evaluating fetal status and prompt delivery if indicated. We present a case of a pregnant female with multiple stab wounds and cardiac tamponade who undergoes emergent cesarean section.

Case Report: The patient is a 22 year old female, G2P1001 at 36 week gestation who presented with penetrating stab wounds to the right upper quadrant (with eviscerated colon and omentum), right neck, left shoulder and back. Primary survey exhibited GCS score of 14 and hemodynamic stability. Fetal ultrasound revealed fetal bradycardia which led to the decision for emergent cesarean delivery and exploratory laparotomy.

After induction of general anesthesia and delivery of a fetus with Apgars 5/8/8, inspection of the bowel and solid organs showed no injury. While an arterial line and additional IVs were placed, the patient abruptly became hemodynamically unstable. Blood products and vasopressors were initiated. Oxygen saturation dropped to 92%, PaO₂ on ABG was 60 on FiO₂ of 1.0. End tidal CO₂ was noted to be 22-25 despite no change in ventilation. Point-of-care ultrasound revealed no abnormal pulmonary findings but pericardial fluid accumulation was noted after the surgeon reported possible cardiac injury. Transesophageal echocardiogram confirmed large pericardial fluid accumulation. Cardiovascular surgery was consulted, resulting in a sternotomy, evacuation of pericardial blood clot, and right ventricle perforation repair with an autologous pericardial patch.

A left internal jugular central line was inserted and vasopressor support was weaned given improvement of hemodynamics. Right pleural and mediastinal chest tubes were placed, and the patient was transported to the surgical intensive care unit. On postoperative day 1, closure of the other minor stab wounds was performed at bedside prior to extubation that day. She had an uncomplicated recovery and was discharged home on postoperative day 7.

Discussion: This case emphasizes the complexity of an obstetric patient who has suffered major trauma. Although cardiac tamponade is rare in pregnancy, its signs and symptoms may initially be masked by the physiological increase in blood volume and cardiac output during pregnancy [2]. It is important that providers account for the hemodynamic changes related to pregnancy in their initial evaluation and prompt treatment of both a mother and a vulnerable unborn child.

References:

1. Murphy N, Quinlan J. Trauma in Pregnancy: Assessment, Management, and Prevention. *Am Fam Physician*. 2014 Nov 15;90(10):717-724.
2. Pearce C, Martin S. Trauma and Considerations Unique to Pregnancy. *Obstetrics and Gynecology Clinics*, 2016-12-01, 43(4): 791-808.



Abstract #: ET5-03

Recurrent Large Right Atrial Thrombi in a Parturient: A Case Report

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Co-Authors: Kathleen A. Leavitt, MD - University of Missouri - Kansas City

Case: 27 y/o G4P3 with a history of multiple unprovoked PEs, long-term anticoagulation with apixaban, essential hypertension, and medical nonadherence secondary to a learning disability was admitted with dyspnea. One month prior, she had discovered she was pregnant and stopped taking apixaban. CTA revealed evidence of chronic thromboembolic disease. TTE demonstrated a large 3 x 2 cm mobile right atrial echodensity with associated moderate TR. At 9w2d gestation, she underwent sternotomy with mass excision. Two pedunculated masses were removed from the right atrium. Pathology identified these masses as organized blood clots with no evidence of atrial myxoma or other type of tumor. Her postoperative course was uncomplicated and she was discharged on therapeutic enoxaparin.

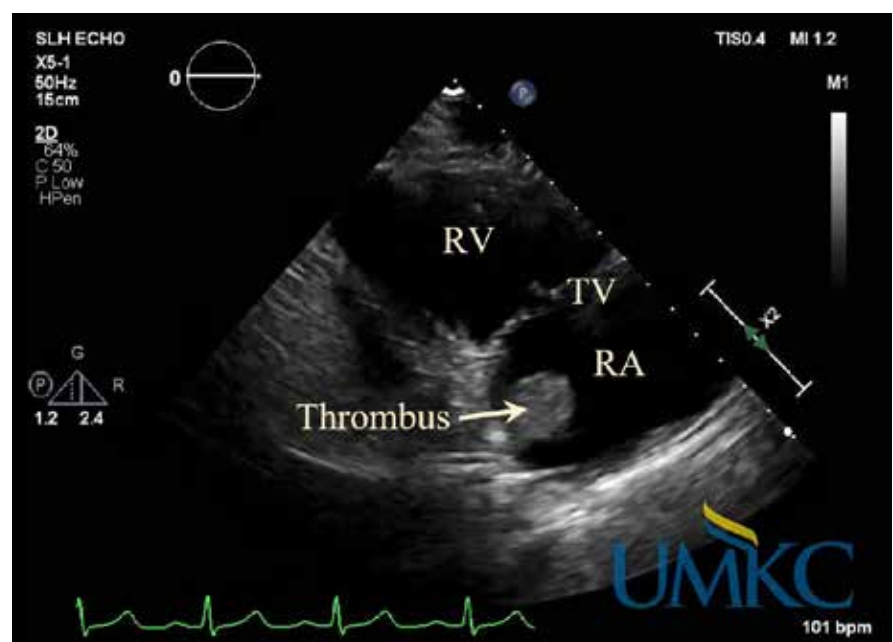
She presented to the MFM clinic at 28w0d and was found to have superimposed preeclampsia, IUGR (3rd percentile), and vasa previa. She was admitted for inpatient management of her prenatal care and anticoagulation. TTE showed recurrence of a 2 x 1.5 cm mobile right atrial mass with associated moderate-severe TR. At 29w3d, patient complained of sudden onset burning chest pain and was found to have interval development of PE burden despite being on therapeutic SQ heparin. Repeat TTE showed worsening right heart strain. Given these new findings, plan was made to deliver imminently.

Patient underwent Cesarean delivery at 30w0d. Obstetric anesthesia, cardiac anesthesia, cardiothoracic surgery, and interventional radiology were involved in the case. Perfusion and a cardiopulmonary bypass machine were available outside of the operating room. Patient received a pre-induction arterial line and was induced under general anesthesia. The fetus was delivered uneventfully 3 minutes after intubation. TEE probe was placed immediately after intubation to monitor the RA mass. Although very mobile, the mass remained unchanged throughout the procedure. MAP remained within 20% of her baseline throughout the anesthetic with no vasopressors required. Patient was extubated and recovered uneventfully in the CVICU. IR planned to remove the mass postpartum, however the patient left AMA prior to this procedure and has been lost to follow-up.

Discussion: Right atrial thrombi in the absence of atrial fibrillation, valvular heart disease, or central line catheter in-situ are exceedingly rare (1,2). In this case, our anesthetic management of her Cesarean delivery included general anesthesia with real-time monitoring of her right atrial thrombus via TEE. Cardiothoracic surgery and interventional radiology were on standby in the event that her thrombus dislodged during delivery. Perfusion was also on standby with a bypass machine outside of the operating room.

References:

1. Sharma et al. CMAJ 2015; 187(5): 350–354
2. Secheresiu et al. J Am Coll Cardiol 2019; 73: 2629



Abstract #: ET5-04

General Anesthesia for Induction of Labor: A Case Report

Presenting Author: Brittany Bunker, M.D.

Presenting Author's Institution: University of Virginia - Charlottesville, Virginia

Co-Authors: Jessica Sheeran, M.D. - University of Virginia

Danny Theodore, M.D. - University of Virginia

General anesthesia (GA) is typically avoided in parturients due to potential maternal and fetal complications. Parturients with severe respiratory failure can necessitate mechanical ventilation to protect their airway and severe thrombocytopenia may be concerning for increased surgical bleeding in a CS. In these unique situations, GA may be necessary for tolerance of mechanical ventilation during an induction of labor (IOL) due to the preference for less bleeding risk after a vaginal delivery than a CS.

A 27-year-old G5P4004 at 37 weeks' gestation admitted for respiratory distress, anemia (Hgb 5.6g/dl), and thrombocytopenia (plts=14 x 10⁹/L) was found to have acute myeloid leukemia. The patient required intubation for hypoxia secondary to pulmonary hemorrhage and subsequently developed a category 2 fetal heart tracing (FHT) with minimal variability. The decision to deliver was made based on the FHT; however, the obstetricians felt her bleeding risk was too high for CS and favored IOL for vaginal delivery. Labor was induced under GA using Sevoflurane for maintenance. The patient required mechanical ventilatory support and multiple transfusions, but ultimately had a successful vaginal delivery 6.5 hours later with Apgar scores of 1 and 3. Both the patient and neonate left the OR in stable condition and were ultimately discharged from the hospital.

There is a paucity of data regarding maternal and fetal ramifications of prolonged use of GA in the intrapartum period. When choosing a technique for maintenance of GA in a parturient, special consideration of anesthetic effect on uterine tone, placental transfer, and anticipated procedure duration is imperative. GA can be maintained via inhaled volatile or IV agents. Volatile agents cause uterine relaxation, but are well-tolerated when used briefly for CS. When volatile agents are used at concentrations >0.7 MAC they can antagonize the effects of oxytocin on the uterus¹. Volatile antagonism of oxytocin at the uterus may have counteracted and prolonged IOL. Propofol was considered, but it is readily transferred across the placenta, can be detected in fetal plasma following an induction dose, and fetal effects of prolonged infusion and high plasma concentrations are unknown². Remifentanyl was also considered given its short context-sensitive half-time, and studies have shown acceptable fetal Apgar scores despite increasing fetal plasma concentrations with infusions³. However, in these studies, remifentanyl was used in conjunction with epidural anesthesia and not at doses suitable for GA.

References:

1. Yamakage, M., et al. "Sevoflurane inhibits contraction of uterine smooth muscle from pregnant rats similarly to halothane and isoflurane." *Can J Anesth* (2002)
2. Sánchez-Alcaraz, A., et al. "Placental transfer and neonatal effects of propofol in caesarean section." *J Clinical Pharmacy and Therapeutics* (2008)
3. Kan, R. et al; "Intravenous Remifentanyl: Placental Transfer, Maternal and Neonatal Effects." *Anesth* (1998)

Abstract #: ET5-05

A PARTURIENT WITH CARDIAC ANGIOSARCOMA AND HEPARIN-INDUCED THROMBOCYTOPENIA

Presenting Author: Jean Marie Carabuena, MD

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Sarah C. Lassey, MD - Brigham and Women's Hospital

Background: Venous thromboembolism (VTE) is a leading cause of maternal morbidity in the peripartum period. Prophylactic anticoagulation is indicated in high-risk parturients. Enoxaparin and unfractionated heparin are first-line agents for VTE prevention and treatment; however, with known or suspected heparin-induced thrombocytopenia (HIT), timely diagnosis and conversion to non-heparin-anticoagulant therapies is essential.¹ HIT in pregnancy is rare and the choice of second-line anticoagulant is not standardized.² We report the use of bivalirudin in a critically ill parturient who developed HIT.

Case: 37-year-old G1P0 with a history of essential thrombocythemia, on prophylactic enoxaparin, presented at 31 weeks with chest pain and shortness of breath. Computed tomography revealed an infiltrating cardiac mass, pulmonary nodules and pulmonary embolism. Transthoracic echocardiogram revealed a large pericardial effusion, ejection fraction 75%, and an irregular mobile echodensity originating from the right atrium, prolapsing through the tricuspid valve into the right ventricle (RV)/RV outflow tract, and extending to the superior vena cava (Fig.1). Therapeutic-range intravenous heparin commenced with marked improvement in breathing. Pulmonary nodule biopsy revealed metastatic angiosarcoma.

Within a week, prior to initiation of chemotherapy, her platelet count progressively dropped (300K at admission, 51K nadir). With suspicion for HIT, heparin was discontinued and anticoagulant therapy with bivalirudin commenced. No controlled data exists on bivalirudin use in pregnancy, and the American Society of Regional Anesthesia Practice Advisory recommends avoiding neuraxial anesthesia; however, bivalirudin has a short half-life and can be monitored with conventional coagulation studies.

Multidisciplinary discussions included initiation of chemotherapy, close fetal and maternal surveillance, detailed delivery plans (Fig. 2), and continuation of anticoagulation with bivalirudin. At 35 weeks, fetal decelerations were noted after a contraction stress test. Bivalirudin was discontinued and a Cesarean delivery was performed under combined spinal-epidural anesthesia without complication.

Conclusion: Consideration of short-acting non-heparin anticoagulants is essential with VTE and HIT, particularly in the third trimester. Bivalirudin, a short-acting direct thrombin inhibitor, was a reasonable alternative. With multidisciplinary planning and continued updates, timely coordination of care and utilization of neuraxial anesthesia for Cesarean delivery were possible in this critically ill parturient.

References:

1. Blood. 2017;129(21):2864-2872
2. Cardiovasc Hematol Agents Med Chem. 2015;13(2):92-7

Abstract #: ET5-05

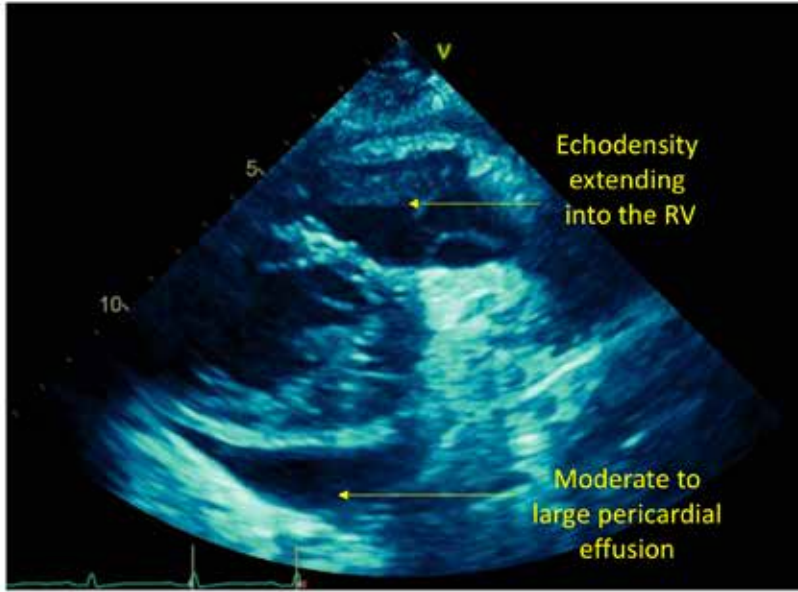


Fig. 1 – Transthoracic echocardiogram with intracardiac mass

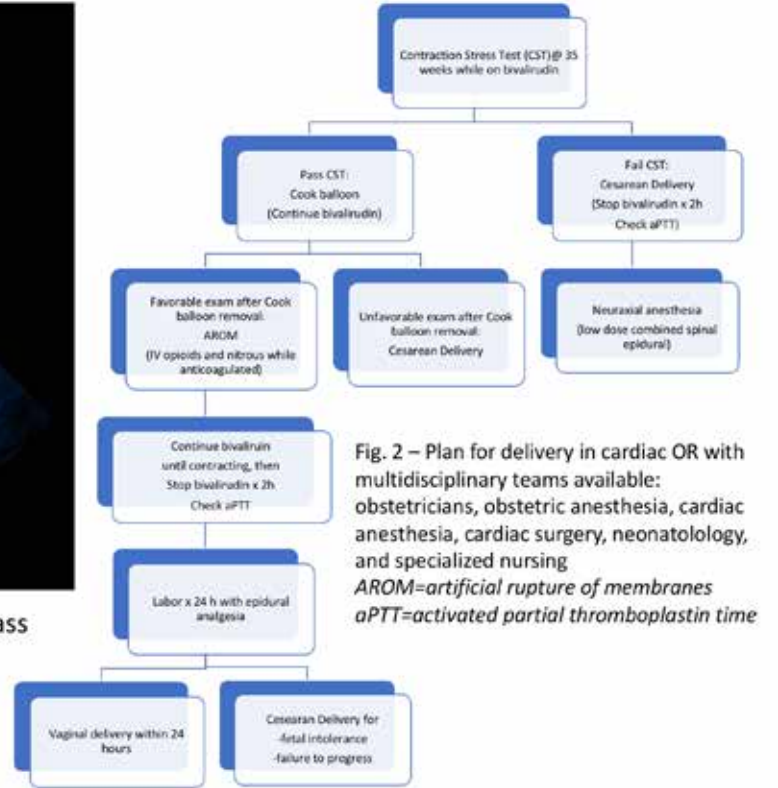


Fig. 2 – Plan for delivery in cardiac OR with multidisciplinary teams available: obstetricians, obstetric anesthesia, cardiac anesthesia, cardiac surgery, neonatology, and specialized nursing
 AROM=artificial rupture of membranes
 aPTT=activated partial thromboplastin time

Abstract #: ET5-06

Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) for a Cesarean Section in a Patient with Morbidly Adherent Placenta

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Co-Authors: Krystal Weierstahl, DO - Medical College of Wisconsin

As cesarean deliveries increase, so have morbidly adherent placenta (MAP) rates. REBOA has been used as a prophylactic and rescue device for hemorrhage in MAP; however, complications can occur [1]. Patient presented for fifth cesarean section (CS) with a placenta percreta and a REBOA for anticipated hemorrhage.

Patient is a 33-year-old female G8P3124 with four prior CS complicated by a placenta percreta with bladder and anterior abdominal wall involvement. The team and patient elected for awake placement of a radial arterial line and central line introducer. A chloroprocaine spinal was utilized for bilateral ureteral stent and femoral arterial line placement. The patient wished to minimize general anesthesia time to the fetus, and thus was induced prior to incision. A rapid sequence induction and intubation was performed. After, 1gm of tranexamic acid (TXA) was administered and surgery began. Following delivery, the patient had profound bleeding; massive transfusion was initiated and cell saver utilized. Trauma Surgery exchanged the femoral arterial line to the REBOA emergently. They had difficulty exchanging the arterial line and advancing the REBOA, but it was rapidly inflated. Hysterectomy was performed. The REBOA allowed visualization of the surgical field, which had been impossible prior to inflation. Three REBOA balloons were utilized as hemostasis could not be achieved. Repeat dose of 1gm TXA was administered. Serial thromboelastography (TEG), arterial blood gas, and coagulation studies were monitored. Despite TEG appearing hypercoagulable and coagulation studies showing adequate resuscitation, hemorrhage continued with estimated blood loss of 25 L. Damage control was initiated; abdomen packed, wound vacuum placed, REBOA balloon removed but sheath remained, and the patient was transported to the intensive care unit. Hours later, she returned to the operating room due to lower extremity (LE) ischemia and continued bleeding. She required bilateral internal iliac artery embolization for hemostasis. Surgery performed external iliac artery stenting for dissection, thrombectomy of the external iliac to femoral artery, removal of sheath, and a prophylactic fasciotomy. Hemostasis was achieved; abdomen and fasciotomy sites closed.

Many techniques are used to manage hemorrhage including REBOA and TXA, each with risks. Case reports exist of thrombosis occurring when arterial occlusion devices are utilized in conjunction with TXA and TXA alone for placenta percreta. In our case, LE ischemia may have resulted from direct trauma during REBOA placement; it is possible the TXA contributed to the arterial thrombosis secondary to the REBOA and sheath occupying the vasculature for a prolonged time [2]. While current TXA studies have shown reduction in bleeding and safety, we propose careful use of this medication.

References:

1. Cahill et al. Placenta Accreta Spectrum. Am J of Obstet and Gyn. 2018;219(6)
2. Hajmurad et al. A&A Case Reports. 2017;9:90-3

Abstract #: ET5-07

Reverse Takotsubo cardiomyopathy during cesarean delivery

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Reine Zbeidy - University of Miami/Jackson Memorial Hospital

Reverse Takotsubo can be a rare form of stress induced cardiomyopathy affecting women of childbearing age in the peripartum period. Here we present a case of reverse Takotsubo cardiomyopathy (rTCM) during cesarean delivery (CD) under combined spinal epidural (CSE) anesthesia.

Case report: A 32 year-old primigravid patient with history of gestational hypertension underwent elective CD due to twin gestation. A CSE with 11.25mg hyperbaric bupivacaine and opioids was administered with a prophylactic phenylephrine infusion and crystalloid coload. The patient remained hemodynamically stable with left lateral tilt and after 15 minutes a T4 sensory level was achieved bilaterally. Prior to commencing surgery, the obstetrician asked the lateral tilt be reduced with which the patient became hypotensive and bradycardic (HR 38). Left uterine displacement was reinstated, phenylephrine stopped and ephedrine (total 10mg) and 0.2mg glycopyrrolate were administered. The patient immediately developed severe hypertension (218/110) and headache with a wide complex tachycardia. The patient was stabilized with intravenous antihypertensives (esmolol 80mg and nicardipine 0.2mg), amiodarone 150mg and lidocaine 100mg and the surgery was commenced. However, the patient developed hypoxemia with hemodynamic instability necessitating conversion to general anesthesia. Both babies were delivered with Apgars of 9 at 1 minute. Invasive monitoring with arterial and central venous access was established. Intraoperative transesophageal echocardiogram revealed basal hypokinesia with reduced ejection fraction. The intraoperative course was complicated with hemorrhage secondary to uterine atony. The patient was aggressively treated with inotropes, blood transfusion and uterotonics. After stabilization in the OR, the patient was extubated and transferred to the cardiac ICU without inotropic support. Her troponins were elevated and repeat echocardiogram showed reduced left ventricular systolic function (EF 45%) with basal hypokinesia and apical hyperkinesia suggestive of rTCM. The patient remained hemodynamically stable and asymptomatic, she did not require any diuretics, her troponins trended down and she had no further arrhythmias. On postoperative day 1 she was transferred out of the ICU, she was ambulating and she was able to breastfeed. On postoperative day 3 she was discharged home and repeat echocardiogram at 1 month was completely normal.

Conclusion: It is important to consider rTCM as a rare but identifiable cause of acute heart failure in the peripartum period. Drug induced rTCM has been rarely reported, but anesthesiologists must be vigilant that perioperative use of sympathomimetics and anti-muscarinics can precipitate or unmask the condition.

Abstract #: ET5-08

Bilateral Serous Retinal Detachments in Parturient with Preeclampsia with Severe Features

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Presenting Author's Institution: Mount Sinai West and St. Luke's Hospitals - New York, New York

Co-Authors: Rami Diab, MD - Mount Sinai West and St. Luke's Hospitals

Deborah Stein, MD - Mount Sinai West and St. Luke's Hospitals

Patient is a 34 year-old G1P0 at 36w0d gestation who presented with right temporal headache for multiple days, blurred vision, and severe range blood pressures (200s/100s mmHg). Patient was induced for chronic hypertension and superimposed preeclampsia with severe features. Her medical history was significant for intermittent severe range blood pressures over the past 5 years, but she was never placed on antihypertensive medications; she also had ADHD, anxiety, and a history of HSV. Initial management consisted of magnesium sulfate, betamethasone, labetalol, and hydralazine, with pressures stabilizing in the range of 140/80-90 mmHg. An epidural was electively placed prior to induction with Foley balloon and oxytocin started. Oxytocin augmentation was stopped due to idiopathic hyponatremia. Decision was soon made to proceed for a cesarean delivery due to category 2 tracing remote from delivery in setting of preeclampsia with severe features. Surgery was uneventful, EBL 800mL, neonate delivered, APGAR scores 6/8, and the neonate was taken to the NICU for observation. POD 1 was significant for a hemorrhage of 1L with drop in Hct from 39 to 23.7, requiring additional uterotonics, 2 units pRBC transfusion, and exam under anesthesia with placement of a Bakri balloon. Patient developed DIC (INR = 2.1) requiring transfusion of one unit each of FFP, cryoprecipitate, and platelets. At this point the total EBL was noted to be 2.8L. POD 1 patient complained of worsening of her vision. Initially, the vision defect was described as having a film over the eyes, and progressed to no longer being able to discern faces and only seeing colors, outlines, and bright lights. Imaging was negative for PRES and venous sinus thrombosis. Ophthalmology evaluation afforded the diagnosis of bilateral serous retinal detachments in setting of preeclampsia. Non-surgical therapy of blood pressure management was suggested as treatment, and patient was managed with nifedipine, labetalol, and methylprednisolone with difficulty controlling her BP. Patient was then transferred to outside institution for treatment under a retinal specialist. She was discharged home on POD 9 with resolution of her vision and on a medication regimen of four-antihypertensives.

Abstract #: ET5-09

A RARE CASE OF SEVERE HYONATREMIA AND POSTPARTUM NEUROLOGIC CHANGES IN PREECLAMPSIA

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Presenting Author's Institution: Northwestern University Feinberg School of Medicine

Co-Authors: Feyce M. Peralta, MD - Northwestern University Feinberg School of Medicine

Paul Scott, MD - Northwestern University, Feinberg School of Medicine

Introduction: Preeclampsia is characterized by new-onset hypertension and proteinuria after 20 weeks gestation.¹ "Severe features" typically denotes progression to multiorgan impairment, including neurologic sequela. Hyponatremia can be seen with preeclampsia, with reported incidences of 3-10%.³ We present the case of a preeclamptic female with severe features and hyponatremia that developed peripartum neurologic changes.

Case: A 32-year-old G1P0 female with history of migraines and severe pubic symphysis diastasis presented at 35 5/7 weeks with a twin pregnancy for evaluation of headache, abdominal pain, nausea, and severe lower extremity pitting edema. She was found to have high blood pressures (161/98), a urine protein to creatinine ratio of 2.9 and serum sodium of 122 mmol/L. She was admitted for preeclampsia with severe features; her blood pressure was controlled with antihypertensives and hyponatremia with fluid restriction. However, her sodium levels fell to 118, prompting emergent Cesarean delivery. Prior to delivery, she developed a headache and blurry vision concerning for hyponatremia versus worsening preeclampsia and was treated with hypertonic saline and furosemide. She received an uncomplicated spinal anesthetic and the intraoperative course was complicated by a 2 L postpartum hemorrhage treated with 800 mL of crystalloid. She was transferred to the intensive care unit for frequent neurological and sodium monitoring. Postpartum she received additional hypertonic saline with sodium levels improving from 130 on postoperative day one (POD1) to 143 on POD4, ultimately having resolution of her symptoms. On POD4, she developed recurrent headache and blurry vision associated with pronator drift. MRI showed hyperintensity in the central pons and bilateral thalami concerning for central pontine myelinolysis versus posterior reversible encephalopathy syndrome (PRES). Diagnosed with PRES, she was discharged home PPD6 with complete resolution of her symptoms.

Discussion: Preeclampsia-associated hyponatremia is likely related to inappropriate vasopressin release in the setting of intravascular depletion in an otherwise hypervolemic state versus a preeclamptic placenta with decreased vasopressinase production.² Prior case reports described hyponatremia in preeclampsia to be rare; however, recent studies have shown that hyponatremia is common and more prevalent with severe features and twin gestations.³ This case is unique as the patient's headache and blurry vision could be secondary to hyponatremia or preeclampsia. When severe hyponatremia is present, it is important to include neurological sequela associated with hyponatremia and rapid correction of serum sodium levels (cerebral edema and central pontine myelinolysis) into the differential for neurological changes in the peripartum period and management plan.

References:

1. Dyer (2020) Chesnut's Obstetric Anes. 6:841-865.
2. Kahramanoglu (2014) Gynecol Obstet. 4:5.
3. Razavi (2017) J Perinat Med. 45(4):467-470.

Abstract #: ET5-10

The Most Influential Publications in Obstetric Anesthesiology, 1998-2017: Utilizing the Delphi Method for Expert Consensus

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Presenting Author's Institution: Brigham and Women's Hospital, Harvard Medical School

Co-Authors: Brian Bateman

William Camann, MD - Brigham & Women's Hospital, Boston

Michaela Farber

Lawrence Tsen

Background: There have been many advances in obstetric anesthesiology in the last two decades. We sought to create a list of highly influential publications in the field using the Delphi method amongst a group of obstetric anesthesiology experts to create an important educational, clinical, and research resource.

Methods: Experts in the field, defined as obstetric anesthesiologists selected to present the Gerard W. Ostheimer Lecture at the Society for Obstetric Anesthesia and Perinatology (SOAP) annual meeting within the past 20 years, were recruited to participate. The Delphi technique¹ was employed by administering 3 rounds of surveys. After each round, responses were collected and used as choices for subsequent surveys with the goal of obtaining group consensus for approximately 20 obstetric anesthesiology publications from 1998 to 2017.

In round 1, each expert was asked to identify 6 publications: the top 3 publications from the year covered in their Ostheimer lecture and 3 additional publications from 1998 to 2017. Highly influential publications were defined as those that changed traditional views, invoked meaningful practices, catalyzed additional research, and fostered ideas or practices that had durability over time.

For round 2, each participant was asked to select 10 publications from a collated list from round 1; all publications identified in round 1 were included as options in round 2. For the third round, the publications that were selected at least once during round 2 were included and each participant was asked to select 20 publications. While the initial goal was to identify 20 influential publications, the number of publications closest to 20 would be determined to be the top publications in the event of a tie. The total number of citations and citations per year of the final round 3 publications were recorded, with these determinations made on Web of Science on August 6, 2019.

Results: Survey round 1 had a response rate of 100% and yielded 82 publications. Round 2 had a response rate of 95% and yielded 57 publications that had at least 1 vote. Round 3 had a response rate of 100% and yielded 22 publications that received 9 or more votes (Table 1).

Conclusions: The principal finding was the identification of 22 highly influential scientific publications from 1998 to 2017. Key themes in the publications chosen included the reduction of maternal morbidity and mortality and refinements in the analgesic and anesthetic management of labor and delivery.

The field of obstetric anesthesiology is evolving, as reflected in the breadth and scope of these high-impact publications. Continued efforts toward lowering maternal morbidity and mortality, optimizing pain relief, understanding preeclampsia and other maternal medical co-morbidities, managing postpartum hemorrhage, and refining maternal hemodynamics during labor and delivery remain important priorities for future research.

References:

1. Diamond IR, et al. J Clin Epidemiol 2014;67:401-9.

Abstract #: ET5-10

Table 1: Top Obstetric Anesthesia Papers by Category, Summary, Total Citations, Citation Average Per Year, and Number of Votes in Round 3 of Survey

Citation	Summary	Total Citations	Citation Average/Year	Votes in Round 3
<i>Labor Analgesia</i>				
Comparative Obstetric Mobile Epidural Trial (COMET) Study Group UK. Effect of low dose versus traditional epidural techniques on mode of delivery: a randomized controlled trial. <i>Lancet</i> . 2001;358(9275):19-23.	RCT showing that lower dose epidural techniques conferred a lower risk of operative vaginal delivery compared to traditional higher dose techniques.	197	10.37	15
Sia AT, Lim Y, Ocampo C. A comparison of a basal infusion with automated mandatory boluses in parturient-controlled epidural analgesia during labor. <i>Anesth Analg</i> . 2007;104(3):673-8.	RCT demonstrating that automated mandatory intermittent bolus techniques + PCEA resulted in decreased local anesthetic consumption compared to continuous infusion + PCEA.	55	4.23	9
<i>Cesarean Delivery</i>				
Lydon-Rochelle M, Holt V, Easterling TR, Martin DP. Risk of uterine rupture during labor among women with a prior cesarean delivery. <i>N Engl J Med</i> . 2001;345(1):3-8.	Large, longitudinal, retrospective cohort study that found that a trial of labor after CD was associated with an increased risk of uterine rupture, particularly if labor was induced with prostaglandins.	503	26.47	9
Ngan Kee WD, Khaw KS, Ng FF, Lee BB. Prophylactic phenylephrine infusion for preventing hypotension during spinal anesthesia for cesarean delivery. <i>Anesth Analg</i> . 2004;98(3):815-821.	RCT establishing that a prophylactic phenylephrine infusion started after spinal for CD decreased the incidence and severity of hypotension without adverse effects upon fetal acid-base status.	97	6.06	18
Ngan Kee WD, Khaw KS, Tan PE, Ng FF, Karmakar MK. Placental transfer and fetal metabolic effects of phenylephrine and ephedrine during spinal anesthesia for cesarean delivery. <i>Anesthesiology</i> . 2009;111(3):506-12.	RCT showing that ephedrine crosses the placenta to a greater extent than phenylephrine and suggests that phenylephrine may be the preferred vasopressor with regards to fetal oxygen supply and demand balance.	119	10.82	16
Ngan Kee WD, Lee A, Khaw KS, Ng FF, Karmakar MK, Gin T. A randomized double-blinded comparison of phenylephrine and ephedrine infusion combinations to maintain blood pressure during spinal anesthesia for cesarean delivery: the effects on fetal acid-base status and hemodynamic control. <i>Anesth Analg</i> . 2008;107(4):1295-302.	RCT examining the effect of combining phenylephrine and ephedrine infusions, finding that as the proportion of phenylephrine decreased and the proportion of ephedrine increased, hemodynamic stability decreased and fetal acid-base status worsened.	108	9.00	9
Wong CA, Scavone BM, Peaceman AM, et al. The risk of cesarean delivery with neuraxial analgesia given early versus late in labor. <i>N Engl J Med</i> . 2005;352(7):655-65.	RCT showing that receiving intrathecal opioids early in labor does not increase the risk of CD compared to parenteral opioids.	206	13.73	20
<i>Postpartum Hemorrhage</i>				
Charbit B, Mandelbrot L, Samain E, et al. The decrease of fibrinogen is an early predictor of the severity of postpartum hemorrhage. <i>J Thromb Haemost</i> . 2007;5(2):266-273.	Prospective multicenter study examining predictive markers of severe PPH, with fibrinogen being the only marker associated with severe PPH.	359	27.62	11
WOMAN Trial Collaborators. Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum hemorrhage (WOMAN): an international, randomised, double-blinded, placebo-controlled trial. <i>Lancet</i> . 2017;389(10084):2105-2116.	Large, multicenter RCT which found that 1g of tranexamic acid given within 3 hours of delivery reduces death due to bleeding without adverse effects.	191	63.67	15
<i>Morbidity & Mortality</i>				
Creanga AA, Berg CJ, Syverson C, Seed K, Bruce FC, Callaghan WM. Pregnancy-related mortality in the United States, 2006-2010. <i>Obstet Gynecol</i> . 2015;125(1):5-12.	Retrospective review of CDC pregnancy mortality data, finding an increase in pregnancy-related mortality, particularly among black women and also with increasing age.	299	59.80	10
D'Angelo R, Smiley RM, Riley ET, Segal S. Serious complications related to obstetric anesthesia: the serious complication repository	Report compiled by the Society for Obstetric Anesthesia and Perinatology Research Committee from 30 institutions,	77	12.83	17

Abstract #: ET5-10

project of the Society for Obstetric Anesthesia and Perinatology. <i>Anesthesiology</i> . 2014;120(6):1505-12.	describing serious complications related to anesthesia, the most common of which were high neuraxial block, respiratory arrest, and unrecognized intrathecal catheter.			
Hawkins JL, Chang J, Palmer SK, Gibbs CP, Callaghan WM. Anesthesia-related maternal mortality in the United States: 1979-2002. <i>Obstet Gynecol</i> . 2011;117(1):69-74.	Review of anesthesia-related maternal deaths from the Pregnancy Mortality Surveillance System, which found a decrease in anesthetic-related maternal mortality and found decreasing case-fatality rates for general anesthesia, though these rates were still higher than those for neuraxial anesthesia.	124	13.78	9
Mhyre JM, Tsen LC, Einav S, Kuklina EV, Leffert LR, Bateman BT. Cardiac arrest during hospitalization for delivery in the United States, 1998-2011. <i>Anesthesiology</i> . 2014;120(4):810-8.	Study using the Nationwide Inpatient Sample that found 1 in 12,000 hospitalizations for delivery is complicated by cardiac arrest, most commonly due to PPH, heart failure, amniotic fluid embolism, and sepsis.	79	13.17	9
Mushambi MC, Kinsella SM, Popat M, et. al. Obstetric Anaesthetists' Association and Difficult Airway Society guidelines for the management of difficult and failed tracheal intubation in obstetrics. <i>Anaesthesia</i> . 2015;70(11):1286-306.	Obstetric anesthesia specific guidelines for management of difficult and failed intubation during general anesthesia.	133	26.60	11
Shields LE, Wiesner S, Klein C, Pelletreau B, Hedriana HL. Use of Maternal Early Warning Trigger tool reduces maternal morbidity. <i>Am J Obstet Gynecol</i> . 2016;214(4):527.e1-527.e6.	Multicenter study showing that use of the Maternal Early Warning Trigger tool significantly reduces severe maternal morbidity by addressing the most common causes of maternal morbidity.	27	6.75	13
Thomas TA, Cooper GM, Editorial Board of the Confidential Enquiries into Maternal Deaths in the United Kingdom. Maternal deaths from anaesthesia. An extract from <i>Why Mothers Die</i>	Detailed discussion of selected illustrative cases of maternal deaths in the United Kingdom, in addition to an analysis of	63	3.50	9
1997-1999, the Confidential Enquiries into Maternal Deaths in the United Kingdom. <i>Br J Anaesth</i> . 2002;89(3):499-508.	whether standard of care was met in each case.			
Weinberg G, Ripper R, Feinstein DL, Hoffman W. Lipid emulsion infusion rescues dogs from bupivacaine-induced cardiac toxicity. <i>Reg Anesth Pain Med</i> . 2003;28(3):198-202.	First study in larger animals demonstrating that lipid emulsion therapy is effective in rescuing dogs from bupivacaine-induced cardiac toxicity.	352	20.71	15
Hypertensive Disorders of Pregnancy				
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Palmer CM, Emerson S, Volgoropolous D, Alves D. Dose-response relationship of intrathecal morphine for postcesarean analgesia. <i>Anesthesiology</i> . 1999;90(2):437-44.	Dose finding study illustrating that the optimal dose of intrathecal morphine for CD is likely no more than 100mcg.	151	7.19	15
Other				
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RCT = Randomized Controlled Trial; PCEA = Patient Controlled Epidural Analgesia; CD = Cesarean Delivery; PPH = Postpartum Hemorrhage; CDC = Centers for Disease Control

Abstract #: T-01

A case of osmotic demyelination syndrome detected after caesarean delivery in the patient with the administration of magnesium sulfate for threatened preterm labor

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Magnesium sulfate (Mg) has been used as tocolytic drug and induces some complications such as muscle weakness. The osmotic demyelination syndrome (ODS) associated with pregnancy is rare, although can lead to muscle weakness and quadriplegia. In addition, transient neurologic symptoms and cauda equina syndrome following spinal anesthesia could result in gait disorder. Herein, we report that the patient with Mg administration as tocolytic agent presented with gait disorder due to ODS detected after caesarean delivery.

A 36-year-old pregnant woman was hospitalized in week 26 and day 6 for threatened preterm labor and parenteral ritodrine hydrochloride for tocolysis was administrated. However, 21 days later, because her liver enzyme was increased, it was gradually decreased and Mg was began to administrate. From the 5th day of Mg administration, she complained muscle weakness in lower limbs and dizziness. Finally, on 10th day, she was not able to walk as usual. These symptoms were considered to be adverse events related to hypermagnesemia, but the administration rate of Mg was increased for tocolysis. However, on the 16th day of Mg administration that is week 32 and day 1, Mg was discontinued for dyspnea. Then, emergency cesarean delivery was performed under uneventful spinal anesthesia. After that, despite stopping Mg administration, she still was not able to walk as usual. On 5th postoperative day(POD), an anesthesiologist consulted for gait disorder confirmed that the patient presented with spastic gait and upper-limbs ataxia. Following the further examination showing hyperactivation of her deep tendon reflexes in both the upper and the lower limbs, her brain magnetic resonance image(MRI) revealed hypersignals in central pontine and medial cerebellum in both the T2 weighted imaging and the diffusion-weighted imaging. Finally, the diagnosis of ODS was made. After that, she started rehabilitation and she was discharged with the ability to walk by herself on the 17th POD. In these clinical course, maximum serum Mg concentration was 5.1mEq/L and, 2 days after stopping of administration of Mg, it decreased to 1.7 mEq/L. The level of serum sodium concentration was within normal range during pregnancy period.

A brain MRI is the gold standard to diagnose ODS, but it takes at least two weeks to become positive after disease onset. This fact explains that ODS occurred before operation. Considering the onset, contribution of parenteral Mg to the pathogenesis of ODS was not denied. The exact mechanism has been unclear, but oligodendrocytes and astrocytes may be vulnerable to the toxic effects of hypermagnesemia. Suspecting ODS is the first step in diagnosing this syndrome, therefore ODS must be considered when patients receiving Mg for threatened preterm birth present with gait disorder, muscle weakness in lower limbs and dizziness.

Abstract #: T-02

Is anesthesiologists' attending to the 30 minute perinatal conference once a week effective to improve the safety of anesthesia for emergency cesarean section?

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Introduction: Preanesthetic evaluation of the patients is an extremely important element for safe anesthesia. Every pregnant woman has an opportunity to need emergency cesarean section (emCS), and we anesthesiologists sometimes cannot spend enough time to get information of the patients at emCS. Although there is no doubt that anesthesiologists' evaluating every pregnant woman prior to deliveries contributes to the safety of anesthesia, the task needs manpower. In Japan, because anesthesiologists are not yet highly sub-specialized, many anesthesiologists at general hospitals are in charge of anesthesia not only for obstetric surgeries but also for various operations. Our hospital is a general and referral institute. We have annual 600 vaginal deliveries and 200 cesarean deliveries including 80 emergency cases, as well as 7,000 surgeries. To improve the safety of emCS, we have sent one anesthesiologist to the perinatal conference held once in a week to get information about high risk pregnancies since 2016. Based on information obtained at the conference, we evaluate patients prior to deliveries regardless of the expected delivery methods. Here, we verify the effects of our effort.

Methods: Medical records of 247 cases priorly evaluated by anesthesiologists, and 327 cases of total emergency cesarean deliveries from January 2016 to December 2019 were examined.

Results: Among 247 cases that were evaluated priorly by anesthesiologists, 102 cases had obstetric risks, e.g. hypertensive disorders of pregnancy, multiple pregnancy, abnormal placentation, and preterm labor. Eighty-nine cases had anesthetic risks, e.g. obesity, spinal disease, and coagulopathies. Fifty-six cases were evaluated because of both obstetric and anesthetic risks. The delivery methods included 83 emergency cesarean sections, 83 planned cesarean sections, 49 normal vaginal deliveries, and 23 instrumental deliveries. Nine cases were referred to other hospital for various reasons. The number of total emCS were 338, and 255 cases were not evaluated prior to surgeries. Thirty cases of them had anesthetic risk factors which should had been evaluated priorly. Anesthetic complications did not occur during the period.

Discussion: We have gained information of high-risk pregnancies at the conference and evaluated not only patients with obstetric or systemic complications but also patients who had risks at performing anesthesia. Sixty-seven percent of patients who had been evaluated priorly by anesthesiologists needed cesarean sections and we could evaluate priorly 73 % of patients who had anesthetic risks and underwent emCS. We managed emCS without major complications during the study period. From above, we consider that our effort is effective and can be continued at hospitals similar to us.

Abstract #: T-03

Readability, Content, Quality and Accuracy Assessment of Internet-Based Patient Education Materials Relating to Anesthesia for Cesarean section

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Introduction: Over 90% of pregnant women search for information¹ related to their pregnancy and cesarean section. Despite an enormous amount of information on the internet, the quality remains unknown. It is important that the quality of the information pregnant women receive is both correct and understandable. The recommendation of the US Dept of Health and Human Services is to provide web-based patient education materials (PEMs) reading level at the sixth-grade.^{2,3} In a prior study, we compared the readability, content, quality and accuracy of PEMs for labor analgesia⁴, and in this study examine web based content about anesthesia for cesareans.

Methods: We compared PEMs of anesthesia for cesarean section from the major society and anesthesiology institutions' websites text and videos versus the top ten results of search engine (Google/YouTube) commercial sites and videos. Readability was assessed utilizing the Flesch-Kincaid Grade Level (FKGL), Gunning Frequency of Gobbledygook (FOG), Simple Measure of Gobbledygook (SMOG), Flesh Reading Ease Score and Coleman-Liau indices. The content was reviewed for inclusion of specific topics related to anesthesia of cesarean section. To assess the quality of the information we used the Patient Education Materials Assessment Tool (PEMAT) for Print and Audio/visual.⁵ The PEMs were independently graded for accuracy by obstetric anesthesiologists.⁴ PEMs readability, quality, and accuracy scores were compared using the independent t-test and content was compared by using the Chi-square test, with $p < 0.05$ significant.

Results: The Accuracy and PEMAT understandability for both Society PEM texts and Society PEM videos were significantly better than commercial website PEMs, $p < .0001$. There was no difference in readability measures between society PEMs for both texts and videos versus commercial PEMs, as well as all groups were above the recommended 6th grade reading level.

Conclusions: Google search results lead to commercial PEMs of variable quality and accuracy. Inaccurate information may lead to incorrect patient expectations and lower satisfaction. Commercial PEMs should be improved and patients should be directed to society PEMs to be better informed about anesthesia for cesarean section. Both Society and commercial PEMs should work to achieve the recommended 6th grade reading level. Access to high quality, accurate, easy to understand PEMs will help patients make informed decisions and discuss their anesthesia options/experience with greater ease and self-determination.

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Abstract #: T-03

Table. Readability, Accuracy, PEMAT and Content Scores of Web-Based Patient Education Materials Related to Anesthesia for Cesarean Section

	Society Text (N=13) Mean ± SD	Non-Society Text (N=10) Mean ± SD	Society Video (N=10) Mean ± SD	Non-Society Video (N=10) Mean ± SD
Readability				
FRES	48.5 ± 11.2	46.6 ± 15.2	51.4 ± 7.0	50.3 ± 24.9
FOG	14.5 ± 2.2	14.7 ± 3.0	15.7 ± 3.0	14.8 ± 6.9
FKGL	11.6 ± 2.2	11.9 ± 2.5	12.6 ± 2.7	11.7 ± 6.3
Coleman-Liau	10.1 ± 1.9	10.3 ± 2.5	9.0 ± 0.8	9.4 ± 2.5
SMOG	10.6 ± 1.6	10.7 ± 2.1	10.6 ± 1.5	10.5 ± 4.5
Accuracy, %	99.5% ± 1%*	61.8% ± 14%	96.9% ± 4%*	52.6% ± 12%
PEMAT				
Understandability	78.1 ± 11.6*	41.2 ± 17.0	80.3 ± 12.2*	55.2 ± 16.0
Actionability	13.8 ± 22.2	4.0 ± 8.4	46.7 ± 42.2	23.3 ± 38.7
Content				
	<i>Frequency</i>	<i>Frequency</i>	<i>Frequency(p=NS)</i>	<i>Frequency</i>
Neuraxial define	85%**	10%	70%	40%
Neuraxial benefit	38%**	80%	40%	30%
Epidural definition	100%**	60%	20%	40%
PDPH	46%**	0%	30%	0%
Hypotension	46%**	0%	50%	10%
Nausea	54%**	0%	40%	10%
Nerve damage	38%**	0%	20%	0%

FOG, FKGL, Coleman-Liau and SMOG scores represent grade level. In the FRES test, higher scores indicate greater readability, corresponding to a lower grade level (e.g., 50-60 = 10th-12th grade/fairly difficult, 60-70 = 8th-9th grade/standard, 70-80 = 7th grade/fairly easy, 80-90 = 6th grade/easy).

**=P< 0.05, *=P<0.001 society v. non-society data. Content society video v. non-society video P>.05.

Abstract #: T-04

Assessing the quality of information received by patients about obstetric analgesia and anaesthesia

Presenting Author: Alisha Allana

Presenting Author's Institution: Queen Alexandra Hospital, Portsmouth, UK

Introduction: Women should have easy access to information about obstetric analgesia and anaesthesia both antenatally and during labour[1]. Consent should include the presentation of evidence-based information by the appropriate individual in different formats and at the appropriate time.

Methods: A survey was designed based on the Royal College of Anaesthetists proposed standards for best practice[2] and approval was obtained from the local audit committee. Patients on the postnatal ward were asked a series of questions by an anaesthetic trainee after consent was gained. This included open and categorical questions about information received antenatally and during labour, any anaesthetic procedure received, and satisfaction rates. The data was analysed and presented locally.

Results: 40 patients completed the verbal survey. 97% of patients stated that they had received information about pain relief during labour in the antenatal period, with 35% receiving information about any form of labour anaesthesia. The majority of this information was from NCT (National Childbirth Trust) classes or discussions with their midwife. 50% of patients were satisfied with the information received antenatally.

80% of patients questioned received an anaesthetic intervention during labour, with 15% of patients recalling written information about their procedure, and 60% recalling verbal information. 85% of patients were satisfied with the information that they had received during labour.

Discussion: Information and consent for obstetric analgesia and anaesthesia can be complex; therefore delivery of information to patients should begin antenatally. The majority of women surveyed received information from discussions with midwives or midwifery-led classes. Low satisfaction rates were primarily due to a lack of information about epidural insertion; minimal information about anaesthesia for emergency procedures during labour; and failure to highlight the side effects of neuraxial blockade such as shivering and itching.

Of the patients who underwent an anaesthetic intervention, just over half the patients were able to recall verbal information, with less than a quarter of the patients being able to recall any form of written information. This highlights the need for multiple forms of information delivery, which is currently done using the epidural information card and discussion with the labour ward anaesthetist. Use of multimedia such as websites or online videos which can be accessed by the patient throughout their pregnancy may improve satisfaction rates and compliance during the procedure.

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Abstract #: T-05

Intraoperative fetal demise during non obstetric surgery; A case report

Presenting Author: Christen Allred, MD MPH

Presenting Author's Institution: University of North Carolina at Chapel Hill

Co-Authors: David Mayer, MD - Univeristy of North Carolina at Chapel Hill

36 yo G4P0030 with a PMH of HTN, T2DM, morbid obesity (BMI 49), and previous gastric bypass surgery presented at 25w5d with severe right upper quadrant pain, elevated WBC, and fever. Her initial presentation was also complicated by DKA and she was started on an insulin drip. General surgery posted her for a laparoscopic cholecystectomy. Prior to surgery the obstetrical team noted normal fetal heart tones via Doppler. Physical exam was notable for a somnolent patient with tachycardia and increased work of breathing. Airway exam was notable for a Mallampati 4 with normal mouth opening but she was unable to participate in remainder of exam due to pain.

A rapid sequence induction was initiated and the airway was secured with direct laryngoscopy, a grade 2b view.. Anesthesia was maintained with isoflurane and cisatracurium. Blood pressure support was facilitated with a norepinephrine infusion, and she was continued on an insulin drip for glucose control. Intraoperative findings were notable for a gangrenous gallbladder with dense abdominal adhesions. Upon closing and removal of surgical drapes a pool of fluid was noted on the operating table and the fetus had delivered vaginally during the case. Neonatal resuscitation was attempted per NRP protocol but was unsuccessful. OBGYN was called emergently. The placenta was delivered and retained placental products were noted. A dilation curettage was performed at this time. The patient remained intubated and was transferred to the ICU for further care.

Although gallstone disease can be common in pregnancy, complications can occur. This case describes an unfortunate series of events that led to an undiscovered preterm delivery during a general anesthetic. Extra uterine infection likely contributed to uterine inflammation and premature parturition. In accordance with the ACOG Committee Opinion on non obstetric surgery in pregnant patients, pre and post fetal heart tones were an acceptable plan of action. Additionally necessary patient positioning for improved surgical visualization led to the inability to detect any changes in fetal status until the conclusion of the case. This case highlights a failure of systems issues in the perioperative care of a parturient with a viable fetus. The case was delayed until late in the evening leading to no nicu team and minimal equipment being present for an unplanned delivery. Additional systems issues included poor communication and planning between the surgical, obstetrical, and anesthesia teams. Although the outcome may not have been different, many systems changes have been initiated after this case.

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Abstract #: T-06

Reduction of Uterine Incarceration Under Spinal Anesthesia

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Presenting Author's Institution: University of North Carolina at Chapel Hill

Co-Authors: Jeremy Gue, MD - University of North Carolina Hospitals

David Mayer, MD - University of North Carolina at Chapel Hill

Introduction: Uterine incarceration is a rare obstetric disorder that occurs when the uterus becomes entrapped behind the sacral promontory. With multiple treatment options to reduce the uterus, there is no universally accepted anesthetic technique. Our case demonstrates successful reduction performed safely under spinal anesthesia.

Case: A 37 yo G1P0 13w5d with a history of stage 1B1 cervical adenocarcinoma s/p robotic radical trachelectomy, abdominal cerclage, and chemotherapy who presented to her primary care physician (PCP) with inability to void and abdominal pain. Because of urinary retention, self catheterization was required the previous 2 weeks. On exam, she was found to have an incarcerated uterus. Manual reduction was unsuccessful in the outpatient setting. The plan was for reduction of the incarcerated uterus under neuraxial anesthesia.

Spinal anesthesia was performed with 5 mg of hyperbaric bupivacaine and 10 mcg intrathecal fentanyl. The uterus was noted to be in a more midline position and easily tilted to an appropriate position on manual exam. It was also discovered that there was laxity in the posterior vaginal fornix likely due to lack of posterior support and prior uterosacral ligament compromise from her previous surgery. This allowed for her uterus to retrovert with ease particularly with filling of the bladder. To address this, a pessary was placed and the patient was able to void spontaneously. Symptoms improved with the enlargement of the gravid uterus and the pessary was removed. The patient was subsequently delivered at 37w0d via low transverse cesarean section and combined spinal epidural anesthesia without complication.

Discussion: A radical trachelectomy is a new procedure used to treat early stage cervical cancer. It is notable for being fertility sparing in young women. In our patient however, it likely contributed to her further development of an incarcerated uterus. Patients with an incarcerated uterus are at risk for vaginal bleeding, further pain, and loss of pregnancy. Treatment of this patient under spinal anesthesia led to quick diagnosis in a comfortable environment for the patient and physician. It contributed to a treatment approach that allowed her to have increased function and quality of life in her early pregnancy.

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Abstract #: T-07

Trismus in an emergency C-Section: Case Report

Presenting Author: Eric Alspaugh, MD

Presenting Author's Institution: East Carolina Anesthesia Associates, North Carolina

Co-Authors: Ana Ramirez-Chapman, MD - University of Texas at Houston

Jeremy Way, MD - Michigan Private Practice

Background

This study looks at an emergency c-section that is further complicated by succinylcholine induced trismus. We will share our management of the case, and reflect on possible better management options in any potential future case.

Case Presentation: A 38-year-old female G5P3013 with obesity and polyhydramnios presented emergently to us with placental abruption at 30w2 of pregnancy. She was preoxygenated by simple mask as she was wheeled into the operating room. Upon entering the operating room she was placed on the surgical table, and we immediately induced anesthesia with propofol, fentanyl, and succinylcholine. Upon induction we were unable to open her mouth at all for intubation. Bag mask ventilation was difficult, and only small tidal volumes were achieved despite nasal trumpet. High dose rocuronium was given, without change in jaw opening. Multiple attempts were made to pry open the jaw. Preparations for a cricoidotomy were being made. Finally, with the help of 2 providers, the jaw was pried open to approximately 1/2 inch, and a LMA forced into the mouth. Fortunately, the LMA seated in the correct place. Subsequently the patient was intubated through the LMA with the assistance of a fiberoptic scope.

Conclusion: Trismus is a serious medical emergency in the context of induction of anesthesia. Management involves high suspicion of malignant hyperthermia, and securing an airway is problematic. In emergency c-sections where two lives are at stake, coordination with the Obstetrician is an important component of management as well.

Abstract #: T-08

Anesthetic management of an obstetric patient with Behçet disease complicated by Transverse Myelitis

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Background: Transverse myelitis (TM) is a rare neurological condition that has profound health and quality of life implications. It can be a manifestation of neuro-Behçet's disease (BD). Neuro-Behcet's disease (NBD) is another neurological disorder affecting patients with BD. Each of these conditions can impact the provision of medical care across different clinical settings. The aim of this case report is to discuss anesthesia management in patients with NBD with TM, particularly during C-section.

Case presentation: our case is a 37-year-old female patient in her 34th week of pregnancy, showing manifestations of neuro-Behçet disease and recurrent transvers myelitis. She presented to the clinic to the pre-anesthesia clinic on a wheelchair with worsening of baseline right lower limb weakness. Upon patient's request, the plan was discussed for both general and epidural anesthesia, with both benefits and risks explained. The patient elected to go under neuro-axial anesthesia. Post operatively, the procedure was done without complications. Patient was followed up for six months.

Conclusion: Patients with NBD and TM can be managed safely with epidural anesthesia. Development of standardized recommendations and protocols could greatly improve the quality and outcomes of anesthesia in patients with TM, BD, or NBD. Using neuroaxial approach in these patients was successful as our patient had physiotherapy after her operation. With good follow-up neuro-axial blocks can be performed on NBD patients successfully and safely as well.

Keywords: Behçet disease, epidural, General anesthesia, transvers myelitis.

Abstract #: T-09

Anesthetic Management for the Peripartum Care of Women with Fontan Physiology

Presenting Author: Nicholas An

Presenting Author's Institution: UCLA

Co-Authors: Mary Canobbio - UCLA

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Background: As outcomes for surgical palliation have improved, women with single ventricle congenital heart disease are surviving into their reproductive years and may become pregnant. The cardiovascular changes of pregnancy may stress the Fontan circulation and pose significant risk to the mother and fetus.

Methods: Women with pregnancy and Fontan physiology were identified from the Ahmanson/UCLA Adult Congenital Heart Disease Center database. A total of 35 pregnancies from 24 patients were identified between 2000 and 2017. 24 pregnancies resulted in live births. 4 deliveries were managed at an outside institution and were not included in the study. 20 live births from 19 patients were reviewed and compared for cardiac history, obstetric history, anesthetic management and cardiovascular outcomes.

Results: The most prevalent etiology of single ventricle congenital heart disease was tricuspid atresia with a hypoplastic right ventricle. Prior to pregnancy most women had good functional capacity. Median gestational age at delivery was 35 weeks. 10 out of 20 births were delivered via cesarean section. An epidural was used as the primary anesthetic for 19 deliveries and general anesthesia was used for 1 cesarean section. An arterial line was utilized in the peripartum period for 3 deliveries. Central venous access was established in the peripartum period for 1 patient. 4 patients required nasal canula oxygenation to maintain baseline SpO₂ in the post-partum period. 3 patients were briefly transferred to the intensive care unit post-partum for higher level of monitoring and care.

Conclusion: Epidural anesthesia is recommended to offset the effect of sympathetic outflow on systemic and pulmonary vascular resistance. Judicious fluid management is critical in minimizing post-partum cardiovascular complications. Most patients do not require higher level of care, invasive monitoring or central venous access during the peripartum period.

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Abstract #: T-09

**Table 4.** Anesthetic management for vaginal and cesarean deliveries

Patient	Mode of Delivery	Anesthesia	Invasive Vascular Lines	EBL
4	VV	Bupivacaine 0.625% Fent 2 mcg/ml (8 ml)	none	200
5	VF	Bupivacaine 0.25 % (9 ml) Second Stage: Bupivacaine 0.125 % (6 ml)	none	200
6	VF	Bupivacaine 0.625% Fent 2 mcg/ml (9 ml) Second Stage: Lidocaine 1% (10 ml)	none	800
8	VF	Bupivacaine 0.625% Fent 2 mcg/ml (8 ml)	none	500
9	VF	Bupivacaine 0.625 % Fent 2 mcg/ml (5 ml)	none	1200
12	V	Bupivacaine 0.625% Fent 2 mcg/ml (10 ml) Second Stage: Bupivacaine 0.125% (10 ml)	none	400
14	VF	Bupivacaine 0.625% Fent 2 mcg/ml (5ml) Second Stage: Bupivacaine 0.125% (10 ml)	none	450
15	V	Bupivacaine 0.625% Fent 2 mcg/ml (10 ml)	none	700
18	VF	Bupivacaine 0.625% Fent 2 mcg/ml (10 ml) Second Stage: Bupivacaine 0.25% (10 ml)	none	450
19	V	Bupivacaine 0.625% Fent 2 mcg/ml (10 ml)	none	300
1	CCS	Epidural 2% Lidocaine 20 ml	Arterial line	400
2	LTCS	Epidural 2% Lidocaine 25 ml	none	800
3	LTCS	Epidural 2% Lidocaine 20 ml	none	325
6	LTCS	Epidural 2% Lidocaine 23 ml	none	750
7	LTCS	Epidural 2% Lidocaine 15 ml	none	550
10	CCS	General (40 mg etomidate, 7 mg vecuronium)	Arterial line and Central Venous Access	1200
11	LTCS	Epidural 2% Lidocaine 17 ml	none	550
13	LTCS	Epidural 2% Lidocaine 25 ml	Arterial line	240
16	LTCS	Epidural 2% Lidocaine 25 ml	none	675
17	LTCS	Epidural 2% Lidocaine 20 ml	none	770

Patient #10 is the only patient who required pressors during the peripartum period. Patient was on dopamine drip for duration of the cesarean section □

Abstract #: T-10**Peripartum Cardiomyopathy: a case report****Presenting Author:** Ioannis Angelidis, MD, MSPH**Presenting Author's Institution:** Loyola University Medical Center - Chicago, Illinois**Co-Authors:** Audrice Francois, MD - Loyola University Medical Center

Peripartum cardiomyopathy (PPMC) is a rare disorder in which left ventricular systolic dysfunction and symptoms of heart failure occur at the end of pregnancy or in the first five months post-partum¹. The women may have no previous history of structural heart disease.

We present a case of a 38-year old G1P01 who had a cesarean section at 26 weeks. She had preeclampsia with severe features with intrauterine growth restriction, breech presentation and uncontrolled DM2 with end organ damage (diabetic retinopathy). Pre-section transthoracic echography (TTE) showed ejection fraction (EF) of 55% and mild pericardial effusion. Our patient had uncomplicated delivery and was discharged on post-operative day three.

One month later, she presented to the ED with worsening shortness of breath with activity, weakness and severe leg edema. A TTE showed an EF 25% and a large pericardial effusion. She was admitted to the cardiac care unit for monitoring and treatment of cardiac tamponade. An MRI showed worsening pericardial effusion. This was confirmed with a TTE, showing right ventricle collapse. Pericardiocentesis was attempted unsuccessfully, as the patient could not lie flat. Subsequent TTEs showed progressive improvement with EF of 30%, then 40% and decreased pericardial effusion after aggressive diuresis. The patient was discharged one week later. A follow up TTE three weeks later showed recovered EF of 55% with minimal pericardial effusion.

Myocarditis, abnormal immune response to pregnancy, and prolonged tocolysis have been linked to PPMC¹. The recognition of heart failure in a pregnant or postpartum woman is difficult as the normal physical exam in pregnancy can often mimic disease. Estimates of its incidence is approximately 1/3000 live births in the USA². Karafiatova et. all presented a PPMC case with spontaneous recovery after 3 weeks². Interestingly, Hayworth presented a PPMC case of a patient who experienced cardiac arrest, requiring intubation and vasopressors, and finally urgently a left ventricular assist device (LVAD)³. Treatment varies from salt and water restriction, to medications such as diuretics, beta blockers, anticoagulation and to more aggressive measures such as LVAD or ECMO placement for refractory cases.

Peripartum cardiomyopathy is a life-threatening condition which is challenging to both diagnose and treat. More recent survival rates of above 90% emphasize the importance of early recognition and treatment of the condition. Risk stratification from large registries such as IPAC and EURObRP is promising for improved clinical outcomes¹.

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Abstract #: T-11

Peripartum Management of Parturient with Respiratory Compromise Secondary to Multinodular Goiter

Presenting Author: Kelechi Anyaehie

Presenting Author's Institution: University of Texas Southwestern Medical Center

Maternal thyroid dysfunction is common during pregnancy due to the metabolic changes in pregnancy. It has also been associated with preterm delivery or fetal and maternal complications. We present a parturient with an enlarging goiter with respiratory compressive symptoms and the anesthetic and obstetric challenges of her management.

Case: A 38 yo morbidly obese G3P0 at 33w with history of thyroid multinodular goiter, poorly controlled hypertension, type 2 diabetes, and asthma presented to labor and delivery for blood pressure evaluation. Her antepartum course was complicated by an enlarging goiter that was incidentally found on exam and confirmed by ultrasound during her second trimester. At 30 weeks she presented with stridor, worsening dyspnea, dysphagia, orthopnea and apneic spells at night. Anesthesia and ENT were consulted for evaluation of her airway with bedside bronchoscopy. ENT was unable to view beyond the vocal cords however, it was assessed that she was intubatable from above with video laryngoscopy, 5.0 endotracheal tube and adequate ramping with awake fiberoptic as an option. An MRI was recommended but urgent thyroidectomy was not indicated as patient was stable.

During this admission, she had continuous severe range BPs resistant to labetalol at home resulting in severe pre-eclampsia. She was started on IV magnesium sulfate with the plan for induction of labor with pitocin. A dural puncture epidural was placed uneventfully however, fetal monitoring was unsuccessful due to patient's body habitus and cooperation. The decision was made to proceed with cesarean delivery given inability to monitor FHTs in setting of induction for severe pre-eclampsia. Upon evaluation, epidural analgesia was found to be one sided with a plan to replace with low dose combined spinal epidural in the OR with ENT on standby. In the OR, patient was difficult resulting in a wet tap and an intrathecal catheter was placed and slowly dosed with 1.2cc hyperbaric bupivacaine until a T3 level was achieved. She remained supine without any issues, requiring two pillows for comfort. She underwent a primary classical C-section and bilateral tubal ligation without surgical complications and discharged home 3 days later.

Discussion: Airway obstruction from a goiter during pregnancy is rare but can occur with high morbidity¹. Administering a general anesthetic to a patient with potentially "difficult airway" and aspiration risk combined with the physiologic decrease in FRC, could increase the risk of hypoxia to the mother and fetus. Continuous spinal anesthesia becomes an ideal option if unintentional dural puncture occurs particularly in morbidly obese patients who have a higher rate of failed epidurals and emergency C-sections². Early recognition and evaluation with a multidisciplinary approach ensured a successful outcome for mother and baby.

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Abstract #: T-12

Neuraxial Dexmedetomidine for Obstetric Anesthesia

Presenting Author: Thomas Baribeault

Presenting Author's Institution: Southern regional medical center

Neuraxial opioids are a main component of obstetric analgesia and anesthesia; however, they have a high incidence of side effects and visceral pain from uterine manipulation is not well controlled. Dexmedetomidine is a relatively new alpha 2 agonist that has multiple benefits for treating the obstetric patient when given via the intrathecal or epidural route but also has risks and side effects. This presentation includes a review of published literature and two case studies that illustrate how the use of dexmedetomidine has improved the care of obstetric patients.

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Abstract #: T-13

Successful anesthetic management for caesarean delivery in a patient with vascular Ehlers Danlos Syndrome

Presenting Author: Brett Barnes, DO

Presenting Author's Institution: IU School of Medicine

Co-Authors: Ji Hyun Lee, MD - Indiana University School of Medicine

Introduction: Vascular Ehlers Danlos Syndrome (vEDS) is a rare genetic connective tissue disorder affecting an estimated 1/50,000-1/200,000^[1]. This type of EDS is a severe multi-organ disease involving the skin, blood vessels, gastrointestinal track, and uterus. Various complications such as premature rupture of membranes, arterial dissection, bowel and uterine rupture, wound dehiscence, high-degree perineal lacerations, and postpartum hemorrhage have been reported peripartum^[4,1]. It has an estimated mortality of 5.3%.^[5] Due to its rarity, there is a lack of standard care for vEDS parturients undergoing delivery, although some authors suggested a planned caesarean delivery (CD) and avoidance of neuraxial techniques^[6].

Case Report: A 29-year-old G2P0010 at 39 weeks with vEDS from a null mutation in the COL3A1 gene, who was well known to the anesthesia service from prior multidisciplinary meetings, presented for a planned CD under general anesthesia (GA). This phenotype accounts for about 5% of vEDS cases^[4]. Her symptoms included easy bruising and mild menorrhagia, which are consistent with limited data that the null mutation presents as a milder phenotype^[3]. Two large bore IV's and a radial arterial line were placed via ultrasound guidance and blood products, as well as adjuvant uterotonics, were ordered preoperatively. The patient was induced in the main operating room via rapid sequence induction, and GETA was maintained with inhaled anesthetics. After delivery, an oxytocin infusion achieved adequate uterine tone and the surgery finished with an estimated blood loss of 590mL. Since blood loss was less than expected, bilateral TAP blocks were performed for postoperative pain management. The patient emerged smoothly from GA and had no postpartum complications.

Discussion: Although we elected GA in this case, there were a few reported cases with successful use of spinal anesthesia for CD in vEDS^[2]. After weighing risks and benefits, it may be reasonable to consider neuraxial anesthesia in mild phenotypes of vEDS.

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Abstract #: T-14**A Christmas gift: Patient with HOCM and baseline LVOT gradient >120 mmHg presents for urgent cesarean delivery**

Presenting Author: Aharon E. Benelyahoo, MD

Presenting Author's Institution: Yale Anesthesiology - New Haven, Connecticut

Co-Authors: Aymen Alian - Yale School of Medicine

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Hypertrophic Obstructive cardiomyopathy (HOCM) is the aberrant, asymmetrical increase in the left ventricular (LV) myocardium of the heart (i.e., LV wall thickness > 1.5 cm) in the absence of abnormal loading conditions.¹ The most common variant is associated with left ventricular outflow tract (LVOT) obstruction and mitral regurgitation.²

Case Report: A 28-year-old G7P1 at 39 weeks presented to Labor and Delivery with ruptured membranes and contracting. She was diagnosed with HCM at 11 weeks' gestation after a 4/6 murmur was noted on physical exam. Echocardiogram revealed severe septal hypertrophy with >120 mmHg LVOT gradient and severe mitral regurgitation. She was diagnosed as NYHA class II, CARPREG II score 3, and WHO class II-III for HOCM without prior cardiac events/symptoms. Her LVOT gradient improved to 58 mmHg at 38 weeks' gestation. She was asymptomatic throughout pregnancy denying dyspnea, chest pain, lower extremity edema, dizziness or syncope and had no limitations in her activities of daily living.

The patient was taken to the operating room for urgent repeat cesarean delivery. Arterial line was placed for hemodynamic monitoring. She was tachycardic and anxious. Midazolam and metoprolol were administered to decrease the patient's blood pressure (BP). An epidural was placed without incidence. Her BP and heart rate continued to slowly decrease, and surgery commenced. A phenylephrine infusion was used to maintain BP within 20% of her baseline. Large amounts of fluid administration were avoided and limited to 500cc. By the end of the case, phenylephrine was titrated off, bilateral TAP blocks were performed, and the epidural catheter was removed.

The patient recovered in the cardiac care unit where she became hypertensive to the 150s and tachycardic to the 90s. This resolved over the next few hours, but on POD 1, she again became hypertensive (>160/>110) and tachycardic. There was concern for pre-eclampsia with severe features. She also became anemic (hematocrit 21%) and received 1 unit of pRBCs. Later, it was discovered that the patient was discarding her anti-hypertensive medication which was attributed as the cause of her returned hemodynamic increases. Patient was discharged on post-operative day 3.

In the U.S., cardiovascular disease is now the leading cause of death in pregnant women and in women during the postpartum period.³ Even those who are asymptomatic in the prenatal period may suddenly decompensate during the 3rd trimester and postpartum due to the stress on the underlying cardiac disease by the physiological changes that occur.⁴ Minimizing sympathetic stimulation, prevention of tachycardia, and maintenance of preload and sinus rhythm are essential anesthetic goals for parturients with HCM.

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Abstract #: T-15**Lateral Femoral Cutaneous Nerve Block for Acute, Severe Meralgia Paresthetica in a Parturient.****Presenting Author:** Laura Libuit, MD**Presenting Author's Institution:** University of Maryland Medical Center**Co-Authors:** Omar Alyamani, MD, D.ABA - King Abdulaziz University, Jeddah, Saudi Arabia

Shobana Bharadwaj, MBBS - University Of Maryland Medical Center

Bhavani Shankar Kodali, MD - University of Maryland Medical Center

Khang Lee, MD - University of Maryland School of Medicine

Pregnancy and labor are amongst the risk factors for Meralgia Paresthetica (MP). Reports found the overall incidence of MP to be 4.3 in every 10,000 person per year. In pregnancy, the odds ratio (OR) is 12 at the 95% confidence interval. Patients and even physicians may mistakenly relate the neurological manifestations of MP to neuraxial anesthesia. We report a case of acute and severe MP pain during labor, not relieved by labor epidural analgesia. Complete resolution was the result of a lateral femoral cutaneous nerve block during labor.

A 22yo G1P0 at 40 weeks estimated gestational age and a BMI of 46 who requested epidural analgesia shortly after starting elective induction of labor. Programmed intermittent Epidural Bolus with Bupivacaine 0.0625% and Fentanyl 2mcg/ml was utilized for labor analgesia, with patient controlled analgesia, total not exceeding 48ml per hour. After 24 hours of labor, her PCEA demand doses significantly increased and she reported severe left lateral thigh 10/10 pain in the distribution of the lateral femoral cutaneous nerve (LFCN). Her labor pain was controlled, and the thigh pain was unrelated to contractions. On examination, she had adequate sensory analgesia (T6-S3) with no motor weakness of lower limbs. The clinical diagnosis of MP was discussed with the patient and LFCN block was offered to her for pain relief. The patient consented to LFCN block as the thigh pain was intolerable to her. Bupivacaine 0.25% 5 milliliters were injected near the LFCN under ultrasound guidance that resulted in complete resolution of the MP symptoms in 10 minutes. The same epidural catheter was used for an uneventful abdominal delivery 6 hours later due to arrest of labor. Four weeks postpartum, the symptoms did not recur, and the patient recalled the nerve block as a quick intervention with excellent results.

Anatomical studies suggested that the course of the LFCN puts it at risk for irritation from tension and mechanical friction. MP is well known for its gradual onset and mostly altered sensation character. Due to the sudden onset and severity of the pain in this case, we suspect that progressive weight gain during pregnancy, position during this prolonged labor along with obesity, fluid retention from Pitocin triggered the relatively sudden entrapment of the LFCN. Careful examination and assessment of breakthrough pain during labor neuraxial analgesia is of great importance. Anesthesiologists may be asked to assess patients with lower extremity paresthesia during labor or the postpartum period, especially when a neuraxial technique has been utilized. Meralgia Paresthetica can develop during labor, have a relatively rapid onset and severe presentation. A LFCN block with ultrasound guidance during pregnancy and labor can be quick, relatively safe and effective.

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Abstract #: T-16

Anesthetic Management of Skull Base Tumor During Pregnancy

Presenting Author: Arunthevaraja Karuppiah, MBBS, MD

Presenting Author's Institution: University of Maryland Medical Center

Co-Authors: Shobana Bharadwaj, MBBS - University Of Maryland Medical Center

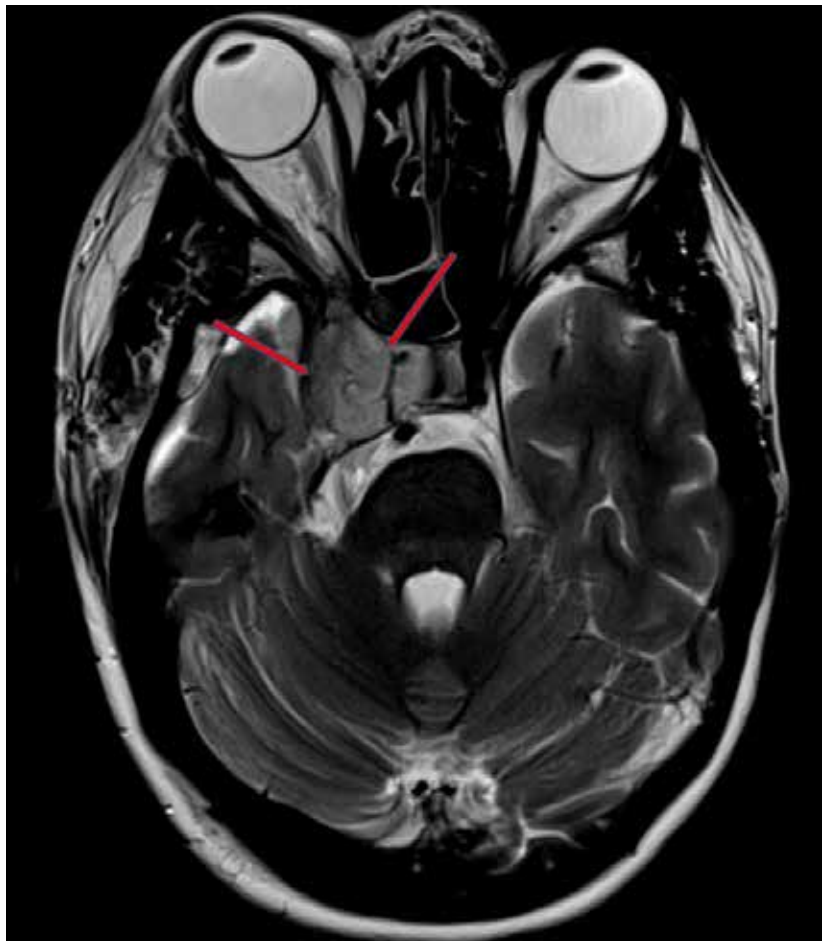
Misael Del Valle, MD - University of Maryland Medical Center

Jessica Galey, MD - University of Maryland Medical Center

Douglas Martz, MD - University of Maryland School of Medicine

42yo G3P1011 at 23weeks estimated gestational age (EGA) presented to our hospital with a Rt paraclinoid skull base tumor, (likely meningioma), causing a Rt visual field defect secondary to optic nerve compression. The original surgical plan was to start the patient on dexamethasone and resect the tumor postpartum. However, due to progressive visual loss a the decision was made to proceed with craniotomy. at 30weeks EGA. After premedication with sodium citrate and metoclopramide, and left uterine displacement, standard ASA and continuous fetal monitoring and tocodynamometry were placed. A rapid sequence induction with lidocaine, propofol, fentanyl and rocuronium was performed and the airway was secured after direct laryngoscopy with a 7.0 mm tracheal tube. Two large bore intravenous cannula and an arterial line were placed, and somatosensory evoked potential monitoring was initiated. Lumbar CSF drain was placed to facilitate brain relaxation and to avoid the use of mannitol or hypertonic saline. A right frontotemporal craniotomy was performed for tumor debulking. Anesthesia was maintained with propofol and fentanyl infusions, and 0.5 MAC of sevoflurane for uterine quiescence. Dexamethasone was continued and levetiracetam was given for seizure prophylaxis. As anticipated under general anesthesia, FHR monitoring showed decreased variability. There were periods where the anesthetic plane needed to be deepened with propofol secondary to surgical stimulation and this correlated to a reduction in baseline fetal heart rate, however no decelerations were observed.

At the end of the procedure, scalp blocks with 0.25% ropivacaine were performed and IV Tylenol administered for postop analgesia. Patient was extubated without any neurological deficits in the operating room and monitored in the Neurosurgical ICU.. The patient required minimal narcotics post operatively. On postoperative day 6, patient had preterm premature rupture of membranes (PPROM) followed by persistent and significant variable decelerations with minimal variability and breech presentation for which cesarean delivery was urgently performed. Due to recent craniotomy, lumbar drain placement, and urgent nature of procedure, general anesthesia was utilized for the cesarean delivery. Patient was extubated, neurologically intact, at the end of the procedure and discharged home one week later and neonate was admitted to NICU for prematurity. Multidisciplinary approach, timely intervention and diligent monitoring culminated in preserving maternal vision and safe delivery of the fetus.



Abstract #: T-17

Under Pressure: Neuraxial versus General Anesthesia for Cesarean Delivery in a Patient with Midline Shift and Multiple Sclerosis

Presenting Author: Andrew Black, MD

Presenting Author's Institution: University of Illinois Hospital and Health Sciences System

Co-Authors: Corinne Weinstein, M.D. - University of Illinois Hospital & Health Sciences System

Introduction: Historically, neuraxial anesthesia has been avoided in parturients with evidence of space-occupying brain lesions due to the concern for elevated ICP and the various complications that can arise. There is increasing evidence of neuraxial anesthesia being safely performed in such patients, but it often requires multidisciplinary discussions and advanced planning. Literature on neuraxial being performed in parturients with pre-existing subdural hygromas is limited, and this may lead the clinician to opt for GA in such patients. We describe a case where general anesthesia was chosen under such circumstances compounded by the added complexity of multiple sclerosis, seizures, and evidence of midline shift.

Case Presentation: OI was a 34 yo G1P0 @ 40+2 with a PMH of Astrocytoma s/p tumor resection/chemo, subdural hygroma with stable midline shift, seizures, and multiple sclerosis who presented for a scheduled cesarean delivery. Given the radiographic evidence of midline shift, it was recommended the patient have an assisted 2nd stage of labor avoiding the pressure changes associated with valsalva. The month prior to delivery, further discussions were held between Anesthesia, Neuro-oncology, Neurosurgery, and Obstetrics to discuss the optimal delivery plan. Her case was presented at a neuro-oncology multi-disciplinary conference. The opinion was that a neuraxial procedure would place the patient at increased risk for rupture of subdural veins, and this trauma would cause an acute subdural hematoma compounding the mass effect seen from the existing chronic subdural fluid collection. It was ultimately agreed upon to avoid neuraxial anesthesia in addition to the potential valsalva associated with labor altogether. The patient underwent cesarean delivery performed under GA with particular care to avoid increases in ICP on induction and throughout the case. The procedure was tolerated without complications and the patient was discharged on POD #3.

Discussion: Parturients with evidence of increased intracranial pressure require multidisciplinary discussion regarding the preferred anesthetic to avoid harm. Counterintuitive to traditional thought, neuraxial anesthesia may be less risky than GA in some circumstances, however, in the setting of complex intracranial pathology and comorbidity, general anesthesia may be the preferred method.

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Abstract #: T-18

Neonatal Alloimmune Thrombocytopenia, Implications in Obstetric Anesthesiology

Presenting Author: Maria C. Borrelli, D.O.

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Introduction: Neonatal Alloimmune Thrombocytopenia (NAIT) is a rare condition in which maternal antibodies become alloimmunized against fetal platelet antigens causing thrombocytopenia. Unlike Rhesus disease, NAIT can cause severe fetal thrombocytopenia in the first pregnancy in 40-60% of cases. The Human Platelet Antigen-1a (HPA-1a) antibody accounts for 80% of cases, where the mother is HPA-1b/b (lacks HPA-1a Antigen) and fetus is HPA-1a/b; causing maternal HPA-1a antibodies to target fetal platelets. Although rare (1/1,000-5,000 live births), it is the most common cause of neonatal thrombocytopenia and intracranial hemorrhage in term infants, leading to death in up to 10% and long-term neurologic sequelae in up to 26%. While nearly 80% of intracranial hemorrhage occur in utero, vaginal delivery is not recommended in high risk cases without fetal blood sampling (a procedure with significant risk).

Case: 29 y/o G2P1 with past medical history of morbid obesity, chronic hypertension, gestational diabetes and NAIT in her first pregnancy, presents with preterm premature rupture of membranes (PPROM) at 35 weeks. 17 months prior, she gave birth to a full-term infant by vaginal delivery. The newborn, while being worked up for jaundice, was found to have a platelet count of 23K. The newborn received one donor platelet transfusion and, fortunately, did not suffer any bleeding complications. The patient and her husband were then worked up for NAIT, which revealed maternal HPA-1a antibodies and her husband was homozygous for HPA-1a; making the likelihood of NAIT in this current pregnancy 100%. In order to reduce the chances of severe thrombocytopenia in this fetus, she began weekly IVIG regimen at 20 weeks, daily high dose oral prednisone, and prophylactic enoxaparin due to high thromboembolic risk factors (IVIG, pregnancy, morbid obesity). She was scheduled for cesarean section (CS) at 36 weeks, however she presented with PPRM at 35 weeks. She underwent a non-emergent, uncomplicated CS under combined spinal epidural more than 12 hours after her last dose of enoxaparin and received a stress dose of intravenous steroids intraoperatively. Newborn's platelet count was normal (186K) and did not experience any signs of abnormal bleeding. Both mother and baby had an uneventful hospital stay.

Conclusion: NAIT is a rare disease that poses significant risk to the fetus and the preventative management is not without risk to mother. Its implications ante-, intra-, and post-partum are important to all members of the perinatal team. Obstetric anesthesia implications include: need for CS, limitations of neuraxial anesthesia due to anticoagulation, and risks of adrenal insufficiency/glucose intolerance secondary to high dose steroid regimen.

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Abstract #: T-19

Expectant Management and Spontaneous Resolution of Uterine Incarceration in a Second Trimester Primigravida

Presenting Author: Ian Borsecnik

Presenting Author's Institution: Ochsner Clinic Foundation - New Orleans, Louisiana

Co-Authors: Colleen Martel - Ochsner Clinic Foundation

Introduction: Uterine incarceration is a rare phenomenon that presents substantial risk to both the viability of the fetus and the health of the mother. The risk of spontaneous abortion in the second trimester is approximately 33 percent and compression on GI, urinary and vascular structures have led to complications in the mother. Multiple factors have been associated with the development of uterine incarceration including fibroids, uterine retroversion and pelvic adhesions¹.

Case: A 29 year old G1P0 at 24 weeks and 6 days presented to the ED with pelvic and low back pain. She was known to have a retroverted uterus and multiple fibroids. The patient was evaluated with MRI and was found to have uterine incarceration, with a 10.9 x 9.3 x 11 cm anterior segment fibroid, which can be identified in a cephalad position on the included figure. Based upon gestational age the decision was made to manage expectantly. The patient was monitored for 2 days while receiving betamethasone for fetal lung maturity. A plan for cesarean section at 32-34 weeks was made contingent upon the development of no further complications such as urinary retention or bowel obstruction. Surprisingly, at 31 weeks 4 days, the fetus was found to be transverse lie on ultrasound with resolution of the uterine incarceration. Delivery was at 39 weeks by planned c-section with a combined spinal epidural technique. The delivery was complicated by fibroids, requiring a T-shaped skin incision, a classical uterine incision as well as a true knot in the umbilical cord.

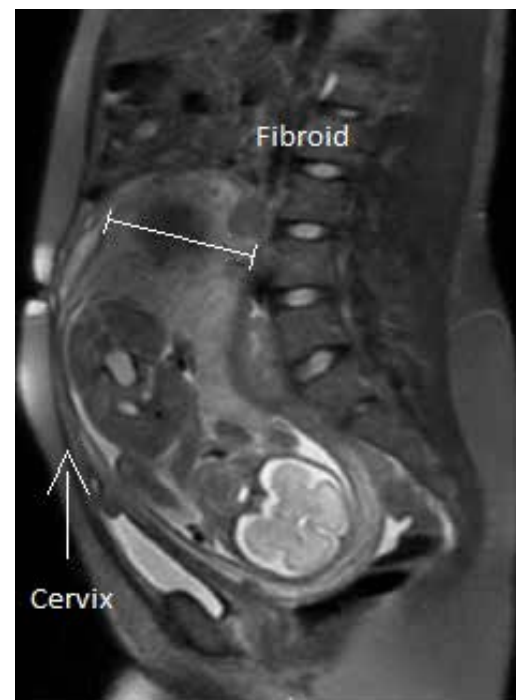
Discussion: Initial diagnosis of uterine incarceration is often confirmed and managed with ultrasonography, however MRI is the gold standard imaging modality for diagnosis and preoperative planning¹.

After 20 weeks gestational age, the patient should be managed expectantly due to the low likelihood of reducing the incarceration and increased risk of complications from manipulating the uterus. If it is identified before 20 weeks gestational age, the uterus should be repositioned through progressively invasive techniques². Spontaneous resolution has occurred after performing spinal anesthesia³. If intervention is planned, the muscular relaxation provided by spinal anesthesia may enhance the likelihood of success, not unlike external cephalic version⁴.

If the incarceration has not resolved, delivery is likely to be complicated by the incarceration's underlying cause as well as malposition of the uterus at the time of delivery. Vaginal delivery is always contraindicated. A thoughtful perioperative plan should always be implemented.

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Abstract #: T-20

The Potential for High Dependency Unit Utilization on a Level IV Obstetric Unit

Presenting Author: Lance Roberts, MD

Presenting Author’s Institution: Ochsner Clinic Foundation

Co-Authors: Allison Clark, MD - Ochsner Clinic Foundation

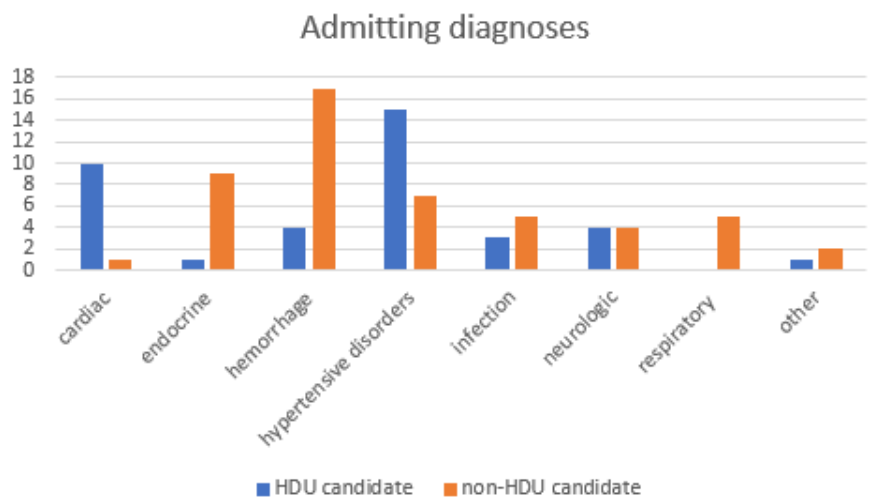
Jane Martin, MD - Ochsner Clinic Foundation

Introduction: High Dependency Units (HDU) allow for care of parturients at an increased risk of morbidity to continue on the labor unit, avoiding costly intensive care unit (ICU) admission and disruption of the family unit during hospitalization. This retrospective project aimed to quantify the potential for HDU utilization at a Level IV maternal care center.

Methods: All maternal ICU admissions for a three year period were reviewed by obstetric anesthesia and maternal fetal medicine. Maternal demographic data, ICU and hospital length of stay (LOS), ASA classification, admitting and secondary diagnoses, invasive monitoring, and ventilatory requirements were recorded. Cases were then classified as HDU vs. ICU appropriate by both teams based on need for mechanical ventilation, multiorgan failure, or complex condition requiring ICU care.

Results: Ochsner Baptist is a level IV tertiary referral center for the Gulf Coast and state of Louisiana. A total of 88 parturients were admitted to the ICU over this 3 year period (January 2016-December 2018) representing < 1% of all deliveries at our facility. 34 (38.6%) of these cases met HDU admission criteria. Demographic data (parity, ethnicity, age, or body mass index), ASA classifications, and comorbidities did not differ between groups. HDU candidates were more likely to be admitted for endocrine disorders and hemorrhage, while non-HDU candidates were more likely to be admitted for cardiac and hypertensive disorders ($p < 0.01$). HDU candidates were less likely to require invasive monitoring (34% vs. 56%, $p < 0.01$), less likely to suffer complications during hospitalization ($p < 0.01$), had shorter ICU (1.4 vs. 3.5 days, $p < 0.01$) & hospital LOS (6 vs 9 days, $p=0.04$).

Discussion: HDU care is an underutilized method of providing a higher level of maternal care at our institution, and had the potential to decrease maternal ICU admission by 38.6% over a 3 year period. This model should be considered for a multitude of reasons, most importantly keeping these patients in close proximity to their obstetric providers and obstetric anesthesia colleagues, reducing hospital costs, increasing maternal comfort, and reducing disruption of the family unit by allowing rooming in with the neonate and family. On our unit we will use this data to encourage the use of newly built HDU rooms when admission criteria are met.



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Abstract #: T-21

A Retrospective Study of Acute Post-Operative Pain Following Cesarean Section in Patients on Opioid Agonist Pharmacotherapy

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Introduction: Opioid agonist pharmacotherapy, most commonly methadone or buprenorphine, is strongly recommended for patients with opioid use disorder during pregnancy to reduce the risk of relapse and obstetric complications.¹ Patients on opioid agonist pharmacotherapy can have difficulty achieving adequate pain relief following cesarean section and often require higher doses of opioids; however small retrospective studies have been conflicting.¹⁻⁵

Methods: We generated a comprehensive dataset of all patients who underwent cesarean section at our institution between January 2016 and December 2018. We compared 24 hour postoperative opioid consumption for patients receiving methadone or buprenorphine at the time of surgery with data from patients who were not receiving opioid agonist pharmacotherapy. Postoperative doses of methadone and buprenorphine were excluded. Secondary outcomes were highest pain score in the first 24 hours and length of stay after surgery. Data were compared between subgroups using nonparametric methods, with subsequent adjustment for covariates by ANCOVA or ordinal logistic regression, as appropriate.

Results: Median opioid consumption during the first 24 hours after surgery was over three times higher for patients taking methadone or buprenorphine (median [interquartile range]: 105 [69.5-120] MME and 97.5 [75-120] MME, respectively, compared with 30 [0-64] MME among women not taking opioid agonists, $p < 0.001$). Highest pain scores observed during the first 24 hours after surgery were also higher for patients taking methadone or buprenorphine (mean (standard deviation): 8.3 (1.5) and 8.2 (1.6), respectively, compared with 5.5 (2.2), $p < 0.001$). These differences remained significant after adjustment for covariates (maternal age, smoking and marital status, parity, use of intrathecal morphine, chronic pain, hypertension, and mental health comorbidity). Length of stay after surgery was also higher for patients taking methadone or buprenorphine (median [interquartile range]: 72 [68-79.5] and 73 [69-77] hours, respectively, compared with 71 [62-76] hours, $p = 0.002$). Again, this difference remained significant with adjustment for covariates (parity, gestation type, marital status, race, the use of intrathecal morphine, depression, hypertension, and renal insufficiency). There were no differences in the above outcome variables between the buprenorphine and methadone groups.

Conclusions: Our results support a strong relationship between opioid agonist pharmacotherapy and increased post cesarean section pain. In light of the current opioid epidemic, further studies are urgently needed to investigate and identify improved pain management strategies in this patient population.

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Abstract #: T-22**General versus Regional Anesthesia and Neonatal Data (GRAND) Study.****Presenting Author:** Liviu Cojocaru, MD, FACOG**Presenting Author's Institution:** University of Maryland Medical Center - Baltimore, Maryland**Co-Authors:** Shobana Bharadwaj, MBBS - University Of Maryland Medical Center

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Ozhan Turan, MD, PhD, FACOG - University of Maryland School of Medicine

Background: Cesarean section is the most common surgery performed in U.S. (1). Despite previous controversies, a 2012 Cochrane review reported no difference in the neonatal outcomes with general anesthesia (GA) versus regional anesthesia (RA) (2). In this review, start of anesthesia to delivery time (SADT) was not discussed. In a recent randomized controlled trial that also reported no difference in neonatal outcomes, time from induction of general anesthesia to delivery was < 10 minutes (min) (3). The present study evaluates neonatal outcomes with GA and RA with prolonged (>10 min) SADT.

Methods: Data was extracted from Complex Obstetrical Surgery Database. Cases with gestational age >34 weeks and SADT >10 min were reviewed. Cases with fetal anomalies, twin gestations, emergent cases or cases done for patients in labor were excluded. Data divided in 2 groups: cases done under GA and RA. Gestational age at delivery, hypotensive episodes (systolic blood pressure < 100 mmHg at any point during SADT), Apgar scores at 1 and 5 min, arterial cord blood pH (ApH), base excess (BE) and SADT were compared between the 2 groups. Comparisons were made using the Mann-Whitney U test and the χ^2 , as appropriate, using SPSS software (version 26.0; SPSS Inc, Chicago, IL). Pearson correlation was used to evaluate relationship between the SADT and ApH, BE, Apgar scores at 1 and 5 min.

Results: Out of 136 cases, 41 were done under GA and 94 under RA. Gestational age at delivery were lower in the GA group 36 weeks (34-38.1) versus 37.1 weeks (34-39.3), $p < 0.001$. Hypotensive episodes were similar between groups ($p=0.17$). Median SADT time was 41 min [11-82] and there was no difference between groups ($p=0.55$). There was no correlation between SADT and Apgar score at 1 ($r=0.01$) and 5 min ($r=0.03$) or the ApH ($r=0.06$) and BE ($r=0.07$). Even though the Apgar score at 1 and 5 min were lower in the GA group 3.5 (1-9) vs 8 (3-9) and 7 (2-9) vs 9 (0-10) respectively, $p < 0.001$, the ApH was higher in the GA group 7.25 (7.06-7.35) vs 7.22 (7.04-7.35), $p=0.01$ (GRAND table). There were 3 cases of ApH < 7.1, of which 2 in the RA and 1 in GA. In all 3 cases, Apgar score at 5 min was 7 or higher.

Conclusion: In a population cared for by a well-conducted multidisciplinary service, favorable neonatal outcomes at the time of delivery are expected with both GA and RA even with prolonged SADT.

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3. Chen Y et al. Comparison of Effects of General Anesthesia and Combined Spinal/Epidural Anesthesia for Cesarean Delivery on Umbilical Cord Blood Gas Values: A Double-Blind, Randomized, Controlled Study. Med Sci Monit 2019;25:5272-9.

Abstract #: T-22

Study variables	General anesthesia	Regional anesthesia	p-value
Age in years, median (min-max)	32.5 (22-45)	32 (24-43)	0.68
Gravity, median (min-max)	4 (1-10)	4.5 (1-12)	0.07
Gestational age at delivery in weeks, median (min-max)	36 (34-38.1)	37.1 (34-39.3)	<0.001*
Hypotensive episodes, n, %	13 (41.9)	18 (58.1)	0.17
SADT in minutes, median (min-max)	43.2 (11-79)	41 (20-82)	0.55
Apgar at 1 minute, median (min-max)	3.5 (1-9)	8 (3-9)	<0.001*
Apgar at 5 minutes, median (min-max)	7 (2-9)	9 (0-10)	<0.001*
Umbilical cord arterial pH, median (min-max)	7.25 (7.06-7.35)	7.22 (7.04-7.35)	0.012*
Umbilical cord base excess, median (min-max)	-2.3 (-0.6 – -12.7)	-3.6 (-0.1 – -11.4)	0.001*
Variables are reported as median (min-max) (Mann-Whitney U test) and n (percentage) (χ^2). *Statistically significant.			

Abstract #: T-23

Nitroglycerin usage amongst Canadian anesthesiologists - A multi-center survey

Presenting Author: Thomas Drew

Presenting Author's Institution:

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Nitroglycerin is a potent tocolytic agent used to achieve rapid uterine relaxation during obstetric emergencies.¹ The use of nitroglycerin for obstetric indications by Canadian anesthesiologists is unknown and no guidelines exist for its use. We sought to investigate current practice across Canadian Anesthesiology Society (CAS) members through the dissemination of a web-based nationwide survey. After institutional research ethics board and CAS Executive Committee approval, a survey link was distributed to 2,334 CAS members with two follow up reminder emails one week apart. Data on indications and dosing of nitroglycerin were collected.

Of those who were contacted, 258/2334 (11%) responded and 175/2334 (8%) completed the survey from 102 centres across all 11 provinces in Canada. The obstetric clinical indications that respondents consider nitroglycerin for are detailed in Figure 1. The intravenous form of the drug is preferred by 80% respondents over the sublingual metered spray (20%). There is wide variability in the doses of intravenous nitroglycerin that clinicians use; 42% use an initial dose of 50 µg, 31% use 100 µg and 18% use 200 µg. Nine percent of respondents would never consider the intravenous route of administration. In those patients with oxytocin exposure in labor, 59% of respondents would not alter the dose of nitroglycerin if required, whereas 9% would increase the dose, 2% would decrease the dose and 30% of respondents were unsure if they would increase or decrease the dose of nitroglycerin.

With regard to oxytocin dosing during 3rd stage of labor after the administration of predelivery nitroglycerin to enable rapid uterine relaxation; 59% of respondents would administer the same dose of oxytocin, 18% would choose a higher dose, 5% would use a lower dose and 18% were unsure. Fifty-five percent of respondents would not expect the patient to require more than one uterotonic agent postpartum and 24% of respondents expect a second uterotonic drug to be required with 21% being unsure.

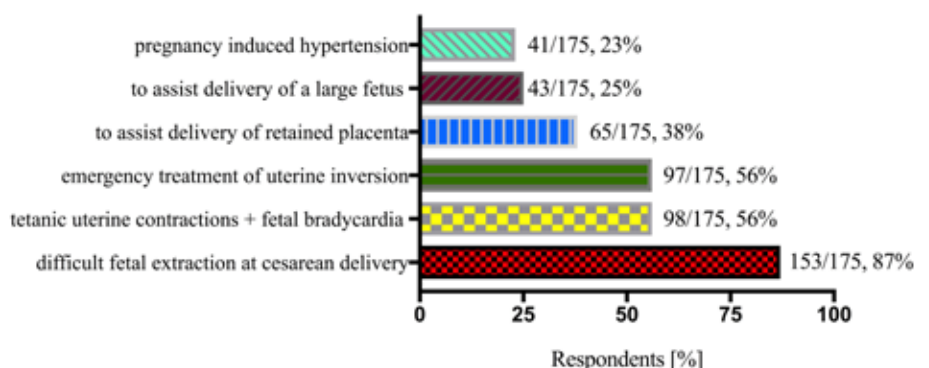
Respondents base their current practice of nitroglycerin usage on perceived effectiveness (61%) and individual preference (57%) rather than local departmental protocols (21%), scientific literature (13%) or society guidelines (5%).

The response rate via the CAS email survey distribution system was low. Lack of time and increased survey burden are proposed to contribute to low physician response rates in web based surveys.² Our results demonstrate substantial variability in the use of nitroglycerin for obstetric indications amongst Canadian Anesthesiologists. Lack of guidelines and evidence supporting the use of nitroglycerin may contribute to this variability in clinical practice. Further research into the use of nitroglycerin for obstetric indications is required.

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1. J Obstet Gynaecol Can 2002; 24: 403-409
2. BMC Med Res Methodol 2015; 15: 32

In which obstetric situations would you consider using nitroglycerin ?



Abstract #: T-24

A Multidisciplinary Approach to Peripartum Triage of Patients to the Operating Room

Presenting Author: Shirley Duarte, M.D.

Presenting Author's Institution: Johns Hopkins Medicine

Co-Authors: Jamie Murphy, M.D. - Johns Hopkins Medicine

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Background: Care prioritization based on patient needs helps allocate available facility resources. Inaccurate triaging can delay adequate care, potentially leading to adverse outcomes. In our hospital's Labor and Delivery operating rooms (ORs), triage decisions were made based on assessment of maternal and fetal factors. However, lack of standardization of acuity terminology (e.g. Stat, Emergent, Urgent, Semi-stat) represented a high risk for miscommunication and patient harm.

Methods: A standardized stratification system for obstetric (OB) patients requiring surgical management was implemented in July 2017 with the goal of improving communication, time to incision, and neonatal outcomes. Expectations and timing to ORs for each team member in OB, OB anesthesia, nursing, Neonatal Intensive Care, surgical and clinical technologists were clearly delineated. The new leveling system consists of four categories based on concern for maternal and fetal status: Red - compromised status, Orange - at risk for compromised but stable, Yellow - stable but requiring surgical intervention, and Green - stable scheduled case. Patient level assignment could change based on reassessment. Data was compared for non-scheduled cases pre- (control group) and post (leveled group) program implementation.

Results: 512 and 775 non-scheduled cases occurred pre- and post-implementation, respectively. Age, race, nulliparity and smoking history were not statistically different between groups, nor were they different between triage levels. Estimated gestational age (EGA) was significantly different between levels, with Red having the lowest EGA (33.7 ± 8.4 mo) compared to Orange (37.1 ± 4.2 mo), Yellow (36.1 ± 6.1 mo) and control (37.9 ± 7.2 mo; $P=0.03$). Orange had the highest rate of induction of labor at 41% compared to 32%, 22% and 23% in Red, Yellow and control groups, respectively ($P=0.02$). Fetal intolerance of labor (FIOL) was the most frequent indication for Red triage (63%). Among Orange cases the most common indications were arrest of descent (35%) and FIOL (33%). In both the Yellow and control groups a patient with prior history of c-section, presenting in labor and desiring a c-section was the most frequent indication (30% and 31%, respectively). The average Decision to Room Entry times were 19.2, 48, and 139 mins for Red, Orange and Yellow respectively, while Decision to Incision (DTI) times were 39.6, 84, and 180 mins. Overall, there were no differences between the leveled and control groups in terms of neonatal outcomes such as APGAR < 7, pH < 7.1, or need for NICU. Red cases had the highest frequency of APGAR < 7, pH < 7.1, and need for NICU, suggesting appropriate triaging of acuity.

Conclusions: Future work will involve retrospectively assigning triage levels to the control cases in a blinded manner to allow for a more accurate comparison of DTI times and neonatal outcomes pre- and post-intervention.

Abstract #: T-25

Decision to Incision Time: Effects of Pre-briefs Prior to Unscheduled Cesarean Deliveries

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Background: The importance of a shared team mental model on patient safety outcomes is undisputed.^{1,2} Furthermore, pre-briefs on labor and delivery units prior to unscheduled cesarean deliveries (UCD) are a critical touch point for shared understanding among multidisciplinary team members. These discussions identify pertinent maternal and neonatal information and establish appropriate timing for cesarean deliveries. The effect of decision-to-incision (DTI) times on maternal and fetal outcomes is debated;³ however, shorter times may have beneficial implications for throughput and operating room efficiency on busy obstetric units. We examined decision-to-OR (DTO) and DTI times prior to and following the implementation of a mandatory pre-brief for UCD.

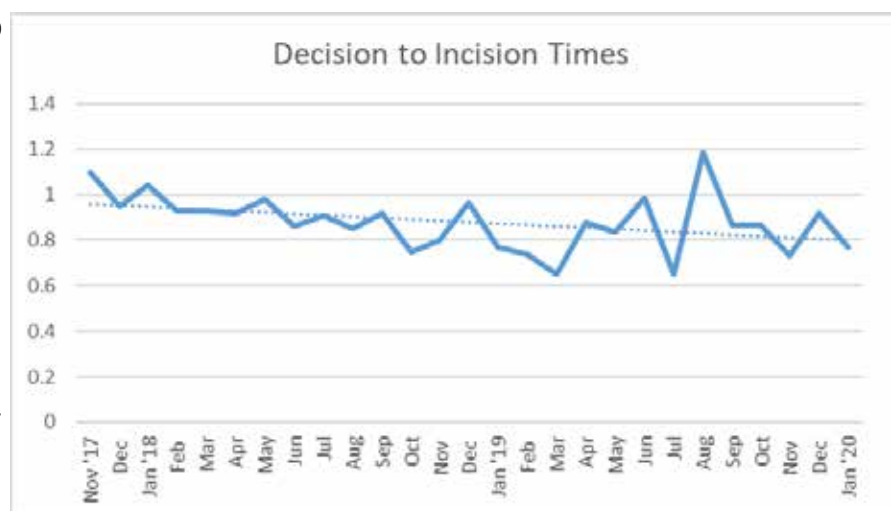
Methods: A mandatory pre-brief was implemented on our labor and delivery unit for all UCD on October 1, 2018. The pre-brief included a nurse-led summary of relevant maternal, pregnancy, labor, and fetal factors followed by a team discussion of operational requirements, hemorrhage risk assessment and urgency of cesarean delivery. Medical records for women having UCD between November 2017 and January 2020 were reviewed to determine the effect of pre-brief implementation on DTO and DTI times.

Results: 1594 UCD occurred during the specified time period, of which 772 (48%) did not have either the decision or incision time recorded. 822 records (52%) were therefore included in the final analysis. Prior to pre-brief implementation there were 398 UCD with a median DTO time of 31 min (IQR 16-49) and median DTI time of 56.5 min (IQR 37-78.5). Post pre-brief implementation, there were 424 UCD with a median DTO time of 26 min (IQR 9-41) and median DTI time of 48 min (IQR 28-71).

Discussion: Recent meta-analyses evaluating the use of a strict 30-minute DTI timeframe for UCD have failed to demonstrate improved neonatal or maternal outcomes.^{3,4} Our institution's DTI times are above the 30-minute timeframe; however, implementation of a mandatory pre-brief was associated with reduced median DTO and DTI times. Our study showed that there is considerable room for improvement in documentation of decision, OR entry, and incision times. Documentation is important not only for medicolegal purposes but also as a starting point for data collection to evaluate OR efficiency on labor and delivery. Our study showed that a robust pre-brief system designed to improve communication can indirectly decreased DTO and DTI times. Further studies are required to determine the effect decreasing these times has on OR efficiency, utilization and patient throughput.

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4. Tolcher et al. *Obstet Gynecol* 2014; 123:536-48



Abstract #: T-26

Enhanced Recovery After Cesarean Delivery: Similarities and Differences between Anesthesiology and Obstetric Component Societies' Recommendations

Presenting Author: Jennifer Gage, MD

Presenting Author's Institution: Larner College of Medicine, University of Vermont - BURLINGTON, Vermont

Introduction: Enhanced Recovery After Surgery (ERAS) programs measurably improve patient outcomes (1). The application of enhanced recovery principles for abdominal surgery modified and applied to cesarean delivery has generated limited patient outcome data. Recently, both the ERAS Society (ERAS-S) and the Society for Obstetric Anesthesia and Perinatology (SOAP) have introduced formal ERAS guidelines for cesarean delivery (ERAC) (2,3,4,5). As it is necessary to have multidisciplinary consensus and compliance to demonstrate improved patient outcomes, this work aims to elucidate the similarities and differences between the two societies' recommendations.

Methods: The SOAP Consensus Statement and ERAS-S guidelines were compared side-by-side with examination of each element for presence or absence in the guideline set, level of evidence, and strength of society recommendation.

Results: The two societies used different grading systems to evaluate levels of evidence balanced with expert opinion regarding risk/benefit to determine the strength of recommendation for each element. SOAP specifies elements as simply recommended or required "core" elements for a program to be ERAC. ERAS-S provides recommendations that are strong or weak and prescribes a "Focused Pathway" (adding a neonatal pathway), that begins 30-60 minutes prior to surgery, to promote ERAC for all patients. ERAS-S adds an "Optimized" antenatal pathway for patient education and optimization of co-morbidities. Each set of guidelines share elements recommended by both societies and some specific to its own. SOAP "core" elements also recommended by ERAS-S include: pre-admission information/education, limited fasting, preop carbohydrate loading, antibiotic prophylaxis, multimodal analgesia/prevention/treatment of hypotension & N/V, maintenance of normothermia, VTE prophylaxis, early postop oral intake/mobilization/urinary catheter removal, and proactive discharge planning. SOAP "core" elements not mentioned by ERAS include: uterotonic optimization, promotion of breastfeeding/maternal-infant bonding and rest. Elements only specific to ERAS-S include: optimization of co-morbidities, preop oral antacid + H2 receptor antagonist/avoidance of sedation/mechanical bowel prep, and use of regional anesthesia. No elements are recommended for inclusion by one society and cautioned against by the other.

Discussion: Comparison of SOAP and ERAS-S guidelines for ERAC reveals general consensus with added recommendations made by each society. An ERAC program which incorporates recommended elements of both societies could yield the greatest improvements in maternal and neonatal outcomes.

References:

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2. <https://soap.org/education/provider-education/member-erac-consensus-statement-5-23-19-2/>
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Abstract #: T-27

Use of a Combined Spinal Epidural Technique for Labor Analgesia is Associated With a Lower Incidence of Rescue Analgesia Compared to a Regular Epidural Technique: A Single-Center Retrospective Review

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Co-Authors: Kendall Hammonds, M.S. - Baylor Scott & White Health

Michael P. Hofkamp, M.D. - Baylor Scott & White Health

Blake Maresh, M.S. - Texas A&M Health Sciences Center College of Medicine

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Kristen Vanderhoef, M.D. - University of Florida - Jacksonville

Introduction: A Cochrane analysis found no difference in maternal satisfaction or rescue analgesia when a combined spinal epidural (CSE) technique was compared to a low dose epidural technique for labor analgesia¹. A single center trial found a catheter failure rate of 6.6% and 11.6% for CSE and regular labor epidural (EPI) analgesic techniques, respectively². We hypothesized that subjects who received a CSE technique for labor analgesia would have a lower incidence of catheter replacement and rescue analgesia when compared to subjects who received an EPI technique.

Methods: We searched our electronic medical record system for subjects who had complete documentation of either a CSE or EPI labor analgesic technique performed at our institution between May 1, 2018 and April 30, 2019. Subjects were excluded if the dura was punctured with a Touhy needle. Demographic information including maternal age, height, weight, gravity, parity, and history of previous cesarean delivery were recorded along with the type of labor analgesic technique, whether the subject had an induction of labor, level of training of the operator, last cervical exam prior to neuraxial analgesia, number of physician-administered rescue analgesia events and whether the catheter was replaced.

Results: 1,393 and 2 subjects appeared once and twice in the study, respectively, and 1,206 EPI and 191 CSE labor analgesic techniques were performed. The EPI and CSE groups were similar with respect to gravity and parity and differed in whether labor was induced (45.6% of EPI vs 5.7% of CSE) and last cervical exam prior to neuraxial labor analgesia (4 cm for EPI vs 5 cm for CSE). There was no statistical difference between inexperienced operators (CA1 and below) and experienced operators (CA2 and above) between the two groups. There was also no statistical difference in catheter replacement between the two groups. A multivariate analysis that controlled for cervical dilation prior to neuraxial analgesia found that subjects who received a CSE were less likely to require rescue analgesia compared to subjects who received EPI (odds ratio 0.690; 95% confidence interval 0.478 to 0.980, $p=0.042$).

Discussion: In our study, subjects who received a CSE technique for labor analgesia were less likely to require rescue analgesia compared to subjects who received an EPI technique. We did not find a difference in catheter replacement and that may reflect a less aggressive approach to labor analgesia management compared to other institutions. The main limitation of our study was that the EPI group was approximately six times the size of the CSE group.

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Abstract #: T-28

General Anesthesia and Anesthetic Adjunct Administration Rates for 2,702 Cesarean Deliveries in a Community Setting: A Two-Center Retrospective Review

Presenting Author: Kaitlyn Clevenger

Presenting Author's Institution: Baylor University - Temple, Texas

Co-Authors: Kendall Hammonds, M.S. - Baylor Scott & White Health

Michael P. Hofkamp, M.D. - Baylor Scott & White Health

Blake Maresh, M.S. - Texas A&M Health Sciences Center College of Medicine

Introduction: One academic institution reported a general anesthesia (GA) for cesarean delivery (CD) rate of less than 1%¹. D'Angelo and colleagues reviewed over 96,000 CD and found a GA rate of 5.6%². Neither of these studies examined the use of anesthetic adjuncts during CD that were not performed under GA. A majority of CD in the United States takes place in a community setting, yet there is a paucity of data regarding anesthetic practice in this realm. Our primary aim was to determine the GA for CD rate and two community hospitals over a five-year period and our secondary aim was to determine the rate of anesthetic adjunct administration for CD not involving GA in the same population.

Methods: We generated reports through our electronic medical record system on all CD performed at two community hospitals in our healthcare system between January 1, 2014 and December 31, 2018. For subjects who underwent a CD without GA, data was collected on the primary anesthetic technique and the use of anesthetic adjuncts including inhaled nitrous oxide, sevoflurane, and intravenous (IV) ketamine, fentanyl, morphine, propofol, and midazolam. Subjects who underwent a CD with GA had a more detailed data collection which included demographic information and indication for GA.

Results: 2,702 CD were performed during the study period. 2,226, 232, and 4 subjects appeared once, twice, and three times in the study, respectively. 1,867 CD were performed at one hospital and 835 CD were performed at the other. The rate of GA for CD was 5.22%(141 CD). 56(2.19%), 2(0.08%), 232(9.06%), 149(5.82%), 65(2.4%), 39(1.52%), 168(6.56%) of CD received inhaled nitrous oxide, sevoflurane, and intravenous fentanyl, morphine, midazolam, ketamine, and propofol respectively, without GA. 2,052(75.9%) of CD did not require GA or any anesthetic adjuncts. 68(2.51%), 30(1.11%), and 43(1.59%) of CD were performed with GA for indications of failure of neuraxial anesthetic, maternal/obstetric comorbidities, and perceived lack of time to initiate neuraxial anesthesia, respectively.

Discussion: Our combined GA for CD rate of 5.22% approximated the 5.6% reported by D'Angelo and our neuraxial failure rate of 2.51% was higher than the 1.7% reported from the same study. To achieve our GA for CD rate, 6.56% and 1.52% of our subjects received intravenous propofol and ketamine, respectively. Large scale studies comparing patient satisfaction between CD performed with GA and CD that require the use of significant anesthetic adjuncts are needed.

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2. D'Angelo R et al. Serious Complications Related to Obstetric Anesthesia: The Serious Complication Repository Project of the Society for Obstetric Anesthesia and Perinatology. *Anesthesiology* 2014;120:1505-12

Abstract #: T-29

Airway Management of 137 General Anesthetics for Cesarean Delivery in a Community Setting: A Two-Center Retrospective Study

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Presenting Author's Institution: Texas A&M Health Sciences Center College of Medicine - Temple, Texas

Co-Authors: Kaitlyn Clevenger - Baylor University

Kendall Hammonds, M.S. - Baylor Scott & White Health

Michael P. Hofkamp, M.D. - Baylor Scott & White Health

Introduction: In the SCORE study, D'Angelo and colleagues reported that failed intubation occurs as frequently as 1 out of every 533 cesarean deliveries (CD) conducted under general anesthesia (GA)¹. There is a paucity of detailed data regarding airway management of GA for CD in a community setting. Our primary aim was to report the failed intubation rate of GA for CD from two community hospitals and our secondary aims was to report how airways were ultimately secured when GA was performed for CD.

Methods: Using our electronic medical record system, we searched for patients who had CD from January 1, 2014 to December 31, 2018 at two community hospitals. Demographic information and indication for each CD under GA as well as the mode of laryngoscopy, number of intubation attempts, how the airway was ultimately secured, and complications were recorded.

Results: 2,702 CD were performed during the study period. 141 subjects had GA for CD and 137 of those subjects had complete airway management documentation. Demographics of subjects with complete airway management documentation are included in Table 1. 128 and 5 subjects had their airways secured with direct laryngoscopy (DL) and video laryngoscopy (VL), respectively, on the first attempt. One subject required two attempts of DL for successful endotracheal intubation. Two subjects had their airways managed with a laryngeal mask airway (LMA) after a failed attempt with DL with no further attempts at endotracheal intubation. One subject had a LMA placed for GA after delivery of the fetus with no attempts made at endotracheal intubation. There were no other documented anesthetic complications.

Discussion: Two out of 136 subjects had a failed intubation when DL was attempted for CD under GA, a figure higher than the one reported by D'Angelo¹. VL was not attempted for the two subjects with failed intubation and it is not known if VL was immediately available for rescue. A vast majority of subjects had successful intubation on the first attempt with either DL or VL. One subject had a LMA placed for GA after delivery without attempts at endotracheal intubation. Further large-scale studies are needed that examine the airway management of GA for CD in a community setting.

References:

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Table 1. Subject Demographic Data

Demographic (units)	N	Minimum	Median	Maximum	Yes/no
Maternal Age (years)	137	15	27	44	
Height (cm)	96	147.3	162.6	182.9	
Weight (kg)	100	55.8	89.6	213.3	
BMI (kg/m ²)	88	22.0	33.5	80.7	
Gravity	137	1	2	10	
Parity	137	0	0	8	
Gestational Age (weeks)	137	17.6	38.7	41.9	
Prior cesarean delivery?	137				34/103
Cesarean delivery emergent?	137				37/100

Abstract #: T-30

Postpartum Tubal Ligation Anesthetic Outcomes Before and After the Hyperbaric Bupivacaine Shortage: A Single-Center Retrospective Review

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Introduction: Prior to a shortage in the United States of hyperbaric bupivacaine 0.75% (HB), a single shot spinal (SSS) technique was preferred for postpartum tubal ligation (PPTL) at our institution. Isobaric bupivacaine 0.5% (IB) was substituted for HB from April 2018 to January 2019 and we recommended that a combined spinal epidural (CSE) technique be used for PPTL to allow for rescue of a failed SSS. We hypothesized that subjects who underwent PPTL after the HB shortage would have a higher rate of CSE use and a lower rate of either conversion to general anesthesia (GA) or administration of anesthetic adjuncts (AA) compared to subjects who underwent PPTL prior to the HB shortage.

Methods: We used our electronic medical record system to search for subjects who underwent a PPTL in the 10-month period prior to IB use and the 10-month period after IB use. Subjects were included if they underwent a PPTL using HB with SSS or CSE and had complete documentation. Demographic data, final neuraxial technique, intrathecal opioids, AA, conversion to GA, time of spinal placement, procedure end time, dose in ml of HB, and experience level of the operator performing the neuraxial technique were recorded.

Results: 147 subjects met inclusion criteria with 76 in pre-IB group and 71 in the post-IB group. Table 1 lists the demographic and clinical data of the pre-IB and post-IB groups. 4/36 (11.1%) and 29/111 (26.1%) of all subjects who received a CSE or SSS technique, respectively, required either AA or conversion to GA ($p=0.061$). A multivariate analysis that controlled for intrathecal fentanyl use, time from spinal placement to procedure end, and experience of the operator performing the neuraxial technique found that subjects in the post-IB group were less likely to receive either administration of AA or conversion to GA (odds ratio 0.361; 95% confidence interval 0.145 to 0.845, $p=0.0224$) compared to the pre-IB group.

Discussion: Subjects who had a PPTL in the 10-month period after IB was used were approximately 64% less likely to have administration of AA or require conversion to GA compared to subjects who had a PPTL in the 10-month period before IB use. We attribute this improvement to a new practice of performing CSE techniques for PPTL that persisted after the HB shortage ended. A limitation of our study is that we were underpowered to detect a difference in either administration of AA or conversion to GA between all subjects who received the SSS and CSE techniques.

Abstract #: T-30

Table 1. Demographic and Clinical Data

	Pre-Isobaric Bupivacaine (N=76)	Post-Isobaric Bupivacaine (N=71)	P value
Age (years)	Median 30, Range 22-48, N=76	Median 28, Range 22-42, N=71	0.118
Height (cm)	Median 160, Range 150- 180, N=39	Median 160, Range 150- 170, N=40	0.679
Weight (kg)	Median 82.5, Range 56.2- 147.4, N=72	Median 89.1, Range 55.8- 129.0, N=65	0.287
BMI (kg/m ²)	Median 31.4, Range 21.3- 51.4, N=37	Median 32.9, Range 22.5- 47.3, N=35	0.180
Gravity	Median 4, Range 0-13, N=76	Median 4, Range 1-11, N=71	0.102
Parity	Median 3, Range 1-12, N=76	Median 3, Range 1-8, N=71	0.979
Final neuraxial technique	76 SSS, 0 CSE	35 SSS, 36 CSE	Less than 0.0001*
Operator experience (experienced=CA2 and above, inexperienced=CA1 or below)	Experienced = 25 Inexperienced = 51	Experienced = 19 Inexperienced = 52	0.417
Epidural catheter dosed if CSE technique used	N/A	Yes=11, No=25	N/A
Dose of hyperbaric bupivacaine 0.75% (ml)	Median 2.0, Range 1.2-3.0, N=76	Median 2.0, Range 1.4-2.0, N=71	0.807
Intrathecal Morphine	Yes=1, No=75	Yes=4, No=67	0.197
Intrathecal Fentanyl	Yes=19, No=57	Yes=29, No=42	0.041*
Time between spinal placement to end of procedure (minutes)	Median 39, Range 22-96, N=76	Median 48, Range 16-159, N=71	Less than 0.0001*
Conversion to general anesthesia	Yes=6, No=70	Yes=1, No=70	0.118
Administration of Anesthetic Adjuncts (did not require conversion to general anesthesia)	Yes=16, No=54 (Fentanyl=3, morphine=1, ketamine=0, propofol=5, midazolam =9, nitrous oxide=2)	Yes=10, No=60 (Fentanyl=4, morphine=0, ketamine=2, propofol=4, midazolam =3, nitrous oxide=1)	0.192
Conversion to General Anesthesia or Administration of Anesthetic Adjuncts	Yes=22, No=54	Yes=11, No=60	0.051

Abstract #: T-31

Intrathecal Dose of Hyperbaric Bupivacaine 0.75% Used for Cesarean Delivery Predicts Use of Anesthetic Adjuncts in Subjects Who do not Require General Anesthesia: A Single-Center Retrospective Study

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Introduction: The optimal intrathecal dose of hyperbaric bupivacaine 0.75% (HB) for cesarean delivery (CD) is not known. Furthermore, there is a paucity of detailed data from the community setting that can be generalized to non-academic obstetric anesthesia practice. We hypothesized that a higher intrathecal dose of HB for CD would be associated with a lower rate of anesthetic adjunct (AA) administration in subjects who did not require conversion to general anesthesia (GA) in a community hospital.

Methods: We used our electronic medical record system to search for subjects in a community hospital who had a CD from June 1, 2017 to November 30, 2019, had a spinal anesthetic with HB, and had complete height and weight data. Demographic information was collected along with final neuraxial technique (single shot spinal or combined spinal epidural), date/time of CD start, spinal placement, surgery end; dose of HB, intrathecal morphine and fentanyl, whether anesthetic adjuncts (intravenous fentanyl, morphine, ketamine, propofol, midazolam, inhaled nitrous oxide and sevoflurane) were used, training (physician or nurse anesthetist) of the operator performing the neuraxial anesthetic, total dose of phenylephrine and ephedrine, and estimated blood loss.

Results: 557 subjects met inclusion criteria of which 7 (1.26%) required conversion to GA. Of the remaining 550 subjects, 108 of 550 (19.6%) required AA administration. Demographic and clinical data are included in Table 1. A multivariate analysis that controlled for height, weight, history of prior CD, intrathecal dose of fentanyl and morphine, dose of intravenous phenylephrine and ephedrine, time from spinal placement to CD end, and estimated blood loss found that a 1.5 mg increase in intrathecal HB decreased the incidence of AA administration in subjects who did not require conversion to GA (odds ratio 0.381; 95% confidence interval 0.218 to 0.655, $p=0.0006$). Height, history of previous CD, intravenous ephedrine, intrathecal fentanyl, and time from spinal placement to CD end were also significant predictors of AA administration.

Discussion: A 1.5 mg increase in the intrathecal dose of HB was associated with an approximately 62% risk reduction in AA administration in subjects who did not require GA for CD. In the community setting, the benefit of decreased AA administration resulting from an increased intrathecal dose of HB must be weighed against the potential risk of high neuraxial block.

Table 1: Demographic and Clinical Data

	Anesthetic Adjuncts Administered (N=108)	Anesthetic Adjuncts NOT Administered (N=442)	P value
Maternal age (years)	Median 28.5, Range 16-44, N=108	Median 30, Range 17-49, N=442	0.234
Height (cm)	Median 162.6, Range 149.9-182.9, N=108	Median 162.6, Range 143.5-185.4, N=442	0.566
Weight (kg)	Median 89.85, Range 56.7-160.6, N=108	Median 89.45, Range 47.6-187.4, N=442	0.930
BMI (kg/m ²)	Median 32.65, Range 22-60.7, N=108	Median 33.85, Range 20.1-73.2, N=442	0.832
Gravity	Median 3, Range 1-9, N=108	Median 3, Range 1-9, N=442	0.054
Parity	Median 1, Range 0-7, N=108	Median 1, Range 0-11, N=442	0.234
Gestational Age (weeks)	Median 38.9, Range 27.6-40.9, N=108	Median 38.95, Range 28.4-41.9, N=442	0.743
History of Previous Cesarean Delivery (Yes/No)	Yes = 86, No=22	Yes=308, No=134	0.039*
Neuraxial Anesthesia Type (single shot spinal or combined spinal epidural)	CSE = 4, SSS = 104	CSE = 26, SSS = 416	0.371
Training of Operator (physician or certified registered nurse anesthetist)	MD = 40, CRNA = 68	MD = 177, CRNA = 265	0.566
Dose of Hyperbaric Bupivacaine 0.75% (ml)	Median 1.6, Range 1.4-1.8, N=108	Median 1.6, Range 1.3-2.0, N=442	0.023*
Dose of Intrathecal Fentanyl (mcg)	Median 0, Range 0-10, N=108	Median 0, Range 0-20, N=442	0.001*
Dose of Intrathecal Morphine (mg)	Median 0.2, Range 0-0.3, N=108	Median 0.2, Range 0-0.4, N=442	0.049*
Time From Spinal Placement to Surgical End (minutes)	Median 45.5, Range 28-78, N=108	Median 42, Range 26-91, N=442	0.010*
Total Phenylephrine dose (mcg)	Median 400, Range 0-4140, N=108	Median 400, Range 0-4640, N=442	0.754
Total Ephedrine dose (mg)	Median 0, Range 0-30, N=108	Median 0, Range 0-90, N=442	0.008*
Estimated Blood Loss	Median 600, Range 200-1704, N=107	Median 600, Range 0-2000, N=437	0.219

Abstract #: T-32

Application of finger guided blindy vision orotracheal intubation in resuscitation of neonatal asphyxia

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Objective: To summarize the application of finger guided blindy vision orotracheal intubation in resuscitation of neonatal asphyxia.

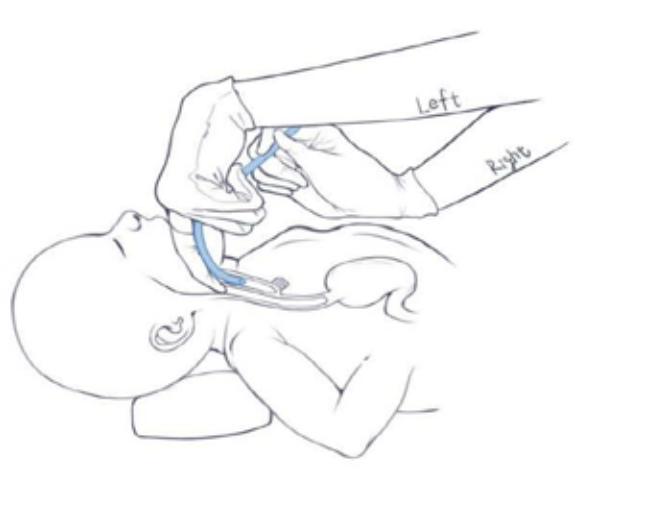
Methods: The procedure of finger guided blindy vision orotracheal intubation FGBI is shown as figure 1. In the first part, the medical documents of FGBI in resuscitation of 1063 asphyxiated newborns during January 1st, 2000 to June 30th, 2019 in Beijing Obstetrics and Gynecology Hospital affiliated to Capital Medical University were analyzed retrospectively. The success rate of intubation, incidence of secondary intubation and the adverse symptom related intubation were noted. In the second part, Laryngoscopy guided direct vision orotracheal intubation(LGVI) and finger guided blindy vision orotracheal intubation(FGBI) on manikins completed respectively by same 10 operators duiring September 1st, 2019 to December 31th, 2019, The insertion time of intubation of each group were recorded and comparied between the two group.

Results: 1. All 1063 cases of asphyxia neonates were successfully intubated by FBVI, the success rate of FBVI intubation was 100% in retrospective analysis. 5 cases of reintubation were recorded in all asphyxia resuscitation, the reintubation incidence rate was 0.47%. No adverse symptom as pharynx and larynx edema and/or hemorrhage after resuscitation were recorded in all asphyxiated newborns medical documents. 2. The average insertion time were prospective observed, It was $5.22 + 0.71s$ by FGBI, significantly lower than that by LGVI $18.71 + 1.97s$, with statistically significant difference ($F = 4.642$, $t = 20.341$, $P = 0.000$) (Table 1). All 20 intubations were completed at once time, no reintubation occurred.

Conclusion: Base above information, It can be concluded that finger guided blindy vision orotracheal intubation(FGBI) was an effective, time saving and safe technique which have been successfully applicated in neonatal asphyxia resuscitation. Besides the routine laryngoscopy guided direct vision orotracheal intubation(LGVI), finger guided blindy vision orotracheal intubation(FGBI) as one of the backup intubation techniques for neonatal asphyxia resuscitation especially in emergency situation or in medical material shortage places can be considered.

Keyword: Blindy vision; Orotracheal Intubation; Neonate; Asphyxia

Fig 1 .Schematic diagram of finger guided blindly vision orotracheal intubation



Preparation: newborn lies in supine position, avoiding excessive neck backwards. The operator stands at the foot side of the newborn, wearing sterile gloves and hold sterile disposable tracheal tube in the right hand.

Step 1: The operator inserts the left index finger through oral cavity down to the epiglottis, the lingual cartilage can be felt by the finger, and the fingertip reaches the position around the level of the thyroid hyoid.

Step 2: hold the trachea catheter in the right hand and lead it to the epiglottis through the oral cavity and oropharynx via the guidance of left finger. The front end of the catheter is located at left finger tip which can feel the front end of the catheter. Push the tracheal tube gently at the glottis level, and the tube enters the trachea without resistance. left finger senses and confirms the insertion and depth of the endotracheal tube, evacuates the airway. orotracheal intubation were completes.

Follow up measures: Adjust the tracheal tube to appropriate depth according to the newborn's weight, assistant connect positive pressure resuscitation air bag for positive pressure ventilation, and confirm the position of the tracheal tube again through bilateral chest auscultation and chest wall movement.

Attention:

1. Keep gently during operation.
2. If the first intubation is unsuccessful and/or the operation time is more than 10 seconds, withdraw the catheter and guide to oxygenate, adjust the tracheal catheter and try again. If the two intubation failed, use other methods to intubate.

Abstract #: T-33

Quality Improvement Survey Study of Obstetric Anesthesia Personnel with STAT C-Section Kit and Its Use in Preventing Inappropriate Practices When Preparing Medications

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Background: When obstetric emergencies occur, they require fast action by the obstetric anesthesiologists and trainees. Particularly for emergency STAT cesarean sections, one major concern is the quick preparation and availability of common medications as delays can have negative consequences on both the mother's and fetal health. The necessity for speed has led to the practice of drawing up commonly used medications ahead of time, which has the potential to create unnecessary medication waste. Additionally, it can put patients at harm for infection by increasing the likelihood of administering expired medication. For this reason, a multidisciplinary team of obstetric anesthesiologists and pharmacists devised a STAT c-section kit, a sealed box that contains the most commonly used medications for c-sections (including lidocaine 2%, chloroprocaine 3%, ephedrine, phenylephrine syringes, and propofol succinylcholine needles and syringes), to be opened upon notification of a STAT c-section. The goal of this quality improvement project was to assess the attitudes and practices of anesthesia providers on the preparation and readiness of common medications used during emergency c-sections. The study also assessed their knowledge and views on the STAT c-section kit.

Methods: Obstetric anesthesiologists, anesthetic fellows, and resident trainees in the anesthesiology department took questionnaire surveys on their practices when preparing medications for STAT c-sections, and their knowledge on the expiration period of medications and contents/location of the STAT c-section kit in the labor ward theater supply area. They were asked whether they found the kit useful, if they would change their current practices, and if it would benefit patient care.

Results: Of 37 responses, 63% stated they prepare medications before emergencies are known and 22% said they prepare medications at the beginning of their shifts. Only 46% correctly identified the expiration time of medication once drawn up - 1 hour as recommended by the Joint Commission. 86% were correctly able to identify all medications/supplies in the STAT c-section kit. 89% found the STAT c-section kit beneficial and 86% believed its use could directly benefit patient care in the OB areas.

Conclusion: The survey indicates that STAT c-section kits, when implemented on an institutional level, have the potential benefit of changing provider practices when drawing up and preparing emergency medication. Additionally, it has the potential to save medication waste costs and encourage safer practices to prevent infections when administering iv and intrathecal medications.



Abstract #: T-34

Engagement with a Perioperative Mobile Application for Mothers undergoing Cesarean Delivery: A Prospective Cohort Study

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Purpose: Giving birth is the most common reason for hospital admission, with Cesarean Delivery (CD) being the most frequently performed inpatient surgery (1). Lack of knowledge about birth complications and potential warning signs contribute to preventable maternal mortality. Through a needs assessment and iterative design process involving patients and obstetric anesthesiologists, we previously developed C-Care, a mobile application for CD focused on perioperative education and self-monitoring of anesthetic complications (1). This study aimed to measure the extent of patient engagement with the mobile application during a pilot implementation, and obtain quantitative and qualitative feedback regarding feasibility (Figure 1).

Method: With institutional ethics board approval and written patient consent, we conducted a prospective cohort study of patients ≥ 18 years ($N=36$) having an elective CD. The usage data from C-Care was tracked and recorded for 30 days after CD. On postoperative days 1-5, patients received a short self-monitoring questionnaire. Fourteen days after surgery, patients received an online survey regarding overall satisfaction, potential impact on care, usability and feasibility of C-Care. Primary outcomes included: number of views of education topics, completion of self-checks, total visits, satisfaction score, and recommendation to others. Secondary outcomes included: rank of education topics by frequency of views, timing of self-monitoring and mobile application visits, incidence of positive self-check symptoms, knowledge delivery, and feedback for improvement.

Results: Thirty-six patients completed the study from 2018 to 2019. Each participant viewed 4.5 ± 2.5 education topics and visited the application 19.4 ± 14.1 times within 30 days postoperatively. The median number of self-monitoring questionnaires completed was 3 ± 1.3 (out of 5). The top three most commonly viewed patient education topics were "Controlling Pain", "The First Few Days", and "Contact Information". Of the 18 respondents who completed the day 14 survey, 83% ($N=15$) patients recommended C-Care to other women, and the median patient satisfaction score was 7.5 (range 2-10). Patients responded that C-Care provided them knowledge about CD and anesthesia ($N=17$, 94%), potential complications to monitor for ($N=15$, 83%), and the recovery process after CD ($N=15$, 83%). Themes related to improvement included the need for more content, and access to the application earlier during pregnancy.

Significance: The trends and usage data from this study increased our understanding of patient behavior with a perioperative mobile application in the setting of CD. The findings could help design more effective and tailored patient education and self-monitoring programs.

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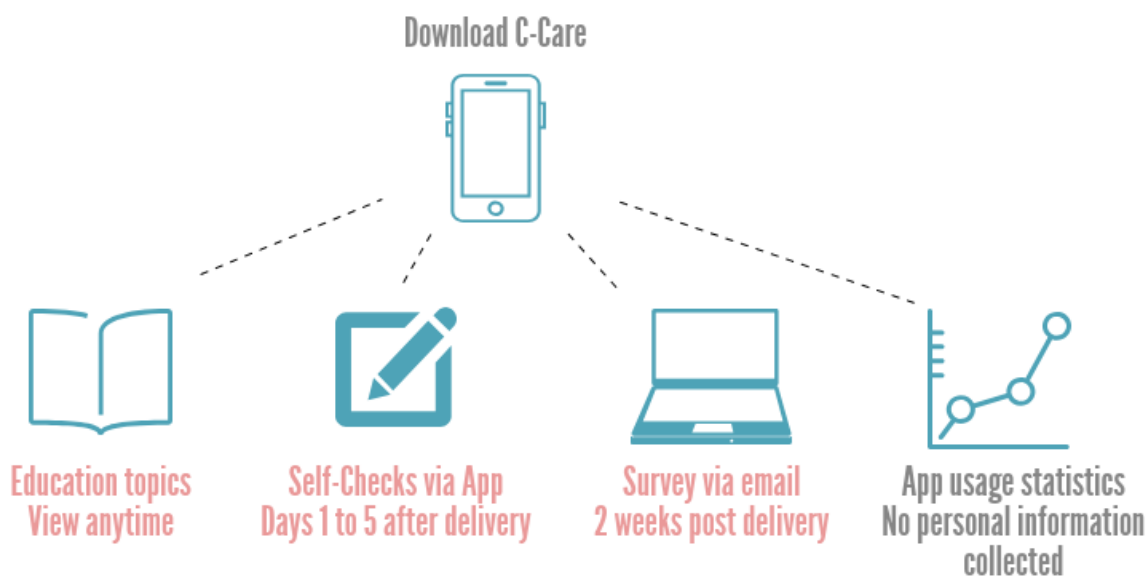
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C-Care App Study Overview



36 women undergoing
Cesarean delivery

- Consent
- Demographics Survey



REB 1023201 Version July 2018

Abstract #: T-35

Maternofetal Factors and Outcomes in Decision-to-Delivery Times in Crash Caesarean Sections: a Retrospective Audit

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Introduction: A Category 1 Caesarean section (CS) is an emergency because of imminent threat to the life of the woman or fetus. A decision-to-delivery interval (DDI) of under 30 min has been recommended as a performance indicator.^{1,2} A protocol was established in our institution that expedited urgent ('crash') CS.

Aims: The aim of the audit was to monitor performance based on DDI, and evaluate its relationship between anesthetic factors, maternal-fetal factors and outcomes.

Methods: Perinatal and anaesthetic data for crash CS from Jan 2015-Dec 2016 was extracted from case files. Data was analyzed and summarized. Linear regression was performed to identify associations with DDI.

Results: 184 patients underwent 'crash' CS. The mean DDI was 9.32 min (SD 2.8). The time from decision for delivery to operating theatre (OT) arrival, time from OT arrival to skin incision and time from skin incision to delivery were 2.61 (SD 1.9), 4.67 (SD 1.91) and 2.19 (SD 1.42) mins respectively.

164 (89.1%) patients underwent general anesthesia (GA), 7 (3.8%) patients had a spinal anesthetic (SA) and 13 (7.1%) patients had their pre-existing labor epidural (EA) topped up. 5 patients had a failed regional (3 with a top-up with a pre-existing epidural and 2 spinal anaesthesia) and were converted to GA.

The median APGAR score at 1 and 5 min was 8.0 and 9.0 respectively. There was no maternal airway morbidity or mortality.

SA for CS was associated with a longer DDI compared to GA (mean difference 3.54 min [1.49-5.58], $p=0.0007$). However, EA for CS was not significantly longer than GA.

A higher body mass index (BMI) was associated with an increased DDI (mean difference 0.11 min [0.01-0.2], $p=0.0334$).

Conclusions: Our DDI was no different from previous years (9.4 min).³ GA for CS had a shorter DDI than SA, but not significantly different from EA, which may result from inadequate sample size. Although GA for CS has been associated with worse neonatal outcomes, regression analysis was not performed because of small numbers. The short duration from OT arrival to skin incision and decreased exposure to anaesthetic agents could mitigate this risk, and the 5 min median APGAR scores was 9.0.

The lack of airway morbidity could be due to an on-site anesthesiology specialist and increased awareness.

Our centre routinely proceeded with 'crash' CS under GA because of the time urgency, and thus was able to meet the recommended cutoff of under 30 min.

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Abstract #: T-36

Anesthetic management in the peripartum period for a 20-year-old female with Ulrich's Muscular Dystrophy.

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Leah Sag - United States Navy

Eugene Smith - United States Navy

Ullrich's congenital muscular dystrophy is a rare connective tissue disorder with a paucity of literature regarding management of anesthesia particularly in the peripartum period, partly owing to the fact that most patients are unable to walk before puberty and respiratory impairment begins by the second decade of life. We describe the antepartum course and considerations for peripartum anesthetic management in a 20 year old primigravida woman in her third trimester with confirmed Ullrich's muscular dystrophy, who arrived to our labor deck with worsening dyspnea though not yet requiring invasive ventilator support.

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Abstract #: T-37

Risk of Epidural Hematoma after Neuraxial Anesthesia in Parturients with low platelet counts : A retrospective analysis

Presenting Author: Mao Mao, physician

Presenting Author's Institution: Women's hospital of Nanjing Medical University - Nanjing, Jiangsu

Background: Parturients with low platelet counts has been considered a relative contraindication to neuraxial techniques as a result of epiduralhematoma. This study is to assess the anesthetic management, complications and outcomes variable of parturients with low platelet counts, and expand the existing data regarding the safety of neuraxial blocks.

Methods: A retrospective cohort analysis was used to estimate the risk for spinal-epidural hematoma in thrombocytopenic parturients with neuraxial anesthesia and the risk of complications in thrombocytopenic parturients with general anesthesia. The anesthetic and obstetric data was collected by Women's hospital of Nanjing Medical University Perioperative database during 2019.

Result: No neuraxial hematoma were observed in 136 thrombocytopenic parturients receiving epidural analgesia or 93 receiving spinal anesthesia. The rate of neuraxial block was significantly higher in parturients with platelet counts of 70–99 000/ μ L (220/229, 96.1%) when compared to parturients with platelet counts of 50–69 000/ μ L and 0–49 000/ μ L (2/12, 16.7% and 7/18, 38.9%, respectively, $P < 0.0001$). Parturients in the lower platelet count ranges had a higher ratio of cesarean delivery under general anesthesia, more blood loss and longer hospital stay.

Conclusions: This study support that the risk of hematoma is low if the platelet count is $< 100\ 000/\mu$ L, especially between 70–99 000/ μ L. The risk of epidural hematoma associated with neuraxial techniques in parturients at a platelet count less than 70 000/ μ L remains poorly defined.

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Table 1 Demographics, obstetric history and etiology of thrombocytopenia

Parameter	Platelet count range			P-value
	0-49 000/ μ L n=12	50-69 000/ μ L n=18	70-99 000/ μ L n=229	
Age(y) [#]	29.75 \pm 3.65	31.28 \pm 5.10	30.30 \pm 3.98	0.54
Gestational age(weeks) [#]	38.77 \pm 1.73	39.29 \pm 1.64	39.36 \pm 1.52	0.44
Gravidity(number) ^{*&}	1.5(1-2)	1.56(1-2)	1.28(1-2)	0.018
Underlying diagnosis				
PE(%)	2(16.7)	1(5.6)	5(2.2)	0.005
Hepatic dysfunction(%)	3(25)	3(16.7)	17(7.4)	
Gestational/unspecified(%)	7(58.3)	14(77.8)	207(90.4)	

Data are: [#]mean \pm SD; ^{*}median (interquartile range); number(percentage). PE: preeclampsia. [&]Post hoc analysis showed a significant difference when comparing gravidity for parturients with platelets counts of 50-69 000/ μ L to 70-99 000/ μ L. P-value<0.05 was considered statistically significant.

Table 2 Outcome variables

Parameter	Platelet count range			P-value
	0-49 000/ μ L n=12	50-69 000/ μ L n=18	70-99 000/ μ L n=229	
Neuraxial block(%)	2(16.7)	7(38.9)	220(96.1)	<0.0001
Epidural	1	7	128	0.08
Spinal	1	-	92	
Cesarean delivery(%)	11(91.7)	11(61.1)	101(44.1)	0.003
General anesthesia/ Cesarean deliveries(%)	10/11(90.9)	11/11(100)	9/101(8.9)	<0.0001
Blood Loss ^{*&}	589.17 \pm 341.05	447.11 \pm 181.92	399.12 \pm 184.53	0.003
Length of stay(days) ^{*&}	6.83 \pm 2.86	5.67 \pm 1.75	5.4 \pm 2.0	0.03

Data are: [#]mean \pm SD; number(percentage). [&]Post hoc analysis showed a significant difference when comparing blood loss and length of stay for parturients with platelets counts of 0-49 000/ μ L to 70-99 000/ μ L. P-value<0.05 was considered statistically significant.

Abstract #: T-38

Anesthetic challenges in a parturient with anorexia nervosa and severe scoliosis

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Co-Authors: Amanda Martins - Unifesp

Anorexia nervosa and scoliosis increase the risks of anesthesia. This poster reports on a case of neuraxial anesthesia performed in a parturient with anorexia nervosa and scoliosis. A 17-yr-old 38-week primigravida presented to the labor room with ruptured membranes. She had no anesthesia pre-assessment. Severe scoliosis was noted. Her lowest weight was 37.4kg (BMI 14.6), and her pre-pregnancy weight was of 39.9kg (BMI 15,6). At presentation, she weighed 46.7kg (BMI 18). The anesthesia team was consulted for 10/10 pain. Due to the unavailability of an ultrasound, a blind combined-spinal-epidural was attempted successfully. Her pain was controlled throughout labor. The newborn had intrauterine growth restriction-8thpercentile. Both mother and baby left the hospital without complications.

The challenges posed by non-surgically corrected scoliosis are mainly related to neuraxial anesthesia. The spinous processes rotation and the spine lateral deviation make needle positioning harder, resulting in a lower efficiency. To mitigate such difficulties, it is recommended to pre-assess patients, study their radiological images, start early, and use imaging to clarify anatomy. It is possible to opt for a paramedian approach aiming the needle towards the convex side of the curve, specifically to overcome the diminished interlaminar space in the concave side of the curve.

The recommendations for anesthesiological management of anorexia nervosa has a lower level of evidence (level IV). To mitigate the increased risks that anorexia nervosa brings one must consider the high incidence of comorbid drug abuse, especially amphetamines, diuretics, and laxatives. In the pre-operative period, focus should be given to rehydration, electrolyte balance, and avoidance of the refeeding syndrome. Since anorexic patients have a delayed gastric emptying time, the use of antacids, prokinetic agents, hydrogen antagonist, and fast sequence intubation is recommended. Most drug doses should be decreased, because anorexia causes lower metabolic rate and hypoalbuminemia. Lowering the dose is especially important for neuromuscular agents, since their effect is potentialized by hypokalemia and myopathy. Hyperventilation, solutions of glucose, and catecholamines should be avoided to not further decrease potassium, which would increase the chance of arrhythmias. As starvation decrease lung compliance, high airway pressures may be necessary to ventilate. Fluid infusion should be done carefully, because patients suffering from anorexia nervosa may have low cardiac reserve.

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Abstract #: T-39

The Perinatal Emergency Team Response Assessment (PETRA) Scale as a self-assessment tool: A high-fidelity in-situ simulation study

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Background: The PETRA scale was developed to assess teamwork in the management of obstetric crises.¹ The scale has previously undergone testing in the simulation setting with expert evaluators and has been shown to be valid and reliable.² However its validity and reliability for self-assessment is unknown. The aim of this study was to assess the validity and reliability of the PETRA scale as a self-assessment tool when used in an in-situ simulation environment on a high-risk labor and delivery unit.

Methods: A high-fidelity simulation of an obstetric emergency (uterine rupture) was carried out 21 times, with 6 different participants in each multi-disciplinary team. Each participant rated their team's performance using the modified PETRA scale (7 domains, 28 items) with a 5-point rubric (1=unacceptable to 5=perfect). Recorded simulation videos were sent to external expert raters for review. Self-assessment of team performance by team members was compared with assessments by three expert raters. The primary outcome was the PETRA scale score (overall and each of 7 domains), as assessed by individual participants and expert raters. Reliability of the PETRA scale within teams and among expert raters was analyzed using intra-class correlation (ICC). Mixed effect models were used to determine if expert ratings were statistically different from the self-assessment of teams.

Results: 125 healthcare personnel participated in the study (staff, fellows, and residents from anesthesiology and obstetrics, medical students, anesthesia assistants, and labor and delivery nurses). With the exception of one domain (situational awareness), scores on all domains and the total PETRA score were statistically different between self-raters and the expert raters, with self-raters tending to rate higher than the experts. (Total score – mean (Standard Error, SE) 4.00 (0.05) for self-assessments, and 3.78 (0.07) for experts' assessments) ($p = 0.0001$) (Table 1).

Low ICC showed low reliability among self-assessment teams and also among expert raters for all domains and the total score. (Total score - ICC 0.08 (95% CI 0.01 - 0.38) for self-assessors, and 0.09 (95% CI 0.00 – 0.77) for experts).

Conclusion: Our study suggests that self-assessment cannot replace expert assessment for the PETRA scale. Specifically, this study demonstrated higher rating scores with self-assessment versus assessment by external expert observers, consistent with the results of other similar simulation studies.³

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Table 1. Comparison of modified PETRA scores between self and expert assessors

Domain	Self-assessment, Least Square Mean (Standard error)	Expert assessment, Least Square Mean (Standard error)	p-value
Shared mental model	4.20 (0.05)	3.87 (0.07)	<0.0001
Communication	3.81 (0.06)	3.65 (0.08)	0.0484
Situation awareness	4.02 (0.06)	3.94 (0.07)	0.3118
Leadership	3.94 (0.08)	3.70 (0.09)	0.0057
Followership	3.99 (0.05)	3.76 (0.07)	0.0042
Workload management	4.06 (0.05)	3.71 (0.07)	<0.0001
Behaviours & Attitudes	4.33 (0.05)	4.02 (0.07)	0.0002
Total	4.00 (0.05)	3.78 (0.07)	0.0011

Abstract #: T-40

Transthoracic Echocardiography, a Useful Tool to Diagnose Refractory Hypotension During a High-Risk Cesarean Section

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Co-Authors: Michael Neilson, MD - University of Nebraska Medical Center

In recent years, transesophageal echocardiography (TEE) has been used to evaluate hemodynamic instability in non-cardiac surgery, including obstetrics¹. However, TEE is impractical when patients are not under general anesthesia. We discuss the use of transthoracic echocardiography (TTE) during a c-section.

A 25-year-old primiparous Caucasian female had an induction of labor at 33 weeks and 6 days of gestation for preeclampsia. Her past medical history included chronic hypertension, kidney failure requiring dialysis, and a failed kidney transplant. We proceed to a c-section under epidural anesthesia for a failure to progress. Halfway through the c-section, she became hypotensive and progressively refractory to fluid and vasopressors. A bedside TTE showed severe left ventricular failure (ejection fraction 25-30%), moderate right ventricular failure, moderate mitral regurgitation, and severe tricuspid regurgitation without pulmonary hypertension. She was started on an epinephrine infusion and was transferred to the intensive care unit.

Common causes of hypotension during c-sections include aorto-caval compression, decreased systemic vascular resistance secondary to neuraxial anesthesia and hemorrhage. Less common and more deadly causes of hypotension are amniotic fluid embolus, massive pulmonary embolus, and peripartum cardiomyopathy. In the context of significant hypotension in an awake patient, bedside TTE is a useful tool that can help to quickly narrow the differential diagnosis and guide treatment¹.

Peripartum cardiomyopathy is defined as an idiopathic cardiomyopathy with left ventricular systolic dysfunction happening towards the end of pregnancy or in the months following delivery without evidence of other possible etiology³. In the United States, its reported incidence is 1 per 1149 to 4350 live births and mortality rate of 0-19%². Its physiopathology is poorly understood but it is associated with pre-eclampsia, chronic hypertension, advanced maternal age, multiple gestation, and African American descent³. Our patient had two of these risk factors. Treatment is supportive. Most recover a normal cardiac function within 6 months. Rarely (6-11%), cardiac transplantation is needed².

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Abstract #: T-41**Assessing the Impact of a Preoperative Huddle on Labor and Delivery****Presenting Author:** Mercades Meuli, DO**Presenting Author's Institution:** Albany Medical Center - Delmar, New York**Co-Authors:** Margaret O'Donoghue, MD - Albany Medical Center

Effective communication on L&D is essential for patient safety as medical errors are often attributed to lack in communication. 1/3 of all obstetric-related malpractice cases involve communication breakdown.¹ SOAP recommends a preoperative huddle for every non-emergent procedure² on L&D. Studies in other surgical areas have demonstrated a reduction in non-routine events, improved climate of safety and increased efficiency after implementation of preoperative huddle.³⁻⁶ However, there is a paucity of data to support the routine use of preoperative huddle on L&D, despite SOAP's recommendation.

Our objectives were to implement a pre-operative huddle on L&D and assess the impact of the huddle. For each huddle performed, we documented any new information identified, change in anesthesia or obstetric plan as a result, and total time for the huddle.

We collected data on 46 total huddles performed for scheduled surgeries and 17 huddles performed for unscheduled surgeries. Out of the 46 total huddles performed for scheduled surgeries, additional information was uncovered nearly 50% of the time. In the unplanned surgeries, additional information was uncovered 70% of the time. Out of the new information gathered during the huddles for scheduled surgery, the most common two categories were new patient information identified and lack of signed paperwork or change in consent. For unscheduled surgeries, antibiotic change accounted for 39% of the total changes found during the huddle. Collectively, the huddles most commonly uncovered new patient information and revealed a lack of signed paperwork or change in consent. Finally, the average time taken for the huddle for scheduled surgeries was 132 seconds and for unscheduled surgeries was 137 seconds.

The pre-operative huddle prior to surgeries on L&D often alerted the team to additional information important for the surgery. New patient information was commonly revealed which may have had significant impact on intraoperative course. Lack of signed paperwork or a change in consent often found, which may improve efficiency and reduce scramble when in the OR. Antibiotic addition or change was often discovered, presumably more so in the non-routine surgeries due to the additional use of azithromycin.

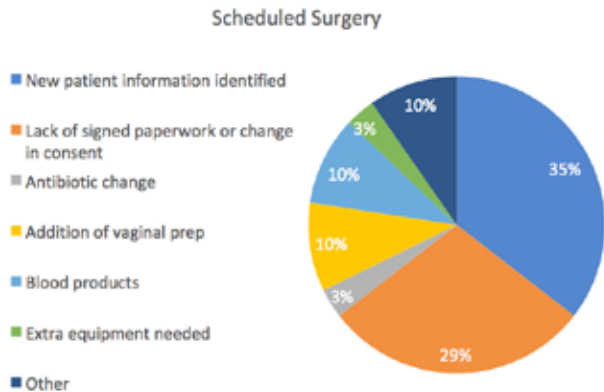
Instituting a pre-operative huddle on L&D improves communication amongst providers and patient safety by identifying additional information or changes to the plan prior to the entering the OR and takes minimal time to complete.

References:

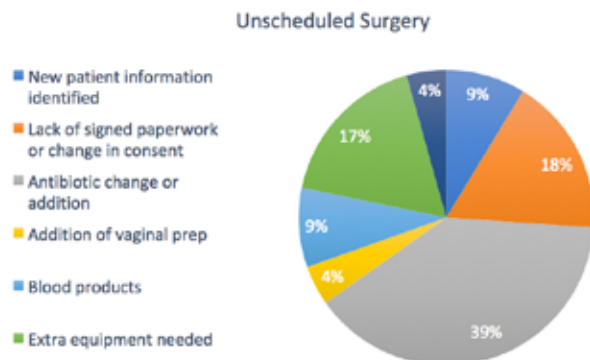
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Abstract #: T-41

Types of additions or changes found during the huddle for scheduled surgeries



Types of additions or changes found during the huddle for unscheduled surgeries



Abstract #: T-42

Diversity of Clinical Practice of Uterotonics during Cesarean Section in Japan: a Cross-Sectional Survey

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Background: It is considered that giving uterotonics after delivering neonate during cesarean section (CS) is a routine practice for preventing postpartum hemorrhage (PPH). Although professional organizations develop various guidelines addressing the issue (1-4), we do not have particular guidelines indicating type of uterotonics, amount of the agents and administration route after delivery in Japan, where obstetrical hemorrhage is still primary cause of maternal death (5). We assumed that heterogeneous practices in CS would be the leading causes of PPH in Japan. Thus, we conducted a cross-sectional questionnaire study to elucidate how uterotonics are diversely used during CS in Japan.

Method: A questionnaire survey was sent to members of the Maternal-Fetal ICU Liaison Council of Japan, which consists of directors of obstetric department in a perinatal center. The questionnaire was addressed clinical data, manpower including anesthesia providers of CS, and how to administer uterotonics during CS in routine and bleeding situation. The questionnaire was circulated in August 2019, and responses before October 2019 were considered valid. Statistical analysis was performed using a t-test for continuous variables, and a significant difference was determined when $p < 0.05$.

Results: We eventually obtained replies from 52 facilities with a response rate of 31.3%. Main results are depicted in Table 1. Majority of, but not all, facilities routinely administered some sort of uterotonics during CS. Obstetricians took the lead of uterotonics administration even during surgery, and most anesthesiologists were not spontaneously given the agent without their directions. The most common first-line uterotonics was oxytocin, and four fifth of facilities selected methylergometrine as the second-line. Oxytocin was mainly administered by intravenous route; however, intramyometrial (IMM) injection was also common route of administering oxytocin in Japan (overall intravenous oxytocin 66.7% versus IMM oxytocin 47.9%). Also, our questionnaire revealed that 18.8% of facilities routinely used methylergometrine during CS. Perinatal centers giving oxytocin by IMM or IM administered significantly higher dose of oxytocin than those giving oxytocin intravenously (9.3 ± 4.6 IU vs. 6.1 ± 4.0 IU, $p=0.016$).

Discussion: Most facilities in Japan select oxytocin as a first line, and half of them choose IMM route. Given uterotonics via IMM route requires higher dose than those from intravenous route to obtain similar uterine contraction during CS and the onset of action is slower (6, 7), so intravenous route must be more preferable. However, most anesthesiologists tend to hesitate to give uterotonics without obstetricians' direction. Thus, evidence-based guidelines would be necessary to be developed.

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Table 1. Uterotonics during CS in Japan	
How often do you use uterotonics during CS?	
Always	50 (96.2%)
Not routinely	2 (3.8%)
How to decide type, timing and dosage of uterotonics during CS?	
Only obstetricians' direction	27 (54.0%)
Independent decision by anesthesiologists	7 (14.0%)
Both physicians' agreement	13 (26.0%)
Others	3 (6.0%)
What is the first-line uterotonics during CS?	
Oxytocin	48 (92.3%)
Methylergometrine	4 (7.7%)
What is the second-line uterotonics during CS?	
Oxytocin	4 (8.9%)
Methylergometrine	36 (80.0%)
Prostaglandin F2 α	4 (8.9%)
Misoprostol	1 (2.2%)
What is a routine practice of uterotonics during CS?	
Oxytocin IV only	21 (43.8%)
Oxytocin IMM only	9 (18.8%)
Oxytocin IMM and IV	9 (18.8%)
Oxytocin IV with methylergometrine IV	1 (2.1%)
Oxytocin IV with methylergometrine IM	1 (2.1%)
Oxytocin IMM with methylergometrine IV	4 (8.3%)
Oxytocin IMM and IV with methylergometrine IV	1 (2.1%)
Oxytocin IM with methylergometrine IV	1 (2.1%)
Methylergometrine IV	1 (2.1%)

CS = cesarean section; IV = intravenous; IMM = intramyometrial; IM = intramuscular

Abstract #: T-43

A Therapeutic Anticoagulation Plan Gone Awry for a Twin Gestation Emergent Cesarean Delivery

Presenting Author: Lisa Nguyen, D.O, M.A.

Presenting Author's Institution: University of Illinois Hospital & Health Sciences System

Co-Authors: Rachel Waldinger, M.D. - University of Illinois Hospital & Health Sciences System
Corinne Weinstein, M.D. - University of Illinois Hospital & Health Sciences System

Introduction: Parturients with VTE are at risk for significant morbidity and mortality in the United States¹, with 9.3% of maternal deaths attributed to VTE². Creating an effective and safe labor plan requires both a multidisciplinary and individualized approach addressing the unique challenges encountered in these high risk parturients. Unfortunately, in spite of optimal planning, unexpected circumstances may present themselves. We describe one such complicated case where an evolving plan was required due to changing clinical circumstances that resulted in an emergent delivery.

Case Presentation: FB was a 23 yo G5P1 @ 25+5 w/ a PMH of multiple DVT/PEs (work up negative for APLS and inherited/acquired thrombophilia), resolved R atrial thrombus, PFO, scoliosis, and an obstetrical history complicated by h/o LTCS x 1 (done under GA) that was admitted for threatened PTL w/ mono-mono twins and category 2 tracings. On admission, a multidisciplinary plan involving hematology, cardiology, pharmacy, obstetrics, and obstetric anesthesiology included continuous monitoring, cesarean delivery at 32-34 weeks, and therapeutic anticoagulation allowing for neuraxial anesthesia. In reality, there were multiple changes made regarding the patient's anticoagulation regimen. With each change, contingency plans were made for possible reversal of anticoagulation and choice of neuraxial vs GA based on timing of most recent anticoagulation dose and current clinical state. The patient's history was further complicated by hemodynamic instability during her previous LTCS and awareness under GA, as well as a resulting documented midazolam allergy. On the morning of HD#35 (30+ 4 WGA), the patient had increasing contractions, thick meconium and progressive cervical change. An emergent cesarean was called. GETA was required given subQ heparin administration < 24 hrs prior. Her delivery and postpartum course were uncomplicated, and she was discharged in stable condition POD#4.

Discussion: The decision regarding neuraxial vs general anesthesia for the complex parturient on therapeutic anticoagulation is a challenge for anesthesiologists². Here, we present a case where obstacles for both neuraxial and GA were present during the planning and execution process of a mono-mono twin delivery.

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Abstract #: T-44

Assessing outcomes of anesthetic management of patients undergoing cesarean delivery with possible hysterectomy

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Introduction: Morbidly adherent placentation (MAP) is increasingly common and contributes to significant peripartum blood loss and coagulopathy. The optimal surgical and anesthetic management of patients with suspected MAP is yet undefined. The aim of this study was to compare maternal and neonatal morbidity in cesarean deliveries with concern for MAP in relation to anesthetic technique (regional, general, or combined regional and general).

Methods: This was an IRB-approved (IRB201802093), single center retrospective case series of women aged 18-50 with suspicion of MAP > 10% based on known risk factors who underwent cesarean delivery with possible hysterectomy between 8/1/2016 and 9/1/2018. Four groups were evaluated based on anesthetic technique: general anesthesia only (GA), regional anesthesia until delivery with conversion to general anesthesia after delivery (RA2GA), regional anesthesia and general anesthesia before and after delivery (RA+GA) and regional anesthesia only (RA). Maternal morbidity was assessed by hypotension, significant bleeding requiring transfusion, difficult intubation, intraoperative and postoperative opioid use, and ICU and hospital length of stay (LOS). Neonatal morbidity was assessed by 5-minute Apgar score APGAR (APGAR5) < 6, need for rescue resuscitation, and NICU and hospital LOS. Data were summarized by descriptive statistics.

Results: Twenty-six cases were included with average case length 272 (SD 119) min; 15 had hysterectomy performed, 8 required transfusion. There were no difficult intubations. GA patients (n=9) had highest median post-operative narcotic use (235 MME) and 5/9 neonates had APGAR5 < 6 and required rescue resuscitation. RA2GA patients (n = 6) had the longest case lengths and hypotension duration. RA patients (n=8) had the lowest median narcotic use (124 MME), shortest LOS (2 d vs 3-4 d), and 0/8 infants had APGAR5 < 6 or required rescue resuscitation.

Discussion: This retrospective case series provides insight into outcomes of different anesthetic strategies for cesarean delivery when MAP is suspected on maternal and neonatal outcomes. Patients who only had general anesthesia for their high-risk cesarean delivery for MAP required more intraoperative and postoperative opioids, but were less hypotensive than either RA groups. Neonates exposed to general anesthesia prior to delivery had lower APGAR5 scores and required more resuscitation than RA groups. Unless otherwise indicated, regional anesthesia may be preferred prior to delivery of the infant due to lower incidence of maternal and neonatal morbidity. Synthesis of additional cases may enable better depiction of major clinical features and further information on effects of different management techniques.

Abstract #: T-45

The Influence of Kybele Program on the Use of the Interfascial Plane Blocks after Cesarean Delivery and Hysterectomy in Serbia

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Co-Authors: Michael Akerman - Cornell Medical Center

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Ivan Velickovic - SUNY Downstate Medical Center

Background: The interfascial plane blocks (IPB) are ultrasound-guided blocks of abdominal or thoracic wall that have an important place in perioperative multimodal pain management. The quadratus lumborum block (QLB) and the erector spinae plane block (ESPB) are newly developed IPBs that provide good postoperative analgesia following gynecologic and obstetric surgery. They were not a part of clinical practice in Serbia before April 2017. Based on the success of a Kybele1 teaching program in obstetric anesthesia, Leskovac General Hospital (LGH) asked for help with regional anesthesia. A teaching visit by a fellowship trained anesthesiologists from the USA was arranged in April of 2017. In January 2019, ESPB became a part of multimodal pain management in LGH.

Methods: All Cesarean Delivery (CD) and hysterectomy cases utilizing either QLB or ESPB that were done during the period April 2017 - December 2019 were obtained from the anesthesia databases of LGH, Sremska Mitrovica General Hospital (SMGH), and Clinic of Gynecology and Obstetrics, Clinical Center of Vojvodina (CCV). Bilateral QLB type 1 or bilateral ESPB T10-11 were performed in cases done under either general anesthesia or spinal anesthesia. Blocks were performed either in the OR (before or at the end of the surgery) or in the recovery room. All patients that had IPB were checked for pain relief.

Results: In LGH, QLB was performed in 45 patients after CD, and in 56 patients after hysterectomy. ESPB was done following one CD case, and in 7 cases before hysterectomy. In CCV, QLB was performed in 361 patients after CD, and in 118 patients after hysterectomy. In SMGH, QLB was performed in 4 patients after CD, and in 4 patients after hysterectomy. All patients experienced good pain relief after surgery/block performance, 0 to 3/10 on a numeric rating scale. In total, IPB was done in 55 patients in 2017, in 196 patients in 2018, and in 319 patients in 2019; a trend of increases in IPB use is seen.

Conclusion: IPBs have become a regular part of postoperative pain management in 3 Serbian hospitals. These blocks have almost eliminated postoperative opioid use in our patients. New international visits are planned in order to train local physicians new blocks. Trained physician are now organizing 3-4 workshops every year in order to train physicians from other hospitals from Serbia and other countries. Successful implementation of QLB in one hospital has started the interest in abdominal wall blocks in several Balkan countries.

References:

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Abstract #: T-46**Every minute counts: Uncovering and Mitigating delays in Maternal Cardiac Arrest First Response.**

Presenting Author: Fatemah Qasem, MBCh

Presenting Author's Institution: University of Calgary

Co-Authors: Adam Cheng, MD, FRCPC - University of Calgary

Jennifer Davidson, RN - University of Calgary

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YiQuan Lin, MD, MHSc, PhD - University of Calgary

Introduction: Maternal cardiac arrest is underreported and continues to occur at rate of 1:20,000 pregnancies.¹ Aggressive maneuvers and multidisciplinary team efforts are required because of the anatomical and physiological changes associated with pregnancy, in addition to taking care of two patients. Advanced cardiac life support (ACLS) must be rapidly administered. Previous work suggests deficits in cardiac arrest care during maternal cardiac arrest.² The primary goal of this study is to characterize the quality of actions by first responders during simulated in-hospital maternal medical emergencies. Secondary goal is to determine the systems issues that contribute to a delayed response and initiation of ACLS. Specific objectives are:

- (1) To examine critical delays by measuring the median duration of the interval between when a resuscitation maneuver was indicated and when it was initiated by first responders.
- (2) To describe the type and frequency of resuscitation errors identified as deviations from AHA guidelines during obstetric cardiac arrest. By addressing this gap in the literature, we hope to highlight areas of future education and/or innovation aimed at improving performance during maternal cardiac arrest care.
- 3.) The uncover systems issues reported that contribute to a delay in performing ACLS and/or reduced quality and safety of care.

Methods: Institutional REB approval was obtained as was written informed consent from participants in the study. We are conducting a prospective observational study including 10 videotaped simulations of in situ maternal cardiac arrest scenarios on L&D unit. Each session is 8 minutes duration and will involve 5 participants (1 anesthesiologist, 1 obstetrician and 3 nurses). The primary outcomes is the median duration of the interval between when a resuscitation maneuver is indicated and when first responders will initiate it.

The secondary outcomes measures are: the type and frequency of resuscitation errors identified as deviations from AHA guidelines during maternal cardiac arrest using check list. Two trained and calibrated video reviewers will review videos in order to capture time to key interventions. In addition CPR quality will be analyzed for rate, depth of chest compressions and ventilation rate.

Results and discussion: To date, we have conducted 3 in situ simulation sessions. The study is feasible - no refusals to participate and no missing data. Recruitment, data collection and entry are ongoing. We anticipate that we will be able to present our results at the meeting.

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Abstract #: T-47

Volume status and fluid management in the early postpartum period

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Background and Goal of Study: Major changes occur in central hemodynamic during early postpartum period: redistribution of fluid from the interstitial space into the bloodstream, which increases the blood volume circulating and cardiac output. All these changes are aimed at stabilizing the patient in the postpartum period with blood loss. However, blood volume circulating during pregnancy and postpartum period remains unknown and studies on its results come to the conclusion about its great variability. The aim of this study was to evaluate the postpartum volume status of puerperas with blood loss 10-20% of blood volume circulating.

Materials and Methods: thirty puerperas after a elective cesarean section with spinal anesthesia, underwent ultrasound evaluation of the heart and inferior vena cava immediately after surgery, 3 and 6 hours.

Results and Discussion: the volume of blood loss measured by the gravimetric method was 914 ± 410 ml, which amounted to 10 to 20% of the blood volume circulating, calculated by the formula $100 \text{ ml} * \text{weight before pregnancy (kg)}$. The ejection fraction of the left ventricle, measured immediately after surgery, 3 and 6 hours, was 55.5% (95% confidence interval 51.9 - 61.6), 58.2% (95% CI 59.4 - 61.2) and 55.4% (95% CI 53.5 - 59.9), respectively. The Friedman test (χ^2) showed the absence of a statistically significant difference of the ejection fraction ($p = 0.692$). Inferior vena cava collapsibility index showed a statistically significant decrease in the measurement periods: 35.5% (95% CI 22.5 - 44.8), 20.5% (95% CI 14.6 - 28.5), 14.4% (95% CI 12.2 - 25.6), respectively, the Friedman test (χ^2) $p = 0.036$. A statistically significant increase of the end-diastolic volume of the left ventricle was also noted: 73.0 ml (95% CI 66.3 - 76.7), 81.2 ml (95% CI 72.9 - 87.3), 89.8 ml (95% CI 80.4 - 96.7), respectively, the Friedman test (χ^2) $p = 0.021$.

Conclusion: Blood loss 10-20% of blood volume circulating or more than 1000 ml does not always require replacement fluid management, redistribution of fluid volume from the interstitial space increases blood volume circulating within 3-6 hours after delivery. Further studies of the volume status are needed.

Abstract #: T-48

Post caesarean section analgesia: A 5 year service evaluation following introduction of tramadol

Presenting Author: Con Papageorgiou

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Co-Authors: Tanya Blagova - Hillingdon Hospital

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Since 2014, regular tramadol has been included as part of our multimodal post caesarean section analgesic regimen. Routine drug rounds and the assessment of pain and nausea scores on observation charts were also reinforced leading to an improvement in pain scores[1]. The UK Medicines Information has concluded that tramadol use is acceptable in breast-feeding parturients[2] but to assure our institution of the efficacy of our multimodal regimen, we conducted a re-audit of post caesarean analgesia.

Methods: This service evaluation project was registered with the audit department. In September 2019, observation charts and drug charts were reviewed from all caesarean deliveries. Primary outcome measured was mean pain score documented (0-10). Additional data collected included parity, category of caesarean, mode of anaesthesia, number of observations recorded, prescription adherence to local guidance, requests for additional analgesia during the first 24 hours, nausea or vomiting and requests for anti-emetics.

Results: Fifty out of a total of 61 caesarean deliveries were included. Pain scores were recorded for 100% of patients, with an average pain score of 0.22. Additional analgesia was dispensed to nine patients, of whom eight required only a single dose. Six patients (12%) required a single dose of anti-emetic. Although 10/49 drug charts deviated from the local guidance, all were due to drug allergy or intraoperative haemorrhage. Forty-six patients (94%) received their analgesia as charted and those that did not were due to patient refusal.

Discussion: This service evaluation shows that our analgesic regimen, introduction of regular drug rounds and improved assessment of pain has resulted in reduced pain scores, although we do recognize that our pain scores are extraordinarily low and may reflect inaccurate documentation by our midwifery colleagues. Furthermore, the incidence of nausea and vomiting remain at an acceptably low level.

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Abstract #: T-49**Independent Risk Factors for Chronic Illicit Substance Use during Pregnancy****Presenting Author:** David Saldivar, MD**Presenting Author's Institution:** West Virginia University, West Virginia**Co-Authors:** Jonathan Bond - WVU

Norman Ferrari - WVU

Linda Nield - WVU

Manuel Vallejo - West Virginia University

Objective: We aimed to determine the incidence of chronic illicit substance use and to identify associated risk factors.**Design:** A two-year time-matched retrospective maternal quality control database (n = 4470) analysis of parturients with chronic illicit substance use compared to controls.**Setting:** A tertiary academic medical center located in a rural setting.**Results:** The rate of chronic illicit substance use was 1.95%. Demographic factors associated with chronic illicit substance use in pregnancy included lower BMI (OR: 0.93; 95% CI: 0.89-0.96, p < 0.0001), higher gravity (OR: 1.24; 95% CI: 1.13-1.36, p < 0.0001), higher parity (OR: 1.38; 95% CI: 1.22-1.57, p < 0.0001), and more live births (OR: 1.30; 95% CI: 1.16-1.46, p < 0.0001). A history of smoking (OR: 10.51; 95% CI: 5.69-19.42, p < 0.0001), alcohol use (OR: 48.98; 95% CI: 17.33-138.40, p < 0.0001), anxiety (OR: 1.88; 95% CI: 1.16-3.05, p = 0.01), and depression (OR: 2.44; 95% CI: 1.55-3.85, p = 0.0001) were significant. Obstetrical factors included transfer on admission (OR: 2.12; 95% CI: 1.16-3.87, p = 0.01), payor insurance (OR: 2.12, 95% CI: 2.10-5.04, p < 0.0001), and Apgar scores < 7 at 1 minute (OR: 0.50; 95% CI: 0.25-1.00, p = 0.049). Multiple variable logistic regression revealed BMI, smoking, alcohol use, and Apgar score < 7 at 1 minute as significant factors.**Conclusions:** Awareness of these factors can assist in identifying and treating parturients with chronic illicit substance use.**References:**

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Abstract #: T-50

Use of a triple prophylactic strategy to prevent post-dural puncture headache: An observational study

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Objective: Postdural puncture headache (PDPH) after accidental dural puncture is a very common complication of epidural analgesia/anesthesia. We observed the ability of a triple prophylactic method (epidural saline and morphine and intravenous Cosyntropin) to prevent PDPH and need for blood patch.

Methods: We retrospectively evaluated the effect of the combination of epidural saline, intravenous Cosyntropin, and epidural morphine in parturients who had accidental dural puncture, on the PDPH rate and the need for epidural blood patch. We report a case series of patients with accidental dural puncture who underwent the triple prophylaxis and other methods.

Results: Thirty-one patients were included in the study. Fourteen cases received triple prophylaxis (45%). Three patients in this group developed PDPH (21%), with two of them requiring a blood patch (14%). Nine patients underwent preventive measures other than triple prophylaxis, with PDPH rate of 55% and one needing blood patch (11%). Conservative management was used in eight patients, with PDPH and blood patch rates of 100% and 62%, respectively.

Conclusion: The triple prophylactic regimen of epidural saline, intravenous Cosyntropin, and epidural morphine used after accidental dural puncture, exhibits great potential to reduce the incidence of PDPH and the need for blood patch in obstetric patients.

Abstract #: T-51

Superior Sagittal Sinus Thrombosis (SSST) in a Parturient with an Unrecognized Dural Puncture (DP), Cause or Coincidence?

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Introduction: Intracranial venous thrombosis (ICVT) is a rare complication of pregnancy. It may accompany DP, making the diagnosis more difficult. We present the diagnostic and management challenges of a parturient with an unrecognized DP who was also diagnosed with SSST.

Case: A 32 y/o G1P0 at 40 1/7 wks gestation, presented in labor. PMH included obesity, asthma, and anemia. An epidural was placed after 3 attempts using an 18G Hustead needle at L4-5, with LOR to air. Following a negative test dose, 5mL 0.25% bupivacaine was given, and a continuous infusion of fentanyl-bupivacaine was started. A T4 level resulted from this small initial dose and no further intervention was required during labor. On PPD #1, our patient complained of intense neck/back pain and was treated with acetaminophen and ibuprofen. On PPD #2, this progressed to a severe non-positional HA and UE paresthesias, without focal neurological deficits or weakness. Pain was controlled with oral analgesics and she was discharged.

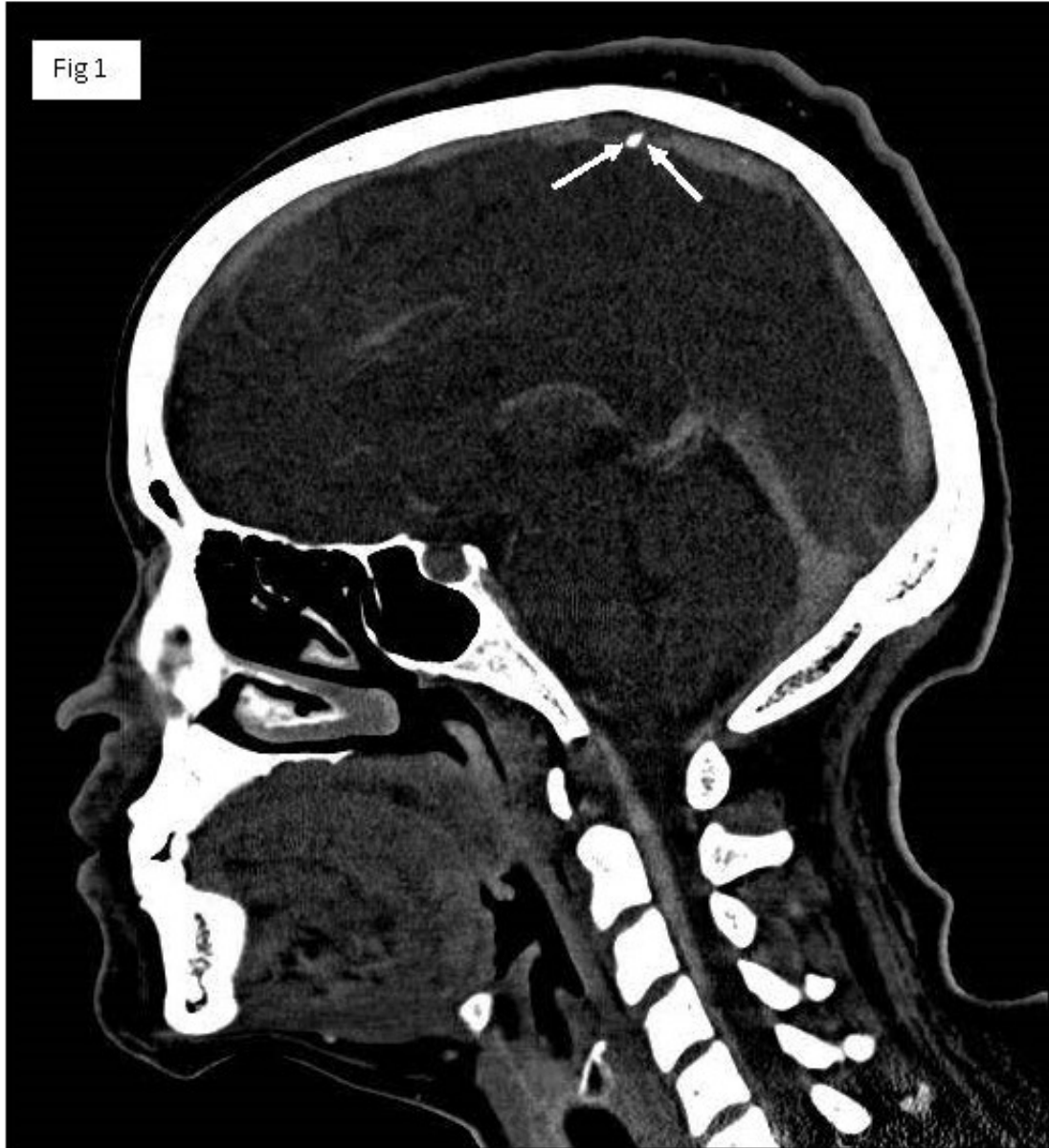
On PPD #4, she developed N/V, paresthesias/weakness in UE, LE, urinary incontinence, + B/L Hoffman's sign and downward Babinski reflexes. Thoracolumbar MRI showed a diffuse, extra-axial fluid collection from T9-10, through the lumbar spine, displacing the cauda equina, nerve roots, and distal cord. Cervical MRI showed pachymeningeal enhancement in the posterior fossa and cervical canal (low CSF pressure), while MRI of the brain demonstrated SSST (fig 1). Three months of extended anticoagulation was recommended.

Discussion: Unintended DP during epidural placement occurs in 0.6-3% of parturients. ICVT is a rare complication of pregnancy with an incidence of 10-20 per 100,000 deliveries [1]. The presentation is quite varied; HA is the most frequent symptom. It is thought that intracranial venous congestion and damage to vessel endothelium during labor and expulsion, in addition to hypercoagulability, contribute to ICVT [1]. MRI with venography is the gold standard for diagnosis, and anticoagulation is the treatment of choice [2,3]. Our case describes SSST in the context of an unrecognized DP. We question whether the DP caused the SSST or was merely coincidental. Traumatic injury to the dura from recent DP may cause intracranial hypotension. Low CSF pressure then leads to venous dilation and stasis, with disruption and damage to the vascular endothelium [1] necessary for ICVT formation. Although our patient's DP was missed, her analgesia was unexpectedly profound, suggesting translocation of epidural medication into the CSF [4,5].

Conclusion: Any postpartum HA after neuraxial analgesia, even without a known dural puncture, should be investigated, as intracranial hypotension may be a risk factor for ICVT [1]. Focal neurological signs and symptoms should raise suspicion, and evaluation with MRI should not be delayed.

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Abstract #: T-52

Multidisciplinary Bloodless Medicine Approach to Placenta Previa and Accreta

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Co-Authors: Brent Earls, MD - Medstar Georgetown University Hospital

Susanna Kmiecik, MD - Medstar Georgetown University Hospital

We present the case of a 38 y/o G6P2022 female who is a practicing Jehovah's Witness with history of two previous c-sections, who was discovered to have placenta previa and placenta accreta on routine imaging. Due to the risk of hemorrhage, her care was coordinated early by a multidisciplinary team that included Anesthesiology, Obstetrics, Radiology, Urology, Bloodless Medicine, and Nursing. The medical teams worked in concert with the patient to develop a plan that would respect her religious views and autonomy, while anticipating the unique challenges present in this obstetric case, specifically the potential for massive intraoperative hemorrhage. The patient expressed this was her last desired pregnancy, therefore a plan for hysterectomy following Cesarean delivery was planned to ensure safe delivery and limit expected blood loss. On the day of surgery, she first underwent epidural placement followed by bilateral hypogastric artery balloons with interventional radiology. She was then taken to the operating room, where Urology inserted bilateral ureteral stents while being careful to maintain the integrity of the balloon catheters. The Obstetric team was then able to perform an uneventful Cesarean section delivering a healthy baby. The hysterectomy with bilateral salpingectomy was then converted to general anesthesia, as planned, without complication. The procedure went well with only 1200cc of blood loss and the patient was hemodynamically stable throughout.

The teaching point surrounding this case and the reason for its unique characteristics lies in the successful outcome of a challenging case and the interdisciplinary team it required. At our institution, a specific program of Bloodless Medicine and Surgery has been established to help uphold the values of patients who refuse blood products, while maximizing patient safety. Hemorrhage is a well-known risk of placenta previa and accreta, with reported blood loss in Jehovah's Witness patients ranging from 100-5500mL (Tachi, 2018). Hemorrhage is commonly combated by transfusing packed red blood cells and other human blood products, however that was not an option for this case. Each team performed pre-operative assessment and communicated their requirements for the case. Careful consideration of each team was required, as the precise order of events was of utmost importance. Additionally, while intra-arterial balloon occlusion is a well-documented rescue method for hemorrhage, pre-operative placement was crucial to ensuring blood loss could be controlled in a timely manner in the event of occurrence.

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Abstract #: T-53

A Real Pain in the... Head

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Presenting Author's Institution: Department of Anesthesiology - Gainesville, Florida

Co-Authors: Cameron Smith, MD, PhD - University of Florida

Postpartum headache (PPHA) is very common. As the differential diagnosis can be quite broad, it is imperative to evaluate each case as each headache type has specific signs, symptoms, workup and treatment. We present a case of a 31-year-old G2P1 female who presented to labor and delivery for persistent headaches after emergent c-section at 32 weeks, 6 days gestation under single-shot spinal due to intrauterine fetal demise of Baby B and decreased fetal motion of Baby A. The patient was recovering well and presented to her obstetrician's office 6 days later for routine follow-up. She reported a headache with mild positionality which was assumed to be a post-dural puncture headache (PDPH). Arrangements were made for her admission to labor and delivery for anesthesia exam and epidural blood patch (EBP) placement. EBP was performed without any relief. Other potential causes of headache were investigated. Workup included CTV head with and without contrast, BMP and CBC. All results were within normal limits. Consultation was then placed to the Acute Pain Service (APS), specifically to an attending APS anesthesiologist with expertise in headache. Evaluation by the APS led to a diagnosis of severe tension headache. and the patient was treated with bilateral pterygopalatine fossa and greater occipital nerve blocks, leading to complete relief.

Determining the cause of postpartum headaches allows for proper treatment without unnecessary tests or procedures. PPHA can be characterized as primary, secondary and post-procedural. Primary headaches are defined as, "a recurrence of a disorder for which the patient already suffered from prior to delivery." Most often these headaches include migraines and tension headaches. Migraines are more common in females than males, 60% present unilaterally, last 4-72 hr, described as pulsating or throbbing, and often associated with nausea/vomiting/visual changes/phonophobia/photophobia. Tension headaches are usually bilateral and diffuse, last days to weeks, and are normally described as dull or squeezing. Secondary headaches are defined as, "headaches due to another medical condition." Examples include head/neck trauma, substance use or withdrawal, infection, psychiatric, or cranial/cervical vascular disorder. These headaches are brought on by the inciting event and cease with the correction or treatment of the primary ailment. PDPH are classified as post-procedural headaches. The incidence of PDPH after 25G spinal needle placement is 1-3.5%, pain is described in the frontal-occipital region with radiation to the neck with possible cranial nerve deficits. The key to this diagnosis is that pain is increased tremendously with sitting up and is relieved or abates with laying down.

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Abstract #: T-54

Tracheomalacia with Triplets

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Presenting Author's Institution: UNIV OF KANSAS DEPARTMENT OF ANESTHESIOLOGY

Co-Authors: Robin Walters, MD - UNIV OF KANSAS DEPARTMENT OF ANESTHESIOLOGY

Introduction: Tracheomalacia refers to diffuse or segmental tracheal weakness. When extrathoracic, this results in exaggerated luminal narrowing and stridor during inspiration. When airway collapse occurs, this often results in periods of prolonged intubation and ventilation. When combined with the normal physiological effects of pregnancy, these patients are at increased risk for pulmonary complications. We present the case of a patient with tracheomalacia for repeat cesarean delivery of triplets.

Case: A 35-year-old woman G2P1001 at 31 weeks-of-gestation with monochorionic-triamniotic triplet pregnancy was admitted for preeclampsia with plans to perform repeat cesarean delivery at 34 weeks. Anesthesia was consulted to evaluate the patient given her history of tracheomalacia (tracheostomy-dependent for 10 years), subglottic stenosis and unilateral vocal cord paralysis. Review of symptoms was positive for sleep apnea, worsening dyspnea and dysphonia. Physical exam was notable for an inspiratory stridor and suprasternal retractions in the sitting position. The patient was unable to lay further than 20-degree recombinant without worsening of her stridor and increased work of breathing. Spirometry demonstrated a moderate to severe reduction in vital capacity and moderately decreased total lung capacity, consistent with moderate restrictive pulmonary disease.

A multidisciplinary team was assembled to facilitate the workup and management of this high-risk patient. The team consisted of an anesthesiologist, a respiratory therapist, an otolaryngologist, and a maternal-fetal medicine (MFM) specialist. Neuraxial anesthesia was preferred over general anesthesia given this patient's history of tracheomalacia and the pregnancy-associated increased risks of difficult airway management. The cesarean delivery was performed under combined spinal-epidural (CSE) anesthesia while the patient was maintained on non-invasive ventilation (NIV) via a nasal mask and biphasic positive airway pressure (BiPAP). With the nasal BiPAP, the patient was able to tolerate supine position for the cesarean delivery with no significant drop in her oxygen saturation and minimal dyspnea.

Discussion: Non-invasive positive pressure ventilation (NIPPV) is an accepted treatment for patients with extrathoracic tracheomalacia, however, patients at risk of aspiration are usually not considered candidates for NIPPV. The pregnant woman is physiologically predisposed to aspiration also making the use of NIPPV controversial. However, in this case, the risk of tracheal intubation was considered a higher risk for complications than non-invasive positive pressure. This case also highlights the importance of early referrals to ensure that high-risk women receive anesthetic evaluation before scheduled delivery.

Abstract #: T-55

Why Is She Bleeding? A Case Of Excessive Bleeding Following Labor Epidural Placement

Presenting Author: Elizabeth Snow, MD

Presenting Author's Institution: University of North Carolina

Co-Authors: Lacey Straube, MD - UNC Hospitals

Introduction: Undiagnosed bleeding disorders are a concern on labor and delivery where neuraxial anesthesia is commonly performed. Bleeding disorders can be inherited or acquired and can present with a variety of lab abnormalities.

Case: We discuss the case of a 28 year old G5P1031 parturient with a history of chronic hypertension on aspirin 81 mg up to the day before admission. She presented at 38 weeks and 3 days for induction of labor. She had a cesarean section with her first delivery secondary to failure of induction and was seeking a trial of labor after cesarean. She desired an epidural for labor analgesia and one was placed with a single attempt. Her epidural placement was complicated by excessive bleeding that appeared to be from the soft tissues. A CBC and coagulation studies were sent and were all within normal limits. The initial epidural migrated out due to the accumulation of blood under the dressing and given the normal platelets and coagulation studies and lack of any history of bleeding disorders it was replaced. The replacement required 3 attempts and once again resulted in significant bleeding despite pressure being held for greater than 20 minutes. At this point hematology was consulted and thought a qualitative platelet disorder was most likely and suggested a dose of tranexamic acid and 1 unit of platelets be transfused and that no further neuraxial attempts be made and the existing catheter not be manipulated. Bleeding from the epidural site did improve. She had arrest of dilation at 5 cm and the decision was made to proceed with a second cesarean section. Given the copious bleeding during placement, her epidural catheter was difficult to secure. By the time of surgery, it had already migrated significantly from being 5 cm in the epidural space to 2 cm in the epidural space. Fortunately, it was successfully loaded with 2% lidocaine with 1:200,000 of epinephrine achieving a T4 level. She received an additional unit of platelets and dose of TXA, at the recommendation of hematology, during the cesarean section following increased bleeding with initial incision. Estimated blood loss was about 900 ml. Hematology saw the patient in the morning and after their assessment decided that it was safe to remove the epidural at that time. Following epidural removal her bleeding was controlled and she had a completely normal lower extremity neurological exam.

Discussion: The differential for bleeding in a parturient is broad. It can include both inherited and acquired bleeding disorders. In this case, given her lack of excessive bleeding during her previous cesarean section an acquired bleeding disorder seemed more likely. Given her normal labs, acquired disorders such as HELLP syndrome or DIC were unlikely. A qualitative platelet disorder caused by her 81 mg aspirin use seems most likely in this scenario despite 81 mg aspirin not having a waiting period prior to neuraxial anesthesia¹.

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Abstract #: T-56

Early Recognition and Intervention is Key in Amniotic Fluid Embolism (AFE) – Comparison of Two AFE Cases

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Presenting Author's Institution: University Hospitals Cleveland Medical Center - University Heights, Ohio

Co-Authors: Lora B. Levin, M.D. - University Hospitals Cleveland Medical Center

Amniotic-fluid embolism (AFE) is a rare but highly feared complication by both obstetricians and anesthesiologists due to its high mortality¹. In recent years, there have been some case reports presenting successful management of AFE using extracorporeal membrane oxygenation (ECMO). We report two case reports of AFE at the same institution, one where ECMO was quickly instituted and the other where it was not.

First case is a 15-year-old, gravida 1 para 1-0-0-1, who had vaginal delivery at outside hospital complicated by hemorrhage. A Bakari balloon was placed and patient was aggressively transfused and stabilized. On arrival, patient was noted to be in advanced DIC with fibrinogen of 0. The patient quickly went into pulseless electrical activity (PEA) with cardiovascular collapse. Cardiopulmonary resuscitation (CPR) was quickly initiated. During CPR, the patient continued to have distending abdomen possibly from intraabdominal bleeding. ECMO team was called, but patient never had return of spontaneous circulation (ROSC) or palpable pulse long enough to initiate ECMO. Patient was pronounced deceased after an hour of resuscitation efforts. On autopsy, AFE was confirmed.

Second case is a 43-year-old, gravida 3 para 0-0-2-0, who presented to labor and delivery at 38 weeks gestation. A decision was made to take the patient for cesarean section. During closing, patient lost consciousness and went into PEA arrest. CPR was quickly initiated and the patient achieved ROSC after 2.5 minutes. ECMO team was activated and she was cannulated for Veno-Atrial ECMO. Patient underwent emergent hysterectomy and was transferred to cardiothoracic intensive care unit for further management. The clinical diagnosis was AFE. Eventually patient was discharged home without any neurological deficits.

AFE is a difficult clinical diagnosis. Recent literature portrays a syndrome of severe anaphylactoid reaction to pregnancy with an abrupt change in mental status, CV collapse and DIC occurring around the time of delivery. The utilization of ECMO on AFE patients has been reported. However, there are not enough data and there are concerns for increased bleeding risks in AFE patients². From these cases, we learned AFE should be considered early in patients with CV collapse and/or DIC at the time of delivery. Also, institution of ECMO should be considered promptly despite the risk of bleeding. However, it is not always easily established depending on the institutions protocol and availability of the trained personnel.

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Abstract #: T-57

Extending the limits of neuraxial anesthesia in parturients with thrombocytopenia guided by thromboelastography

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Presenting Author's Institution: Henry Ford Hospital - Detroit, Michigan

Co-Authors: Ami Attali - Henry Ford Hospital

Ryan Krebs - Henry Ford Hospital

Joshua D. Younger, MD - Henry Ford Hospital

Background: Thrombocytopenia is defined as a platelet count of less than 150K per mm³. Platelet counts decrease around 17% throughout pregnancy.¹ Almost 10% of women present with levels below the cutoff. It is thought to be associated with the increased plasma producing dilution effect and increased splenic sequestration.¹ Severe thrombocytopenia < 100K is rare, even in women with pregnancy-related complications.²

Introduction: We present two cases of thrombocytopenia; their management, workup, and implication when present in labor.

22 yo African American female G0P1, with history of Glanzmann thrombasthenia was referred to anesthesia evaluation for a low platelet count of 60K. She was educated about the risk and benefits and she agreed to receive IV opioids in labor. She presented full term in labor, platelets dropped to 45k, received a unit of platelets to 87K. Received IV fentanyl during delivery, midline episiotomy was complicated by a grade 3 laceration, and postpartum hemorrhage (PPH) of 632 ml.

32 yo African American female G3P0 with history of sickle cell trait and asymptomatic thrombocytopenia presented at 8 weeks with platelet levels of 142K. She had platelet transfusions in previous deliveries. Hematology recommended prednisone 100mg daily improved the platelet counts from 50K to 181K. Categorized as ITP, levels dropped again to 29K. Delivery plan was c-section. A second trial of steroids and thromboelastography (TEG) were ordered to warrant an epidural placement in labor. Delivery took place in outside hospital without complications.

Discussion: There is a reasonable explanation for thrombocytopenia to occur during pregnancy, critically low values seem to be due to preexisting conditions rather than the pregnancy related.² Multidisciplinary involvement of hematology and anesthesiology are mandatory. If the thrombocytopenia was present before pregnancy or associated with autoimmune disorders, it is more likely to be secondary to ITP.² ITP management commonly starts with steroids such prednisone at 0.5-2mg/kg for at least 21 days, IVIG as second line.² Glucocorticoids have low risk after first trimester. For neuraxial anesthesia placement threshold for platelet counts ranges from 50 to 80K.² Clinical judgment, risk and benefits had guided decision making. Now, TEG can guide therapy, especially in patients with Glanzmann's thrombasthenia (Gp IIb/IIIa deficiency). Platelet count greater than 56K and a normal TEG result was enough to proceed.³ Despite route of delivery and therapy PPH could still occur.

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Abstract #: T-58

Cesarean delivery in a patient with a congenitally corrected transposition of the great arteries, large ventricular septum defect and severe pulmonary hypertension: a case-report

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Presenting Author's Institution: Tokyo Metropolitan Tama Medical Center - Fuchu City, Tokyo

Co-Authors: Makiko Takada - Tokyo Metropolitan Tama Medical Center

Hirotooshi Yamamoto - Tokyo Metropolitan Tama Medical Center

Background: Congenitally corrected transposition of the great arteries (CCTGA) is a rare congenital malformation which associates discordant atrioventricular and ventriculo-arterial connections. Without associated anomaly such as VSD, pregnancy in women with CCTGA have been reported. (1) We report the management for cesarean delivery (CD) of a 35-year-old Japanese nullipara with severe pulmonary hypertension (pHTN) due to unrepaired large VSD associated with CCTGA.

Case: In childhood, intracardiac repair had not deemed indicated due to pHTN. With furosemide 10mg before pregnancy, she never experienced heart failure or arrhythmia. Chest X-ray showed cardiomegaly and dilated pulmonary arteries. (Fig1) A preconception MRI showed good contractility of both ventricles, but the pulmonary-to-systemic blood flow ratio (Qp/Qs) was 3.8. On echocardiography, right-sided mitral valve max pressure gradient was 73 mmHg.

She was admitted at 16 weeks' gestation for new onset ; preeclampsia was ruled out, but she was kept in hospital on bed rest, furosemide 20mg and heparin sc. Catheterization at 30 weeks confirmed severe pHTN (PAP 121/43(76)mmHg), Ao 129/50(82)mmHg, CI 2.79L/min/m², Qp/Qs 2.24, SVRI 17.6 WU, and PVRI 10.9 WU. Due to severe intrauterine fetal growth restriction, a planned CD was decided at 33 weeks. Invasive monitoring included an arterial and central venous line; a PA catheter was not placed due to concerns about accidental insertion to left-side ventricle through VSD. A lumbar spinal anesthetic with isobaric bupivacaine 2.5mg and fentanyl 20mcg was performed, followed by a thoracic epidural placed at T10-11 with lidocaine 2% 3ml, resulting in sensory block to T4. Epidural ropivacaine 0.2% (5mL/h) was administered during the CD. A right femoral vein sheath for emergency ECMO was placed in case of circulatory collapse. PDE3 inhibitor and nitroglycerin were prepared for possible increase in pHTN. A phenylephrine infusion (16mcg/min + 50mcg bolus) was started for maintenance of SVR. Delivery was uneventful (1400g male, Apgar 8/9), with slow delivery of placenta and oxytocin 5 units/h. Hemodynamic trends are shown (Fig2), after oxytocin initiation, norepinephrine 10-50mcg/h was started. The total estimated blood loss was 1380 mL. The patient's postoperative recovery was uneventful except for a pleural effusion treated with furosemide. Post-CD pain was managed with epidural analgesia (ropivacaine 0.1% with fentanyl 2mcg/ml) for 48h and acetaminophen 720mg q6h, in the ICU. Furosemide and heparin were maintained until discharge on postop day 11.

To our knowledge this is the 1st case of a CD in a patient with CCTGA and severe pHTN. Management goals were: 1) avoidance of stimuli exacerbating pHTN; 2) maintenance of appropriate SVR to decrease the R-L shunt; and 3) avoidance of volume overloading associated with placental removal and uterine contraction.

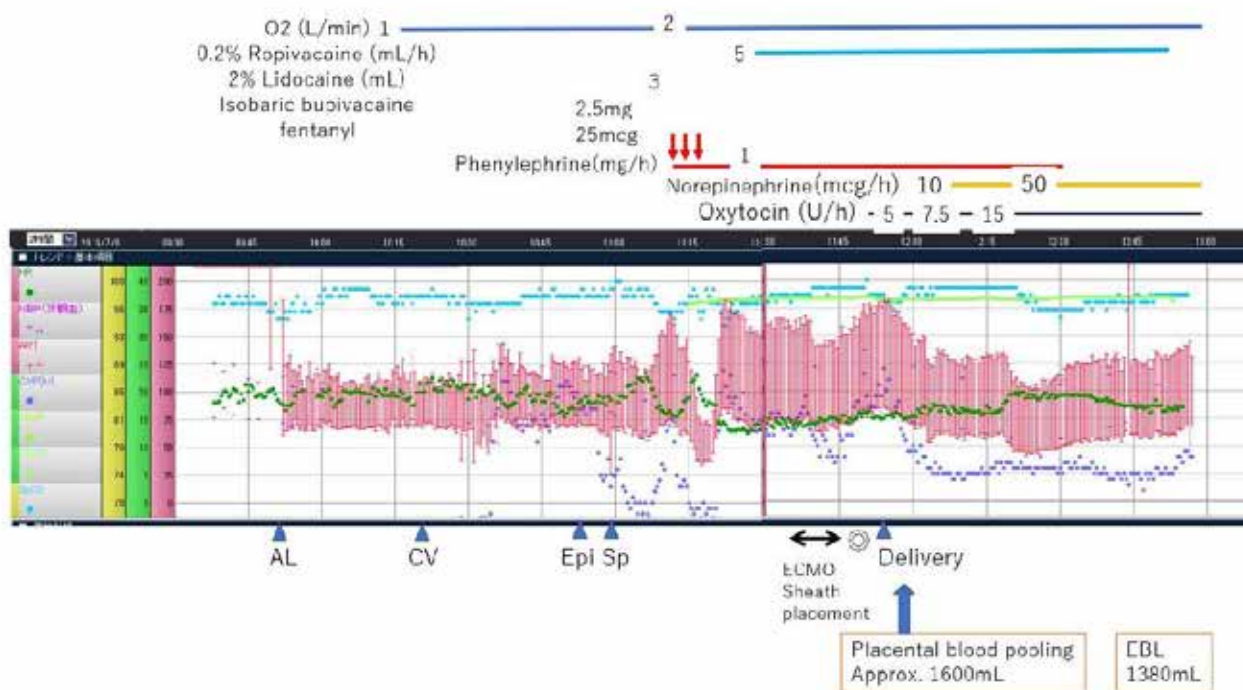
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Fig1



Fig2



Abstract #: T-59

Unilateral Lung Hypoplasia in the Morbidly Obese Obstetric Patient: A Case Report

Presenting Author: Angeli Thawani, D.O.

Presenting Author's Institution: University of Vermont Medical Center - Essex Junction, Vermont

Co-Authors: Lydia Grondin, M.D. - University of Vermont Medical Center

A 31 year old G1P0 with morbid obesity (BMI 73), left lung hypoplasia, bronchiectasis, obstructive sleep apnea with BIPAP intolerance, and gestational hypertension was admitted at 34w1d for bronchiectasis exacerbation and hemoptysis. She developed pre-eclampsia with severe range blood pressure and transaminitis, prompting labor induction.

With high likelihood of conversion from vaginal to cesarean delivery and known difficult airway (mallampati 4, less than 3 fingerbreadth thyromental distance, limited neck range of motion) early placement of an intrathecal catheter was planned for pain management.

A 10 centimeter (cm) 17 gauge Tuohy needle was used to enter the epidural space 6cm from the skin at L3-L4. The Tuohy was advanced 1cm, where free flowing cerebrospinal fluid (CSF) confirmed intrathecal access. A catheter was threaded 7cm into the intrathecal space, with CSF flowing from the tip. Analgesia was started several hours after placement.

On day 2 of induction, conversion to cesarean section was indicated due to arrest of dilation, category 2 fetal tracing, and late decelerations. Catheter aspiration was negative for CSF, but sensory blockade was noted at T2, and motor blockade occurred after 1 mL of 0.75% bupivacaine hydrochloride in dextrose with 15mcg fentanyl was injected via catheter. Another 1 mL of intrathecal 0.5% bupivacaine and intravenous ketamine were given due to pain.

Post-operative pulmonary edema was managed with supplemental oxygen and diuresis. The catheter was removed and multi-modal analgesia was provided.

Discussion: Unilateral lung hypoplasia is a rare congenital anomaly caused by the absence of the respective pulmonary artery (PA). Initial presentation often includes exercise intolerance, recurrent respiratory infection, and/or hemoptysis; average age of diagnosis is 14. CT/MRI show bronchiectatic changes, right lung herniation, left shift of mediastinal structures, and/or early PA termination. Regular echocardiogram is indicated to monitor for pulmonary hypertension, which increases mortality rate.

Anesthetic management of pregnant patients with unilateral hypoplastic lung is not well described in the literature. A case report describes a 23 year old female with left lung agenesis at 36 weeks gestation undergoing elective cesarean section, successfully managed with a combined spinal epidural.

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3. Kruzliak P, Syamasundar RP, Novak M, et al. Unilateral absence of pulmonary artery: Pathophysiology, symptoms, diagnosis and current treatment. *Arch Cardiovasc Dis* 2013;106:448-454

Abstract #: T-59

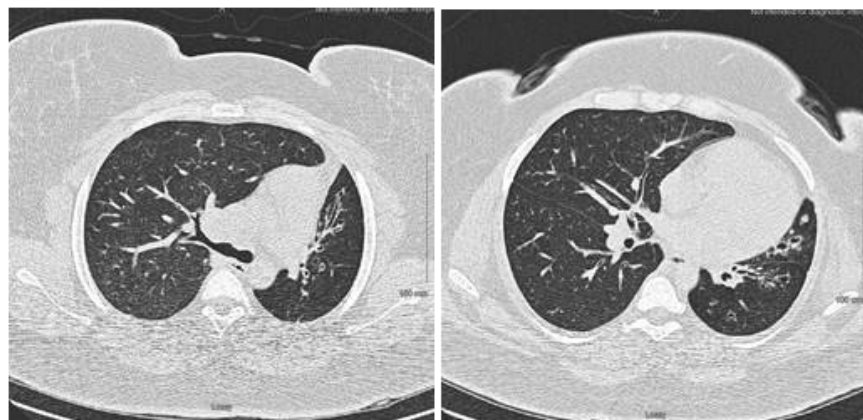


Fig. 1 CT showing right lung herniation, leftward mediastinal shift

Abstract #: T-60

Successful use of extracorporeal membrane oxygenation support in a postpartum patient with severe sepsis and associated cardiomyopathy

Presenting Author: Caroline Thomas, MD

Presenting Author's Institution: University of Chicago - Chicago, Illinois

Co-Authors: Barbara Scavone

Background: Myocardial dysfunction predicts poor outcome in septic patients, with mortality rates near 70%, but sepsis-induced cardiomyopathy (SICM) can resolve. VA ECMO may improve outcomes in patients with severe SICM, with 70% of patients recovering function.

Case: A 23-year-old G1P1 female was transferred from an OSH. 20d prior to admission she had presented to an OSH at 42 wks with no prenatal care and underwent cesarean delivery for arrest of descent complicated by delayed postpartum hemorrhage and hysterectomy. She was discharged after 5d with a wound vacuum in place. 5d later she developed wound dehiscence with bowel evisceration. She was taken to the OR for reduction of bowel and fascial closure and discharged home with wound vacuum 3d later.

7d later, she presented to the OSH with abdominal pain, was found to be septic from an unidentified source with renal dysfunction and DIC, and was transferred to us. Upon arrival she had HR 140, BP 83/44, fever 38.5, RR 40, fibrinogen 130, INR 2.4, plt 53, Hg 7.2, WBC 1.6, HCO₃ 12, Cr 3.2, and lactate 6.5. A bedside TTE was concerning for LVEF 25-30%. Large bore IV's, arterial, and central lines were placed. She received volume resuscitation and broad spectrum antibiotics (vancomycin, cefepime, metronidazole, and fluconazole). She received RBCs, plasma, cryoprecipitate, and platelets. She required rapid up-titration of vasoactive medications to maintain MAP > 65 and within several hrs was on maximal doses of norepinephrine, vasopressin, epinephrine, phenylephrine, dobutamine, and angiotensin II, and was started on CVVHD due to metabolic acidosis. The patient was intubated and mechanically ventilated due to impending respiratory failure.

The patient's metabolic acidosis worsened (ABG 7.19/29/141/12 and lactate 9.8), and she was urgently cannulated to VA ECMO. The patient's hypotension, metabolic lactic acidosis, and DIC improved and she was weaned off vasoactive medications except for dobutamine within 48 hr. CT showed enlarged left kidney and dilated collecting system concerning for pyelonephritis and the patient underwent percutaneous nephrostomy tube placement. She was decannulated after 5d and extubated after 7d. She has a normal mental status, she no longer requires dialysis, and her LVEF has improved to 55%. She will require follow up with plastic surgery due to ischemic digits and necrotic abdominal wound due to vasoconstrictors.

Discussion: Severe sepsis has a mortality rate of 25-45%, and SICM may increase mortality rates further. It can be detected via bedside TTE. Given SICM's rapid resolution, it is reasonable to use VA ECMO to support perfusion until SICM resolves. ECMO cannulation can provide hemodynamic stabilization and allow for reversal of multi-organ dysfunction and procedural interventions to provide source control in septic patients.

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Abstract #: T-61

Obstetric Anesthesia for a Patient with Super-morbid Obesity and History of Disseminated Blastomycosis Complicated by Epidural Abscess

Presenting Author: Caroline Thomas, MD

Presenting Author's Institution: University of Chicago - Chicago, Illinois

Co-Authors: Barbara Scavone

Background: Blastomycosis is caused by *Blastomyces dermatitidis*, a fungus endemic to the southeastern, south central, and Midwestern US. In pregnant women, it commonly presents as disseminated disease in the 2nd and 3rd trimesters with complaints of cough, fever, shortness of breath, night sweats, and weight loss. Treatment of pregnant women consists of IV amphotericin B transitioning to oral itraconazole or voriconazole after delivery.¹

Case Report: A 23-year-old G3P1 female at 37w4d gestation presented for induction of labor due to preeclampsia. History was notable for no prenatal care, history of preeclampsia with severe features in a previous pregnancy, asthma, and BMI 67. The patient had a history of disseminated blastomycosis during a 2017 pregnancy complicated by epidural abscess, osteomyelitis, acute renal failure requiring dialysis, and ARDS requiring ECMO cannulation. She was incompletely treated, having received only 5 of 12 recommended months of voriconazole. Her physical exam was notable for obscure bony landmarks and a Mallampati II airway with a thick neck. BP was 147/74, protein: creatinine ratio was 0.33. Due to incomplete treatment for blastomycosis epidural abscess an infectious disease consult was obtained to determine the risk of persistent or latent epidural blastomycosis. Given her lack of symptoms and remote infection further treatment was deemed unnecessary and therefore the anesthesia team deemed the risk of epidural anesthesia lower than the risk of proceeding without neuraxial analgesia given her increased risk of cesarean delivery and her body habitus, unfavorable airway and the possibility of preeclampsia-associated airway edema. An uncomplicated ultrasound-guided dural puncture epidural procedure provided adequate analgesia. Approximately 12.5 hours after epidural catheter placement the patient had an uncomplicated spontaneous vaginal delivery.

Discussion: Clinical practice guidelines from the Infectious Disease Society of America guide treatment for blastomycosis. For CNS blastomycosis, IDSA recommends 4-6 weeks of liposomal amphotericin B followed by an oral -azole for at least 12 months and until resolution of CSF abnormalities.² Several reports exist of blastomycosis relapse after therapy completion. Given the history of incompletely treated disseminated and epidural blastomycosis an infectious disease consult was obtained to aid the risk benefit analysis of epidural analgesia. Because she had been asymptomatic since 2017 and had completed 5 months of therapy our infectious disease colleagues thought it unlikely she had active blastomycosis. Given her elevated risk of cesarean delivery (increased with obesity and preeclampsia) and the risk of airway mishap with general anesthesia (due to her unfavorable airway, obesity, and preeclampsia) the anesthesia team decided to proceed with epidural analgesia.

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2. Clin Infect Dis 2008; 46:1801

Abstract #: T-62

Perioperative Management of a Parturient with a Spontaneous Cerebrospinal Fluid Leak.

Presenting Author: Joseph H. Tipton, MD

Presenting Author's Institution: The University of Tennessee Graduate School of Medicine - Knoxville, Tennessee

Co-Authors: Carrie Polin, MD - University of Tennessee Graduate School of Medicine

Case: A 28 year old G1P0 female at 35 weeks presented as a transfer from an outside hospital with a one week history of unrelenting positional headache and neck pain with movement. Magnetic resonance imaging (MRI) of the head and spine showed dorsal extradural collection with cerebrospinal fluid (CSF) intensity signal throughout the spine compatible with CSF leak and associated CSF hypotension. Following a multidisciplinary discussion involving the obstetric, anesthesia, and interventional radiology teams, the decision was made to proceed with cesarean section for delivery due to concern of labor worsening the CSF leak, followed by computerized tomography (CT) myelogram to identify the location of the CSF leak. Neuraxial anesthesia for the cesarean delivery was administered with 12mg hyperbaric bupivacaine, 15mcg fentanyl and 150mcg morphine. Shortly after spinal placement, the patient developed symptoms of a high spinal, including marked upper extremity weakness, difficulty with respiration, and hypoxia. The decision was made to convert to general endotracheal anesthesia. At the end of the procedure, the patient had full return of strength and was extubated. Follow up CT myelogram was inconclusive for identifying the location of the CSF leak. A lumbar epidural blood patch was performed by the anesthesia team, which failed to provide relief. The patient then underwent a CT guided multilevel thoracic blood patch with full resolution of symptoms.

Discussion: Spontaneous intracranial hypotension due to spontaneous CSF leaks is a known cause of orthostatic headaches. It primarily occurs in young and middle-aged individuals, with women more often affected than men. The incidence has been estimated at 5 per 100,000 per year in the population (1). Unfortunately, there is limited data on the incidence, diagnosis, and management of spontaneous CSF leaks in the pregnant population and how this diagnosis might affect anesthetic management for delivery.

In our patient, the decision was made to deliver prior to performing a CT guided blood patch to limit fetal exposure to radiation. Our patient developed a high spinal level following a standard intrathecal dose of bupivacaine. Studies have shown that normal saline in the epidural space can display a volume effect, exerting pressure on the intrathecal space leading to changes in drug spread. This can cause a higher level of spinal anesthesia (2). With a spontaneous CSF leak, a significant collection of CSF volume in the epidural space may act in a similar manner. This could explain why our patient had symptoms of a high spinal in contrast to a prior case report of a parturient with a CSF leak caused by a skull base defect in which there was no significant CSF present in the epidural space (3).

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Abstract #: T-63

A Parturient with Paraplegia Attributed to Neuraxial Blockade at an Outside Hospital Refuses General Anesthesia for Repeat Cesarean Delivery: Is Neuraxial Anesthesia Appropriate?

Presenting Author: Roulhac D. Toledano

Presenting Author's Institution: NYU Langone Health --Brooklyn - Brooklyn, New York

Co-Authors: Taron Matevosyan - NYU Langone Health

Abdullah Qatu - NYU Langone Health

A 29 yo G3P1 with a history of paraplegia, obesity, diabetes, and hypertension presented to our Labor & Delivery Unit for repeat cesarean delivery at 38 weeks' gestation. The patient attributed her paralysis to a neuraxial anesthetic performed during her first cesarean delivery at an outside hospital seven years earlier. Medical records at the outside facility were sealed; the only physician familiar with her spinal cord injury was unable to provide additional details. On physical examination, the patient was wheelchair-bound and obese (BMI 41), with a class IV airway. She denied sensation and motor strength of her lower extremities, but was able to ambulate minimally with assistance. She also complained of persistent bowel and bladder incontinence.

While discussing the risks, benefits, and anesthetic options for her repeat cesarean delivery, the patient adamantly refused general anesthesia. Specifically, she stated that she wanted to "watch everything the physicians did." Per her report, general anesthesia was emergently induced after a complication with neuraxial anesthesia at the outside facility, and she experienced bilateral lower extremity immobility upon emergence. A dural puncture epidural (DPE) technique was planned.

A DPE technique was selected for several reasons: catheters placed in the setting of a DPE or combined spinal epidural (CSE) technique are considered more reliable for surgical anesthesia than those placed after a standard epidural procedure; the onset and density of epidurally-administered medications is improved after dural puncture, with enhanced caudal spread; a catheter-based technique provides the capacity to prolong surgical anesthesia; and hemodynamic changes are reduced vis-à-vis a single-shot spinal technique. A DPE was selected in lieu of a CSE technique because we did not intend to administer intrathecal medication in this patient with a spinal cord injury of unknown etiology. However, this patient's cesarean delivery was ultimately performed with a standard epidural technique, as we were unable to visualize cerebrospinal fluid.

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Abstract #: T-64

Case report of NYH Class III heart failure in Cesarean delivery

Presenting Author: Stephen M. Topper, MD, PhD

Presenting Author's Institution: The University of Texas Southwestern Medical Center, Parkland Hospital - arlington, Texas

Co-Authors: Kelechi Anyaehie, MD - The University of Texas Southwestern Medical Center, Parkland Hospital
Miakka Smith, MD - The University of Texas Southwestern Medical Center, Parkland Hospital

Introduction: Dilated cardiomyopathy in the pregnant patient presents a significant challenge during the peripartum period. Guidelines recommend against pregnancy in women with EF < 30% due to high risk of maternal morbidity and mortality as risk of maternal death or adverse cardiac event is between 39 to 60%.^{1,2} Here, we present peripartum management of severe dilated cardiomyopathy in a patient with multiple risk factors.

Case: A 37-year-old G7P4A2 with a history HF_rEF (NYH class III) secondary to methamphetamine abuse, EtOH cirrhosis, and PSA presented for scheduled C-section. She presented with severely elevated BP, likely due to noncompliance. Home medications (metoprolol, furosemide) were restarted, normalizing BP during observation. Labs demonstrated normal PT/INR, elevated AST/ALT, elevated ALP, anemia, normal platelets, and recent amphetamine use. TTE demonstrated EF of 26% with dilated left ventricle and global hypokinesis, but no valvular abnormalities.

Intraoperative course: Due to difficult IV access, a PICC and midline catheter were placed preoperatively. In the OR, an awake A-line was obtained and standard monitors were applied. Epidural was placed with test dose of 3 cc of 1.5% lidocaine with epinephrine, followed by a slow titration of 15cc of 2% lidocaine with epinephrine. Blood pressure was maintained (MAP >70 or 10% of baseline) with vasopressin infusion and intermittent vasopressin boluses. The patient was not able to tolerate the operation under epidural due to anxiety and the case was converted to general with etomidate, succinylcholine, and an epinephrine infusion was started. Maximal vasopressor requirements were 0.06mcg/min of epinephrine and 0.04mcg/min of vasopressin. Following uneventful delivery, uterine atony was noted requiring carboprost. Elevated BP was noted despite discontinuation of vasopressors. Hydralazine was administered with little effect, IM MgSO₄ and MgSO₄ infusion were initiated for pre-eclampsia EBL was 1250mL, and patient was transported to the ICU with an otherwise uneventful hospital course.

Discussion: Management of dilated cardiomyopathy is challenging in the immediate peripartum period. Cardiac output increases by up to 50% during pregnancy, and a further 80% following delivery, placing high strain on the diseased heart and increasing risk of maternal adverse events.³ While several studies have assessed management of peripartum cardiomyopathy, there are few reports examining pregnancy and delivery in women with severe, pre-existing cardiomyopathy.

References:

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Abstract #: T-65

Quadruplet Pregnancy in a Patient with Postural Orthostatic Tachycardia Syndrome and Ehlers Danlos Syndrome

Presenting Author: Vy Tran, MD

Presenting Author's Institution: Ochsner Clinic Foundation

Co-Authors: Roneisha McLendon, MD - Ochsner Clinic Foundation

Introduction: Postural orthostatic tachycardia syndrome (POTS) is a type of dysautonomia that poses challenges during obstetric anesthesia. It is characterized by orthostatic tachycardia (HR >120) with or without hypotension and syncopal or pre-syncopal symptoms. POTS can be debilitating with symptoms that can be provoked by stressors typically seen with physiological changes of pregnancy [1]. POTS can also be associated with Ehlers Danlos syndrome Type III [2]. Both syndromes pose difficulties for anesthetic management during delivery.

Case report: A 25 yo G1P0 with Type III Ehlers Danlos and POTS presented with quad-amniotic quad-chorionic pregnancy after IUI. The patient was seen for consult at 20 weeks gestation. She was managed with twice weekly albumin infusions, droxidopa and labetalol. A cesarean delivery was planned, measures to ensure hemodynamic stability and a CSE was discussed.

The patient presented at 23w3d in preterm labor. She was admitted for tocolytics, betamethasone and MgSO₄. An epidural was placed for expectant management and albumin was infused during the placement for volume. After a negative test dose was given, the patient was checked and found to be completely dilated and was taken for cesarean delivery.

Intra-op, two doses of 10mL 2% lidocaine with 1:200K epinephrine, 100mcg fentanyl and 1mg morphine was administered via the epidural. An infusion of 50mcg/min of phenylephrine was also started. The patient remained hemodynamically stable without extreme tachycardia or hypotension throughout the surgery (Fig.1). Baby A had APGAR score of 0 upon delivery and unable to be resuscitated, Baby B, C and D had APGAR scores of 1 at one minute and 6, 5 and 6 respectively at 10 minutes and were admitted to the neonatal ICU.

Discussion: Patients with POTS present with a myriad of non-specific symptoms making diagnosis and treatment difficult. Many factors during labor and delivery can cause hemodynamic instability which trigger POTS, such as aortocaval compression syndrome, Valsava maneuvers causing hypotension and neuraxial anesthesia causing vasodilation and hypotension [3,4]. The urgency of this case prevented placement, but an arterial line for close blood pressure monitoring should be considered. Phenylephrine is the vasopressor of choice and with exclusive α_1 agonism, can avoid beta activity worsening tachycardia in patients with POTS. Multidisciplinary planning between the obstetrician, MFM specialist and obstetric anesthesiologist is essential to successfully manage the parturient with POTS and associated co-morbidities [4].

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Abstract #: T-65

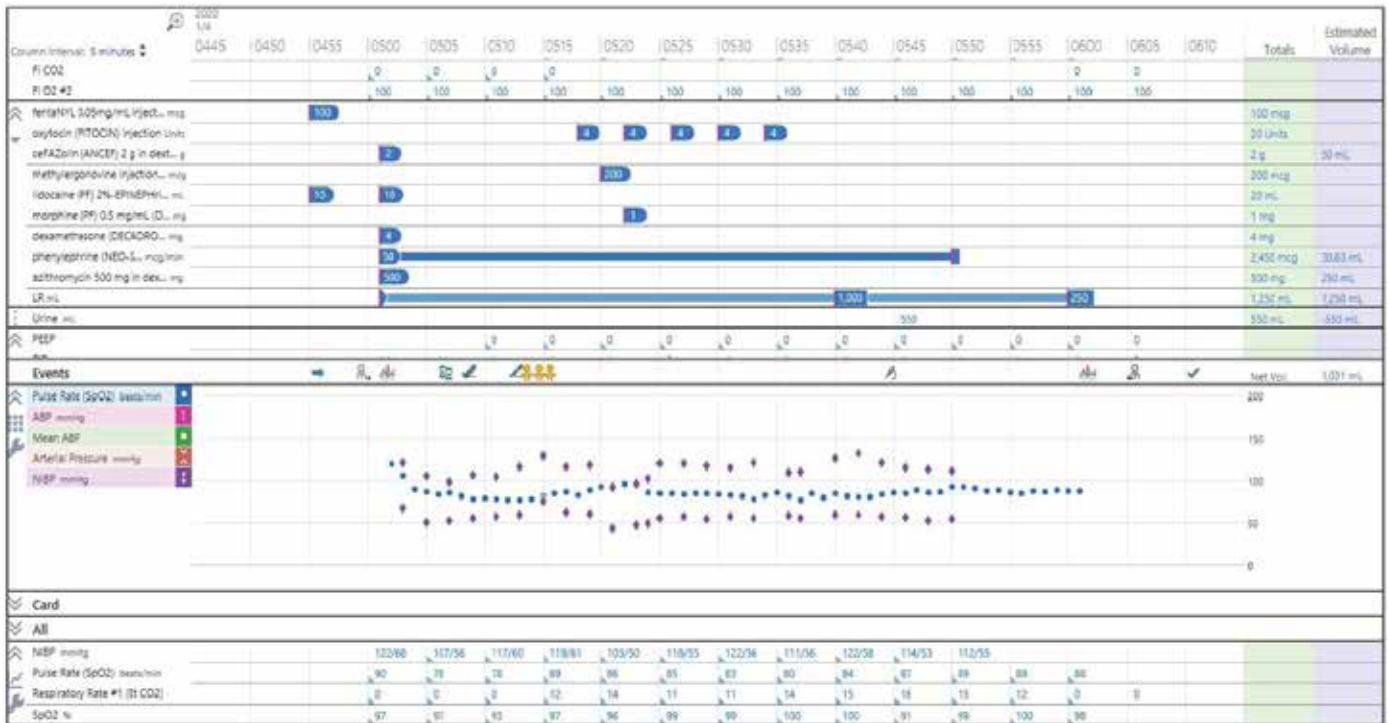


Figure 1: Intraoperative anesthesia record. Patient was started on 50mcg/min phenylephrine infusion throughout surgery. Blood pressure was taken every minute. HR and BP remain stable throughout.

Abstract #: T-66

Prone positioning for the treatment of Acute Respiratory Distress Syndrome in the post-partum patient.

Presenting Author: Vy Tran, MD

Presenting Author's Institution: Ochsner Clinic Foundation

Co-Authors: Adrienne Ray, MD - Ochsner Clinic Foundation

Introduction: Acute respiratory failure is a common cause of morbidity and mortality in the peri-partum period, often associated with preeclampsia, amniotic fluid embolism or cardiomyopathy [1]. Women with pre-e can develop pulmonary edema in the early post-partum period [2]. Left ventricular diastolic dysfunction [2,3] is commonly present and can lead to acute pulmonary edema and progression to ARDS. Here, we discuss the management of a postpartum patient with ARDS and pre-e with severe features requiring mechanical ventilation and prone positioning.

Case report: A 29yo G2P1 presented at 37w1d for repeat c-section for recently diagnosed gestational HTN. C-section performed under CSE was uncomplicated with a calculated EBL of 500mL. Within the first 24hr post-op, she had a pre-syncope episode secondary to anemia and hypovolemia. She received several liters crystalloid and 2 units PRBCs. On POD 2 the patient had elevated BPs requiring multiple anti-hypertensives and was started on MgSO₄. During this time, she complained of SOB was diuresed and placed on supplemental oxygen. Despite adequate diuresis, symptoms continued.

CXR and CTA (Fig.1) both showed bilateral patchy infiltrates. TTE revealed grade II diastolic dysfunction and elevated left atrial pressures. She was admitted to the ICU on POD 7 for increased work of breathing and oxygen requirement. Nicardipine infusion was started and she was intubated for acute hypoxic respiratory failure. ARDS net protocol was initiated but ventilation was difficult with high plateau pressures, so she was placed in prone positioning for 16 hours with improvement in ventilator settings. She was concurrently treated for presumed pneumonia sepsis and extubated on POD11, then discharged on POD16 on multiple oral anti-hypertensives.

Discussion: This case exemplifies the difficulties with diagnosis and management of a parturient in the immediate postpartum period who initially exhibited acute blood loss anemia further complicated by pulmonary edema and ARDS. The etiology of ARDS was likely multifactorial from pre-e with severe range BPs leading to cardiogenic pulmonary edema and superimposed pneumonia. Recognition of diastolic dysfunction in the setting of pre-e and more aggressive treatment of HTN may have prevented the progression to ARDS and need for mechanical ventilation. Permissive hypercapnia, high PEEP, prone positioning with or without muscle relaxant are management options for severe ARDS [4,5]. In this case, the early initiation of prone positioning resulted in improvement in oxygenation.

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Abstract #: T-66

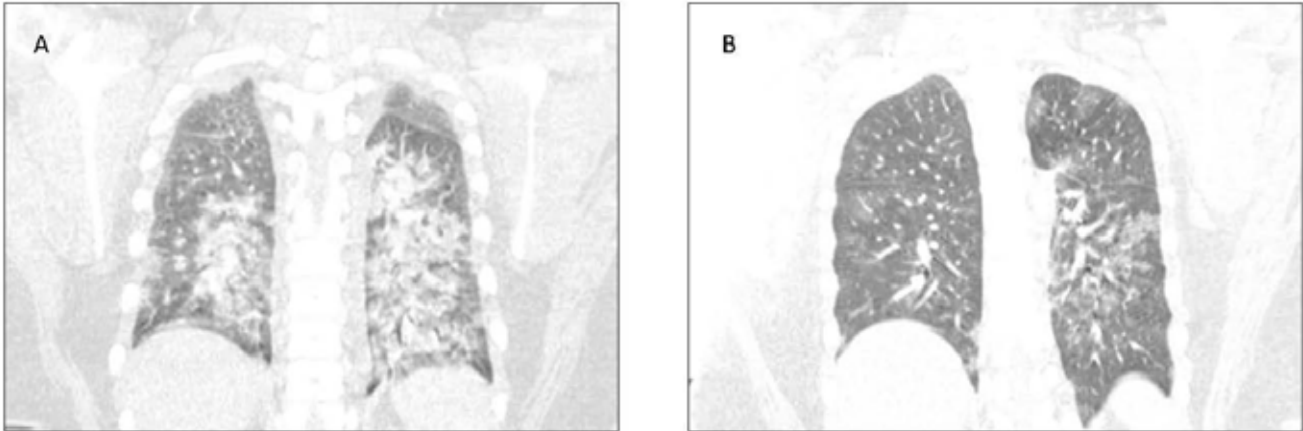


Figure 1: Bilateral ground glass opacities noted on coronal CT images seen in (A) before prone positioning greatly improved as seen in (B).

Abstract #: T-67

Sickle Cell Disease and Opioid Abuse Management in Cesarean Section

Presenting Author: James M. Urness, M.D.

Presenting Author's Institution: Henry Ford Hospital - Royal Oak, Michigan

Co-Authors: Ami Attali, D.O. - Henry Ford Hospital

Joshua D. Younger, MD - Henry Ford Hospital

Introduction: Sickle cell disease is the most common inherited disease worldwide associated with a sixfold increased risk of maternal and fetal morbidity and mortality in pregnancy including marked increases in preeclampsia, preterm births, and stillbirths.¹ Pregnancy correlates with increases in frequency of painful crises, infections, pulmonary complications, thromboembolic events, and antepartum bleeding, even in women who were previously well controlled.¹ Apart from the risks associated with pregnancy, sickle cell patients have much higher utilization of opioids for the management of their pain, resulting in difficult pain control.

Case: Our patient is a 31 year old female G4P3 with a past medical history including sickle cell disease, CVA with deficits, preeclampsia, pulmonary embolism on anticoagulation, bipolar disorder who presented with dyspnea and symptoms suggestive of sickle cell pain crisis. Upon subsequent testing, she was found to be 29 weeks pregnant with dichorionic diamniotic twins. She was admitted and treated for acute pain crisis, however, she developed worsening dyspnea and there was a concern for acute chest syndrome. Prior to admission, the patient was using approximately 180mEq of morphine per day, yet inpatient the patient's pain continued to be poorly controlled with methadone 30mg per day along with patient-controlled analgesia pump. The patient developed preeclampsia with severe features with elevated liver enzymes. The patient was taken for an urgent cesarean section. Preoperative concerns were the availability of blood products as the patient had multiple antibodies, respiratory status with pulmonary embolism, and adequate pain control. Heparin infusion was stopped 4 hours before performing a spinal with 1.6mg of 0.75% hyperbaric bupivacaine, 15mcg of fentanyl, and 200mcg of morphine. The patient tolerated the procedure well only requiring midazolam for an anxiolytic. At the conclusion of the procedure, we performed a transverse abdominus plane block to optimize postoperative analgesia. Upon returning to the ICU her previous pain regimen was resumed with hydromorphone PCA and methadone.

Discussion: Parturients with pre-existing sickle cell disease present additional challenges to their perioperative management in regards to their pathophysiologic considerations and challenging pain management. Prevention should be at the forefront of the early detection and treatment of complications arising from sickle cell disease starting even before pregnancy begins and through the postpartum period. Multimodal pain management must be utilized in order to sufficiently address their pain. Adequate preparedness with an appropriate multidisciplinary team familiar with sickle cell management is key in optimizing outcomes for our complex patients.

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Abstract #: T-68

Spontaneous cervical cerebrospinal fluid leak in an early second trimester pregnant woman successfully treated with lumbar epidural blood patch: a case report.

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Presenting Author's Institution: Henry Ford Hospital - DETROIT, Michigan

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Spontaneous intracranial hypotension (SIH) is caused by cerebrospinal fluid (CSF) leakage, orthostatic headache is a key symptom. If untreated, it can transition into a subdural bleed. Treatment is initially conservative and consists of bed rest, hydration and caffeine, followed by epidural blood patch (EBP) if no clinical response. Other clinical options may include an epidural injection of fibrin glue, and direct surgical repair of the dural tear. Even for CSF leaks in cervical area, lumbar EBP is considered the treatment of choice and usually considered before cervical or thoracic. Cervical or thoracic EBP must be performed along with imaging guidance and carries risks including cranial nerve palsy, subdural hematoma, seizures, chemical meningitis and spinal cord compression, the most feared complication. Repeated EBPs may be required, as lesions related to SIH are more complex and anterior than simple dural defects. If the EBP is successful, relief is usually immediate. Recurrence of symptoms can occur after the blood is reabsorbed if the dural leak persists. However, if the variety of headache has changed, rebound intracranial hypertension or dural venous sinus thrombosis should be considered in the differential diagnosis. We present a case of SIH in a second trimester pregnant woman, not responsive to conservative treatment and with imaging compatible with cervical CSF leak, successfully treated with lumbar EBP. Case report: 34 y.o. female G7P6 at 16 weeks, with medical history of hypothyroidism, who presented in acute distress having orthostatic headache, 10/10 pain, pulsatile in nature, associated with pain in her mid to upper back pain that radiated into the sides of her neck, and nausea and vomiting. Physical exam, showed neck pain with movement and muscular tenderness. She denied any recent trauma, lumbar puncture or associated event. She never had similar symptoms before. The patient was hemodynamically stable and afebrile. Initial workup was negative for infectious etiologies and CT head showed no abnormalities. She received symptomatic treatment and IV fluids. Lumbar Puncture was not performed due to patient refusal. Ophthalmology was consulted, papilledema was ruled out. Initially MRI brain without contrast was performed, showing a very thin scattered T2 hyper - intensity superficial to the cerebral convexities concerning for intracranial hypotension. As the patient was complaining of worsening back pain and headache a subsequent full spine MRI was performed to possibly localize the CSF leak and to assess the spine prior to any procedure. Result showed findings compatible with intracranial hypotension and a cervical CSF leak. A lumbar EBP was performed at L3-L4 level, with 19 ml of autologous blood injected and immediate improvement of symptoms. She currently remains pregnant at 22w+2d weeks gestational age with at this point no additional CSF leak or recurrence of symptoms to date.

Abstract #: T-69

Anesthetic consideration of a parturient with meningioma presented for cesarean section

Presenting Author: Kristine Villegas

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Co-Authors: Alaeldin Darwich - Weill Cornell Medicine- Dept of Anesthesiology

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Although the incidence of intracranial neoplasms in the parturient is low, when present, they may pose an increased risk for herniation with neuraxial anesthesia. The 2 most common brain tumors found during pregnancy are gliomas and meningiomas. Specifically, initially undetected meningiomas can grow significantly during pregnancy due to hormonal changes and present with symptoms related to increased intracranial pressure (ICP) or mass effect including headache, vision changes, nausea/vomiting, and altered mental status. In the 2nd stage of labor, ICP can also increase with valsalva maneuvers and painful uterine contractions. Currently, there is no published data comparing the safety of neuraxial versus general anesthesia (GA) in this patient population. We present a case of a patient with a recently diagnosed meningioma in the 3rd trimester scheduled for cesarean section.

A 25-year-old female, G1P0, presented at 38 weeks gestation with decreased central visual acuity in her right eye consistent with optic neuritis. Further workup on MRI revealed a tuberculoma meningioma impinging on the optic chiasm. Multidisciplinary planning and an anesthesia consult were arranged. After confirmation of minimal mass effect and no elevated ICP, decision was made to proceed with elective cesarean section under spinal anesthesia. Spinal anesthetic was performed at L4-5 interspace with a 27g spinal needle. Spinal dose of 1.6cc hyperbaric 0.75% bupivacaine, 150mcg morphine, and 15mcg fentanyl was administered. The patient underwent cesarean section without complications. On postoperative day (POD) 1, she had no signs of increased ICP. On POD2, follow up MRI showed no significant changes in tumor size or evidence of mass effect. She was discharged on POD3. Plan for tumor resection was made 4 weeks post-partum.

Anesthetic management of parturient with a brain tumor involves appropriate consultation with several multidisciplinary teams and weighing the risks and benefits of each anesthetic option. Evidence of increased ICP, hydrocephalus, mass effect, or worsening neurological symptoms in the antepartum period would place the patient at high risk for herniation during neuraxial procedure. Unintentional dural puncture would allow CSF to flow across a pressure differential into the epidural space and potentially lead to downward herniation of brain tissue. GA may increase ICP during direct laryngoscopy and extubation. In addition, treatment for elevated ICP with hyperventilation can lead to decreased placental blood flow and fetal hypoxia.

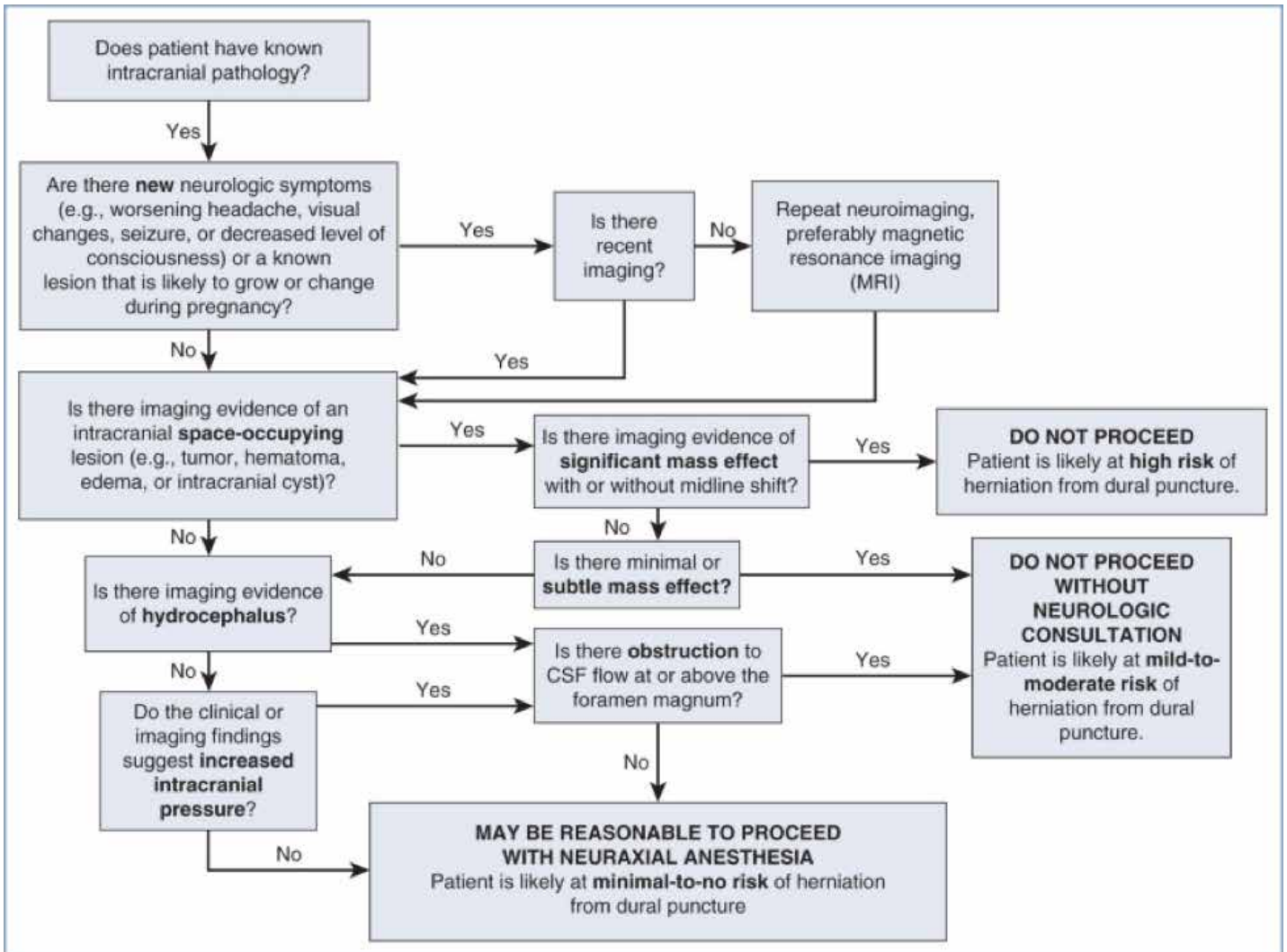
Therefore, it is imperative to tailor the anesthetic plan based on a patient's clinical presentation, neurological work up and obstetric plan.

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Abstract #: T-69



Abstract #: T-70

Awareness of institutional oxytocin protocol during cesarean delivery (CD): a knowledge chasm among maternal care teams.

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Introduction: Maternal oxytocin administration following delivery is an important management strategy to prevent post-partum hemorrhage. However, oxytocin is a high risk, high alert medication and can cause significant hemodynamic changes if administered rapidly or in large doses.¹ A variety of oxytocin administration strategies are available, however an established oxytocin protocol within a facility allows for a) shared understanding among maternal care teams regarding uterine tone assessment and escalation of alternate uterotonic administration; b) accounting for the patient, the system, and the potential adverse effects of this “High-Alert Medication”; and c) maintaining an open line of communication between maternal care teams which is often lacking in obstetric crisis management.^{2,3}

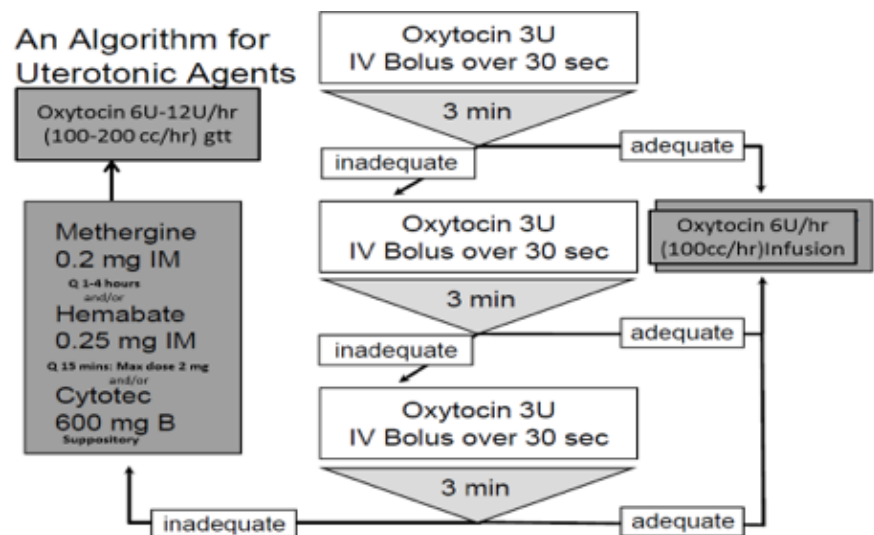
Methods: Our institution utilizes a modified “Rule of Threes” for oxytocin administration (Figure 1). An eight question survey with specifics of the protocol was sent to the obstetric and anesthesia faculty and residents and completed voluntarily.

Results: A total of 83 voluntary respondents took the survey for a response rate of 44%. The average score was 36% correct. Anesthesia faculty scored an average of 48% correct; anesthesia residents scored an average of 54% correct; obstetric faculty scored an average of 21% correct; obstetric residents scored an average of 18% correct.

Discussion: This survey demonstrated that there was a large knowledge gap amongst all members of the maternal care team with regards to oxytocin administration during CD. Education and awareness of the institutional protocol will result in better and safer patient care in the setting of cesarean delivery. Our institution plans to educate with operating room protocol laminates and a document within our electronic medical record learning dashboard.

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Abstract #: T-71

Prolonged Paralysis after Dilation and Evacuation

Presenting Author: Robalee Wanderman

Presenting Author's Institution: Mayo Clinic - Rochester, Minnesota

Co-Authors: Jeffrey Pasternak, MD - Mayo Clinic

Butyrylcholinesterase (BChE) is a plasma enzyme that is responsible for metabolizing a variety of drugs, including succinylcholine. Mutations in the gene for BChE can result in prolonged neuromuscular relaxation after succinylcholine administration¹. Laboratory evaluation of patients with suspected BChE mutations typically involved measuring BChE activity and dibucaine number (DN). With advances in molecular techniques, more than 20 mutations have been identified in the BChE gene. Of these, some result in decreased BChE activity with a normal DN^{2,3}. Here we present the case of a possible rare pseudocholinesterase enzyme variant that resulted in prolonged paralysis after succinylcholine in the setting of decreased BChE activity but a normal dibucaine number.

The patient is a 26-year-old female admitted for dilation and evacuation procedure for missed abortion of twin gestation measuring 13 weeks. The procedure was performed with general anesthesia utilizing single dose succinylcholine for muscle relaxation. The anesthetic was otherwise uneventful except for what appeared to be a prolonged emergence from anesthesia. Ulnar nerve train-of-four (TOF) was assessed and demonstrated significant fade. Anesthesia was immediately re-instituted and 5 hours later the patient had strong TOF and was extubated successfully. Immediately following her procedure, her BChE activity was 1089 U/L (normal=1800-6600 U/L). Five weeks following her procedure, her BChE activity was 1590 U/L and her DN was 82 (normal=70-90). No other reasons for decreased BChE activity could be identified.

The normal allele for BChE is designated "U". Those with a UU genotype have normal BChE activity and DN. The most common mutation is the atypical (or "A") allele and those with an AA genotype have reduced BChE activity and DN. Other alleles exist that can result in decreased BChE activity with a normal DN. One such allele is the silent (or "S") allele where a frameshift mutation results in a stop codon and failure of synthesis of BChE. Thus, those with an SS genotype do not produce BChE. However, individuals with a US genotype have reduced BChE synthesis of a structurally normal BChE. Individuals with a US genotype would have reduced BChE activity with a normal DN such as what was observed in our patient. Clinicians should be aware that some BChE mutations can result in impaired metabolism of succinylcholine in the setting of a normal DN.

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Abstract #: T-72

Effects of preoperative gum chewing on sore throat after general anesthesia with a supraglottic airway device: a randomized controlled trial

Presenting Author: Tingting Wang

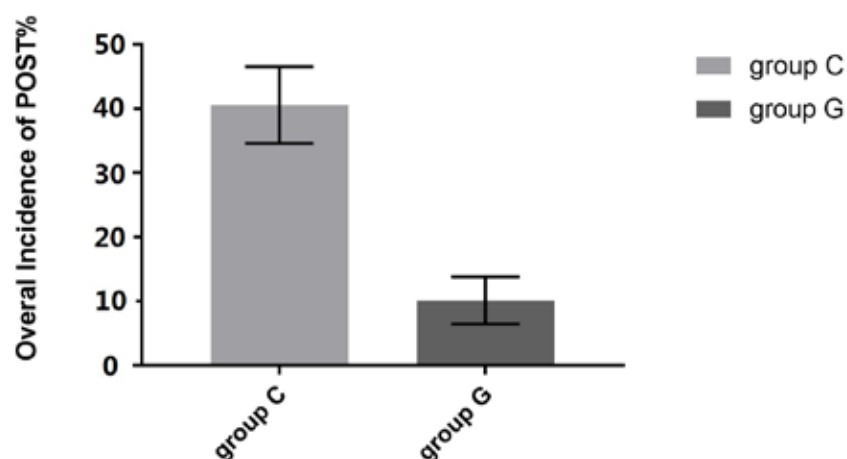
Presenting Author's Institution: Obstetrics & Gynecology Hospital, Fudan University

BACKGROUND: Postoperative sore throat (POST) is not uncommon after general anesthesia with a supraglottic airway (SGA) device. Although it was reported that some pharmacological and nonpharmacological measures can reduce POST, because of limitations and variable success rates, we need to find a simpler and more effective way to alleviate POST.

METHODS: This prospective, observer-blinded, randomized controlled study enrolled 140 patients who required general anesthesia administered via a streamlined liner of the pharyngeal airway (SLIPA™) for < 60 minutes. They were randomly divided into the gum (group G, n=70) and control (group C, n=70) groups. Before the induction of general anesthesia for 5-10 min, the patients in group G chewed gum for 2 minutes. Group C was asked to swallow twice without any additional treatment. A standard anesthesia protocol was followed. The incidence and severity of sore throat were assessed up to 24 h postoperatively. The primary outcome was the incidence of POST numerical rating scale (NRS) scores > 3 within 24 h after surgery, and the secondary outcomes included the POST (NRS) scores 2, 6 and 24 h after surgery.

RESULTS: The incidence of moderate/severe POST (NRS >3) within 24 h after surgery was significantly lower in group G (10.1%, 7/69) than in group C (40.6%, 28/69) (odds ratio 0.386, 95% CI 0.153-0.976, P=0.044). The median (interquartile range [range]) scores at 2, 6, and 24 h after anesthesia in group G were lower than those in the control group at the same times (2 h: 0(0-3[0-4]) vs. 3(0-3[0-6]), P=0.048; 6 h: 0(0-3[0-6]) vs. 2(0-4[0-6]), P=0.048; 24 h: 0(0-1[0-7]) vs. 0(0-2[0-6]), P=0.011). There were 14 patients (20.3%, 14/69) in group G who had blood stains on the SGA device, which was significantly lower than the number in group C (37.7%, 26/69) (P=0.024). In patients with bloody SGA devices, the incidence of POST scores > 3 was significantly lower in group G (14.3%, 2/14) than in group C (73.1%, 19/26) (P< 0.001), while there was no significant difference between the two groups in the incidence of POST score > 3 in patients without bloody SGA devices (group G: 9.1%, 5/55; group C: 20.9%, 9/43; P = 0.145).

CONCLUSIONS: preoperative gum chewing can effectively prevent the occurrence of POST after hysteroscopic surgery with the SLIPA™, which is conducive to the postoperative recovery of patients. That such a simple, inexpensive, and low-risk prophylactic intervention effectively prevents a common and annoying complication of SGA device insertion is remarkable and seems well worth implementing in routine clinical practice.



Abstract #: T-73

Anesthetic management practices for patients with placenta accreta spectrum disorder: A qualitative survey

Presenting Author: Christine Warrick, M.D.

Presenting Author’s Institution: University of Utah

Co-Authors: Alexander J. Butwick, MBBS, FRCA, MS - Stanford University School of Medicine

Introduction: Consensus is lacking regarding optimal anesthetic practices for women with suspected placenta accreta spectrum (PAS) disorder requiring planned cesarean hysterectomy (c-hyst). The aim of this survey was to examine current anesthetic practices for these surgeries.

Methods: With IRB approval, a web-based survey was sent to 10 senior obstetric (OB) anesthesiologists based at academic centers where women with suspected PAS undergo delivery hospitalization. Questions were related to surgical location, staffing, invasive line placement, pharmacologic adjuncts, postoperative care and analgesia. Descriptive data are presented as median (range), and percentages, with sum totals >100% if appropriate.

Results: The survey response rate was 100%. The median hospital-specific c-hyst rate was 4 (1-10) per month; with 2 (0-6) scheduled and 1 (0-3) unscheduled. Data for surgical locations and staffing coverage are presented in Table. The most common surgical location was the main operating room, with care provided in all cases by an attending (100%) and fellow (80%) OB anesthesiologist. A minority of hospitals involve a CRNA (20%) or non-OB anesthesiologist (20%) in these cases. Perioperative checklists are utilized by 40% of respondents. All respondents perform neuraxial blockade, with 60% converting to general anesthesia (GA) after delivery. For suspected percreta, 40% respondents use GA for the entire case. All respondents use at least 2x18G IV cannulas and an arterial line, with 40% using a central line. Most respondents use oxytocin (90%) and tranexamic acid (70%) as pharmacologic adjuncts. During active bleeding, 60% use a fixed ratio transfusion approach. TEG or ROTEM and TEE or TTE are used at 70% and 20% centers, respectively. Most (70%) respondents use a transversus abdominis plane (TAP) or quadratus lumborum (QL) block postoperatively, and 50% use postoperative epidural analgesia via an epidural catheter placed prior to surgery. Postpartum disposition varies across all centers, with 50% having 1 specific location (20% postpartum floor; 20% L&D unit and 10% ICU) and 50% using more than 1 location (including ICU in all centers).

Discussion: Our results suggest that women with PAS undergoing c-hyst are receiving appropriately skilled care from OB anesthesiologists, with neuraxial blockade as a key component of anesthetic care. However, several aspects of postpartum analgesia and care deserve attention.

More respondents use fascial plane blocks than epidural postoperative analgesia, and postpartum disposition varies across hospitals. Research is needed to identify optimal anesthetic and postoperative analgesic practices and appropriate locations for postoperative care.

Table. Characteristics of hospitals that perform cesarean hysterectomies for women with suspected placenta accreta syndrome

	Number of hospitals (%)
Surgical location:	
Main operating room	6 (60%)
Labor and delivery unit	4 (40%)
Hybrid operating rooms	3 (30%)
Staff for each case:	
Attending obstetric anesthesiologist	10 (100%)
Obstetric anesthesia fellow	8 (80%)
Anesthesia resident	7 (70%)
CRNA	2 (20%)
Non-obstetric anesthesiologist	2 (20%)

Abstract #: T-74

Evaluation of the Implementation and Compliance with Institutional Tranexamic Acid Administration Policy for Postpartum Hemorrhage

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Presenting Author's Institution: Weill Cornell Medicine - New York, New York

Co-Authors: Sarah Wu - Weill Cornell Medicine

Background: After the publication of the WOMAN trial results in 2017, tranexamic acid (TXA) use in postpartum hemorrhage treatment became more widespread. In March 2018, after multi-disciplinary approval, our institution introduced a TXA for postpartum hemorrhage (PPH) guideline. This guideline approved usage for PPH greater than 1500 mL of estimated/quantitative blood loss or clinically significant blood loss of lesser amounts (in addition to prophylactic indications). Education of all involved staff was done via live information sessions, emails, and physical reminders.

Material and Methods: Electronic chart review was conducted on all anesthetic records on the Obstetric service from March 2018 to present. Cases were identified with blood loss at or greater than 1500 mL. Compliance with guideline was measured as a percentage of these hemorrhages that met the trigger value in which TXA was actually administered. The compliance was measured monthly and a timeline was created with time points of education (live, electronic, physical reminders). The total number of PPH was also examined before and after the initiation of the guideline. Finally, blood product administration was compared as a percentage of deliveries before and after guideline roll-out.

Results: Compliance increased over time. Compliance was highest at time periods of live education (daily board rounds, Obstetrics Grand Rounds, Anesthesiology Departmental meetings) and lowest during times when electronic education was used solely (email). Since March 2018, there has been an overall modest decrease in percentage of deliveries with PPH. The percentage of patients on postpartum receiving blood products has decreased over the same time period.

Discussion: Live education was the most effective method of improving compliance with our guideline. Our institution has had an overall decrease in both percentage of PPH occurring and a decrease in blood product use postpartum. The guideline trigger for administration of TXA was much higher for our guideline than triggers used in WOMAN trial and others. Since there were no adverse events in our institution related to TXA, a decrease in the trigger value (or establishing different triggers for vaginal and cesarean deliveries) would be expected to decrease hemorrhage further.

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Abstract #: T-75

Enhancing Efficacy of Spinal Anesthesia in a LMIC Through Education and Standardization: A Quality Improvement Study

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Stander Sally, MD - UNC Hospitals

Introduction: Spinal anesthesia is used in low-income countries for patients undergoing obstetric/gynecologic operations to decrease the number of patients requiring general anesthesia (GA)¹. Anesthesia clinical officers (ACOs) at Kamuzu Central Hospital (KCH) in Lilongwe Malawi had a high rate of spinal failure requiring conversion to GA (0.8-4.9% in high-income countries)². This study's purpose was to decrease failed spinal numbers in OB/GYN patients at this low-resource hospital through education and procedural standardization.

Methods: Through this IRB approved study, 18/18 ACOs at KCH collected pre-intervention (pre) data from 2/2018-1/2019 on de-identified patients undergoing OB/GYN operations. A protocol was developed to standardize spinal anesthesia. The ACOs participated in an educational didactic, then collected data until 7/2019. Results were analyzed using SAS software version 9.4. Variables analyzed were: number of spinal attempts, number of providers required, successful spinals (free flow of CSF in the introducer needle), working spinals (no additional analgesia), complications, and spinal dose. Variables were compared using the two-tailed independent sample t-test or Chi-square test. A p-value < 0.05 was considered statistically significant.

Results: There were 174 patients pre and 286 patients post-intervention (post). There was a statistically significant decrease in number of spinal attempts (1.55 pre vs 1.33 post, p-value 0.002) and increase in spinal success rate (93.3% pre vs 98.6% post, p-value 0.006). Use of a standardized dose of spinal bupivacaine was similar (53.5% pre, 55.6% post, p-value 0.56). There was no statistical significance in spinals that worked (92.5% pre vs 96.5% post, p-value 0.058). Pre, 8.1% of patients had complications vs 10.4% post (p-value 0.407). Pre, >1 provider was required in 13.3% of cases vs 7% post (p-value 0.002).

Discussion: Spinal anesthesia standardization and ACO education increased spinal success rate. Didactics increased the likelihood of a successful spinal and decreased the number of providers needed. There was no improvement in spinal use as the sole anesthetic possibly due to the lack of use of the standardized bupivacaine dose; 7.5-10mg of bupivacaine is used due to the concern for high spinal because of the lack resources. Limitations included no collection of surgery type nor emergent vs elective and hypotension was not defined. The protocol included a liter of crystalloid prior to the spinal to minimize hypotension; this was inconsistently performed.

Conclusion: Spinal anesthesia standardization and ACO education can increase spinal success rate for OB/GYN operations in low-resource hospitals.

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Abstract #: T-76

Multifactorial peripartum headache, not all causes are benign: a case report

Presenting Author: Jatturong Wichianson, MD

Presenting Author's Institution: Harbor-UCLA Medical Center

Co-Authors: Quy Tran, MD - Harbor-UCLA Medical Center

Sydney Yee, MD - Harbor-UCLA Medical Center

Introduction: Post-dural puncture headache (PDPH) is a known complication of epidural catheter placement for labor analgesia. However, not every headache in the peripartum period is a PDPH, even in the setting of a known dural puncture. Given that the differential diagnosis for PDPH includes potentially life-threatening conditions, providers must be vigilant in cases of unremitting postpartum headache despite conventional treatments.

Case Presentation: We present a case of a 32 year-old female patient with a past medical history of morbid obesity with a BMI of 57 kg/m² at 33 and 4/7 weeks of gestation, who presented to the high-risk OB clinic for routine care. She had sustained systolic pressures in the 190s mmHg, and was admitted to the labor and delivery ward for observation and blood pressure control.

On hospital day 3 the decision was made to proceed with a cesarean delivery. During placement of an epidural catheter the patient had inadvertent dural puncture with an 18G Tuohy needle. A 20G intrathecal catheter was threaded and once an adequate level was obtained, the surgeons proceeded with cesarean section, which was uneventful.

On postpartum day 1, the patient complained of a positional headache and was counseled regarding management options. She proceeded with an epidural blood patch (EBP) with 15ml autologous blood 36 hours after delivery with resolution of symptoms. Throughout her postpartum course, her pressures remained elevated with SBP in the 150-170s mmHg range. On PPD 4, she continued to complain of a positional headache and received a second EBP with 20ml of autologous blood. Post procedure she had minimal relief of her headache. Physical exam did not reveal any neurological deficit or change in mental status. A CT scan demonstrated diffuse brain edema with slit like ventricles and a paucity of sulci. She was restarted on magnesium and aggressive blood pressure management. The patient had complete resolution of her headache and discharged on PPD7.

Discussion: This case illustrates the importance of close evaluation and follow-up of patients complaining of postpartum headaches refractory to conventional treatment modalities, such as epidural blood patches. Headache in the postpartum period is a common complaint with an incidence ranging from 11-80%. While typically benign, some causes of postpartum headache can be life-threatening and include posterior reversible encephalopathy syndrome (PRES), cerebral venous thrombosis, intracranial hemorrhage, and intracranial lesions and is important to rule out these conditions when managing cases of postpartum headache. This case demonstrates that peripartum headaches can be multifactorial and emphasizes the importance of assessing the entire clinical picture of each patient. When a patient does not have the expected clinical response to management, it is advisable to evaluate for other causes.

Abstract #: T-77

Overcoming healthcare disparities and improving maternal usage of neuraxial analgesia in an underserved community

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Presenting Author's Institution: Harbor-UCLA Medical Center

Co-Authors: Quy Tran, MD - Harbor-UCLA Medical Center

Sydney Yee, MD - Harbor-UCLA Medical Center

Introduction: Labor and childbirth is considered by many to be one of the most painful experiences of a woman's life. Of the pain management modalities in use today, neuraxial analgesia is the most effective in managing labor pain, while also having the most favorable side effect profile on the mother and neonate. Unfortunately, disparities exist in the obstetric patient population, as reflected by lower rates of neuraxial analgesia in non-Caucasian and Medicare patients. As a county hospital with a majority of our patients falling into these categories, we have an unusually high rate of neuraxial analgesia. Here we present demographic information, usage data of anesthetic services, and hypotheses on possible reasons for increased use of neuraxial analgesia at our hospital, which could be easily and cost-effectively replicated at other institutions. **Methods:** The California Maternal Quality Care Collaborative (CMQCC) database and an institutional Department of Anesthesia internal database were used to analyze the patient population between 01/01/2016 and 12/30/2018 with a total of 2488 parturients.

Results: The demographics of the HUMC patient population are as follows: Hispanic 61%, African-American 22%, Caucasian 7%, Asian 9% and Other/Not Specified 2%. Payer status: Medicaid 92%, Private 3%, Self Pay 3%, Other 3%. Age < 20: 7%, 20-29: 54%, 30-39: 34%, >40: 5%. Pre-pregnancy BMI: < 25: 39%, 25-29: 30%, >30 31%. 91% of patients received neuraxial anesthesia and our rate of nulliparous, term, singleton, vertex cesarean sections dropped from 32% in 2015 to 17% in 2018.

Conclusion: Historically, African American and Hispanic women receive neuraxial anesthesia at a rate of 35-50% compared to Caucasian women (60%)¹. At our institution, neuraxial anesthesia is placed in >90% of parturients. We propose several steps to improve the usage of neuraxial analgesia in high-risk and underserved patient populations: 1) Women should be counseled early in their pregnancy regarding neuraxial analgesia or early during their labor; 2) Material to educate patients need to be accessible according to their preferred language and level of education. The usage of video consents may mitigate literacy barriers; 3) Anesthesia should be integrated into the care team model, participating in sign outs and having open communication with nursing staff and obstetricians regarding complex patients. Careful notice should be taken to patients with a high risk of conversion to cesarean delivery and early placement of epidural should be encouraged. We believe that these simple steps can decrease health disparities with regards to neuraxial analgesia which can have downstream effects of decreasing maternal morbidity and mortality.

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Abstract #: T-78

Post Cesarean Section (C/S) Decompensation in a Parturient with Acute Peripartum Cardiomyopathy (PPCM) and Superimposed Preeclampsia with Severe Features

Presenting Author: Menachem Yondorf

Presenting Author's Institution: Thomas Jefferson University Hospital

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Introduction: PPCM is characterized by LV dysfunction in the last month of pregnancy or within 5 months of delivery w/o identifiable cause or prior heart disease (1). Risk factors include gestational HTN/preeclampsia, multiparity, AMA, multi-fetal pregnancy, and AA race. We describe a parturient with acute PPCM and preeclampsia who suffered worsening heart failure after C/S.

Case: A 22 year old G1P0, at 34 5/7 wks, presented after 2 weeks of SOB, fever, chills, cough, and diarrhea. PMH included gestational HTN, obesity, GERD, and palpitations 4 years prior. CTA showed cardiomegaly and pulmonary edema. BNP, UPC, and BP were elevated making a diagnosis of severe preeclampsia. Hydralazine and magnesium were started. TTE demonstrated EF 20%, global hypokinesis, dilated LA, MR, LV enlargement and PAP 29 mmHg, confirming PPCM. Fetal US showed IUGR with decreased end-diastolic flow. PA and arterial catheters were placed and with multidisciplinary guidance, IOL in the CVICU was started. Eight hours after epidural initiation, a prolonged FHR deceleration prompted urgent C/S. The epidural was dosed rapidly and the C/S proceeded. Furosemide was given at cord clamp, but postoperatively, our patient required intubation for worsening pulmonary edema. She was extubated 3 days later after aggressive treatment (bumetanide, nitroglycerin). Prior to D/C, she was fitted for a wearable cardioverter-defibrillator.

Discussion: Early signs/sx of heart failure in a parturient can be obscured by normal physiologic changes of pregnancy. Treatment aims to reduce afterload, preload, and increase contractility. After delivery, a 60-80% increase in CO from uterine auto-transfusion may cause pulmonary edema and complicates management. Our patient was further challenged by the cardiovascular alterations of preeclampsia; multidisciplinary planning was crucial. Vaginal delivery is preferred, but requires hemodynamic monitoring and effective labor analgesia to reduce sympathetic outflow and catecholamines (2). The 2nd stage of labor should be assisted by forceps or vacuum, as valsalva with pushing increases afterload. RA is chosen for C/S; GA is reserved for emergencies or if RA is contraindicated. A titrated epidural or CSE is desired as single-shot spinal may cause rapid sympathetic blockade and hemodynamic instability (3). Post C/S fluid shifts can worsen heart failure; diuresis and limiting intraoperative fluids are essential. Some also suggest using nitroglycerin/nitroprusside to decrease filling pressures (4) and adding inodilators (5).

Conclusion: Worsening heart failure after C/S in a parturient with PPCM and preeclampsia must be anticipated. In addition to epidural anesthesia, judicious fluid replacement, diuresis, and inodilator use may help prevent decompensation.

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Abstract #: T-79

Management of a Parturient with Impending Herniation from a Cerebellar Hemangioblastoma

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Introduction: Although guidelines exist on management of neurosurgical procedures in the parturient, decision making in urgent procedures are less well defined¹. These situations require detailed risk assessment for the timing of delivery and neurosurgical intervention relative to potential maternal/fetal morbidity. Maternal intracranial dynamics assessment should account for lesion location and vascularity, non-communicating hydrocephalus, and symptomatic increase in ICP². We present a multidisciplinary plan for a challenging case of an urgent pre-term cesarean delivery (CD) to facilitate an urgent decompressive craniotomy due to impending tonsillar herniation in a parturient with Von Hippel Lindau Syndrome (vHLS).

Case Presentation: The patient is a 23 yo G1P0 at 34 wga with PMH of vHLS c/b right cerebellar hemangioblastoma. She underwent first trimester evaluation by neurosurgery and MFM for surveillance of the cerebellar lesion, with concern for potential enlargement during pregnancy. Patient was lost to follow-up until 34 wga when she presented with progressive neurological symptoms including headache and gait instability. MRI revealed a significantly increased cerebellar lesion, from 1.9x1.6x1.3 cm to 4.6x4.8x2.9 cm with hydrocephalus and tonsillar herniation.

A multidisciplinary discussion between neurosurgery, obstetric anesthesia, and MFM was held. As tonsillar herniation indicated urgent resection, and fetal/maternal well-being was confirmed, a staged procedure was agreed upon. Given the fetal gestational age relative to tenuous maternal intracranial dynamics, a controlled CD was planned before the urgent craniotomy. Anesthetic concerns included intraoperative lesion rupture or a critical herniation event. GA was utilized to mitigate dangerous changes in ICP due to the vascularity of the lesions and its mass effect. Precautions were taken to avoid increases in ICP during induction, maintenance, and emergence from GA. CD occurred without complications and the patient was transferred to ICU neurologically intact. A craniotomy was performed at 48h post-partum to allow for a degree of normalization of maternal physiology.

Discussion: Performing neurosurgery in a pregnant woman is rare but occasionally unavoidable. Although guidelines exist to conduct anesthetic care, the interplay between neurosurgical intervention, delivery and anesthetic management is challenging. In the scenario where CD is performed prior to resection of an unsecured intracranial lesion, fetal well being, mode of delivery, maternal intracranial dynamics and comorbidities should be considered. We present a case in which a multidisciplinary team developed and executed an individualized plan for a parturient requiring staged urgent CD and urgent neurosurgical intervention.

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Abstract #: T-80

Acquired Hypofibrinogenemia in Obstetric Hemorrhage

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Introduction: Severe obstetric hemorrhage remains a major cause of maternal morbidity and mortality. In severe obstetric hemorrhage fibrinogen falls to critically low levels.¹ Fibrinogen levels as low as 200-300 mg/dl and the rotational thromboelastometry parameter (ROTEM) FIBTEM may predict the progression to severe obstetric hemorrhage.² However the clinical characteristics of patients with clinically significant acquired hypofibrinogenemia with a major obstetric hemorrhage have not been well characterized. The objectives of this project were to: 1) to describe the clinical characteristics of patients who have acquired hypofibrinogenemia and 2) estimate the correlation between fibrinogen measured and ROTEM parameters in patients experiencing an obstetric hemorrhage.

Methods: This IRB approved retrospective observational study included women who experienced a hemorrhage managed with an obstetric hemorrhage massive transfusion protocol (OB-MTP) from September 2012 to May 2018. We collected data on patient demographics, hemorrhage etiology, transfusion practices, obstetric outcomes and laboratory data measured at OB-MTP activation who had an initial fibrinogen level ≤ 250 mg/dl. Patients were then subdivided into 3 groups: fibrinogen 200-250 mg/dl, 151-199 mg/dl and ≤ 150 mg/dl. Data were summarized using descriptive statistics and Pearson's correlation was used to assess the correlation between fibrinogen and ROTEM parameters.

Results: Of the 155 patients with an OB-MTP activation 53 (34%) patients had fibrinogen ≤ 250 mg/dl and the demographic, clinical and transfusion data are described in the table. The median gestational age was lowest in the patients with fibrinogen levels ≤ 150 mg/dl. Uterine atony, placental abruption and coagulopathy were the leading causes of hemorrhage in the patients with fibrinogen levels ≤ 150 mg/dl. The median(IQR) units of PRBCs transfused in each group was: ≤ 150 mg/dl – 4.0 (2.0,6.0), 151-199 mg/dl – 4.0 (3.0, 6.0) and 200-250 mg/dl – 2.5 (1.5, 4.0). Sixty-five percent, 100% and 95% of patients progressed to severe hemorrhage in the fibrinogen 200-250 mg/dl, 151-199 mg/dl and ≤ 150 mg/dl groups respectively. Laboratory data are also presented in the table. Fibrinogen at OB-MTP activation correlated with FIBTEM A10 [correlation coefficient (95% CI) = 0.65 (0.48, 0.77)], A20 [0.65 (0.48, 0.77)], EXTEM alpha angle [0.79 (0.67, 0.86)], A10 [0.79 (0.68, 0.87)] and A20 [0.79 (0.67, 0.86)] measured at the same time points.

Conclusion: Acquired hypofibrinogenemia during obstetric hemorrhage is associated with an increased likelihood of progression to severe hemorrhage. Given the moderate to strong correlation of ROTEM data with fibrinogen levels, combining clinical and laboratory data at the early stages of an obstetric hemorrhage may be used for risk stratification of patients at risk of progression to severe hemorrhage.

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Abstract #: T-80

Clinical Characteristics			
Parameters	≤ 150 mg/dl (N=20)	151 – 199 mg/dl (N=13)	200 – 250 mg/dl (N=20)
Maternal Age (y)	32.00 [25.75, 38.50]	34.00 [28.00, 36.00]	32.50 [29.75, 36.75]
Gestational Age (weeks)	32.50 [26.67, 36.75]	39.00 [37.30, 40.70]	37.75 [35.68, 39.90]
Race/Ethnicity			
Hispanic	5 (25.0%)	0 (0.0%)	6 (30.0%)
Non-Hispanic Black	8 (40.0%)	5 (38.5%)	6 (30.0%)
Non-Hispanic White	6 (30.0%)	2 (15.4%)	7 (35.0%)
Other	1 (5.0%)	6 (46.2%)	1 (5.0%)
BMI (kg/m ²)	30.94 [25.50, 33.35]	28.30 [23.80, 33.90]	29.45 [26.05, 33.89]
Mode of Delivery			
Vaginal	5 (25.0%)	1 (7.7%)	6 (30.0%)
Cesarean	15 (75.0%)	12 (92.3%)	14 (70.0%)
2 nd Line Uterotonics Administered	75.0%	84.6%	80.0%
Transfusion Data			
PRBCs given	4.0 (2.0, 6.0)	4.0 (3.0, 6.0)	2.5 (1.5, 4.0)
Tranexamic Acid Given	65.0%	46.2%	60.0%
Fibrinogen Concentrate Given	40.0%	23.1%	35.0%
Total Blood Products given ≥ 4 units	90.0%	92.3%	45.0%
Total Blood Products given ≥ 8 units	60.0%	61.5%	35.0%
Etiology of Hemorrhage			
Uterine Atony	9 (45.0%)	7 (53.8%)	13 (65.0%)
Abnormal Placentation	1 (5.0%)	3 (23.1%)	4 (20.0%)
Placental Abruption	9 (45.0%)	2 (15.4%)	1 (5.0%)
Coagulopathy	11 (55.0%)	1 (7.7%)	2 (10.0%)
Laboratory Data			
Hemoglobin (g/dl)	7.3 [6.4, 7.9]	7.3 [6.6, 8.3]	8.8 [8.0, 10.3]
Platelet Count X10 ⁹ /L	118.0 [95.0, 147.0]	154.0 [129.0, 185.0]	137.5 [117.0, 168.5]
PT(s)	16.9 [13.2, 18.3]	12.4 [12.0, 13.0]	11.8 [11.5, 13.0]
aPTT(s)	34.7 [29.3, 40.1]	31.8 [28.2, 33.6]	27.3 [26.0, 31.8]
Fibrinogen (mg/dl)	96.5 [63.0, 115.8]	174.0 [159.0, 190.0]	234.0 [214.5, 238.5]
FIBTEM Amplitude at 10 min (mm)	4.0 [3.0, 6.5]	9.0 [8.3, 11.3]	12.0 [11.0, 14.0]
FIBTEM Amplitude at 20 min (mm)	5.5 [3.0, 8.3]	10.0 [9.0, 13.0]	13.0 [11.0, 15.0]
EXTEM Alpha Angle (°)	43.0 [30.0, 60.0]	67.0 [65.0, 68.0]	70.0 [64.0, 72.0]
EXTEM Amplitude at 10 min (mm)	29.5 [19.8, 37.5]	51.0 [47.3, 52.5]	53.0 [48.0, 55.0]
EXTEM Amplitude at 20 min (mm)	43.0 [28.0, 54.0]	58.0 [51.0, 60.0]	60.0 [56.0, 61.0]

Table Characteristics of patients with acquired hypofibrinogenemia during an obstetric hemorrhage

Data are N(%), Median (2⁵th quartile , 7⁵th quartile)

Abstract #: T-81

Labor Epidural Analgesia Using Moderately High Concentrations of Plain Local Anesthetics versus Low Concentrations of Local Anesthetics Combined with Opioids: A Systematic Review and Meta-analysis

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The combination of low concentrations of local anesthetics with opioids is currently the standard mixture for labor epidural analgesia. However, this combination exposes parturients to opioids and increases opioid-induced side effects.

The definition of low concentrations of local anesthetics is $\leq 0.1\%$ bupivacaine, $\leq 0.1\%$ levobupivacaine, or $\leq 0.17\%$ ropivacaine. Previous studies suggested that compared to low concentrations of local anesthetics, high concentrations of local anesthetics increased the risk of assisted vaginal delivery. However, this suggestion was based on the comparison of low concentrations of local anesthetics with different high concentrations of local anesthetics. Some studies found that plain local anesthetics at a moderately high concentration, e.g., $\leq 0.125\%$ bupivacaine, $\leq 0.125\%$ levobupivacaine, or $\leq 0.2\%$ ropivacaine, did not increase the risk of assisted vaginal delivery while providing adequate labor epidural analgesia. We carried out a systematic review and meta-analysis to investigate if the above findings were consistent among all available studies (The registration number with PROSPERO: CRD42019145888).

There are nine randomized controlled trials (RCTs) with a total of 1334 participants that compared moderately high concentrations of plain local anesthetics versus low concentrations of local anesthetics combined with opioids. Meta-analysis of these nine trials showed no differences in the incidence of assisted vaginal delivery or Cesarean delivery between these two groups. The incidence of motor block was higher in the group of moderately high concentrations of plain local anesthetics, while the incidence of pruritis was higher in the group of low concentrations of local anesthetics with opioids. The analgesia efficiency and patient's satisfaction level were comparable between the two groups.

In conclusion, this meta-analysis suggested moderately high concentrations of plain local anesthetics can be considered as a suitable alternative for the common mixture of low concentrations of local anesthetics with opioids.

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Abstract #: T-82

Maternal Outcomes After Blood Transfusion During Hospitalization for Delivery at a Tertiary Care Hospital

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Introduction: Postpartum hemorrhage is a major complication of obstetrics. Blood transfusion is activated in response to acute bleeding. Few studies have been done studying the newborn outcome post-blood transfusion in postpartum hemorrhagic deliveries. In our study, we examined a tertiary care hospital's experience with patients who had received massive blood transfusion due to postpartum hemorrhage.

Method: The research team obtained a list of patients who have blood transfusion due to postpartum hemorrhages between 2009 and 2019. Each medical record was examined for maternal outcomes up to 30 days post blood transfusion. A retrospective record review is completed to review demographics, comorbidities, the indications, amount and type of blood products given, newborn outcomes (ie. APGAR scores, breastfeeding, NICU admission, intrauterine fetal demise), length of stay, re-hospitalization rates, in hospital complications and death.

Results: In total 102 patients underwent blood transfusions. The averages age was 27.5, length of stay was 4.82 days, and RBC transfused 656 mL. About 11 of those patients were re-hospitalized within 30 days of discharge. Roughly 18 patients had in-hospital complications s/p transfusion

Discussion: Breastfeeding has benefits for both maternal and infant health and is mostly encouraged as part of the early infant care. In our study, 28.6% of the newborn whose mother received blood transfusion were breastfed. A previous study found that blood transfusion for postpartum hemorrhage was associated with a lower rate of breastfeeding, comparing to the non-transfused group. This result was adjusted for clinical and demographic factors. If the breastfeeding rate is calculated for the non-transfusion group, the comparison can be made with data from previous studies. The average Apgar score at 1 minute is low for the newborn whose mother received MTP, but by 5 minute the average Apgar was normal. This is often seen in newborns whose mother did not receive any blood transfusion. Also in a study by Oya et al, the Apgar score was found not associated with the incidence of blood transfusion.

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Abstract #: T-83

Maternal Preeclampsia Hemodynamic Characteristics During Cesarean Delivery After Spinal Anesthesia with Ropivacaine

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BACKGROUND: There are very limited research data on maternal preeclampsia hemodynamic changes associated with spinal anesthesia induced by ropivacaine during cesarean delivery.

AIM: The aim of this study was to record and analyze the hemodynamic data in women with preeclampsia undergoing cesarean delivery after spinal anesthesia induced by ropivacaine.

METHODS: Ten eligible women with preeclampsia were enrolled in this prospective observational study. Spinal anesthesia was performed with 2.4ml 0.5% ropivacaine. All participants received routine noninvasive monitoring, central line for central venous pressure (CVP) and FloTrac/Vigileo™ monitor for CO and other hemodynamic parameters. Hemodynamic changes were analyzed at several key time points. The hemodynamic responses to vasopressor interventions and uterotonic agents, and maternal and neonatal outcomes were also observed.

RESULTS: Stable hemodynamic trends were observed in this study (table 1). Cardiac output (CO) and stroke volume (SV) increased mildly during surgery. In contrast, mean arterial pressure (MAP) and systemic vascular resistance (SVR) showed a moderate decrease from induction until the end of surgery. CVP increased obviously after delivery. Oxytocin administration was associated with the most significant hemodynamic fluctuations during surgery, when a profound decrease in MAP and SVR was observed, accompanied by an increase in CO and heart rate (HR). Phenylephrine intervention was only required in three patients, and caused an increase in MAP and SVR with a decrease in HR, SV and CO. The average time from induction of spinal anesthesia to skin incision was 11.9 ± 3.1 min, and to the end of surgery was 57.9 ± 10.7 min. The average blood loss was 430 ± 141.8 ml, and the average infusion volume was 510 ± 137 ml. No maternal and neonatal complications were observed during this study, except temporary episodes of hypotension.

CONCLUSION: Intrathecal low dose ropivacaine produces satisfactory anesthesia in cesarean delivery, and brings stable hemodynamics in preeclampsia patients. Based on the trends of hemodynamic changes during the whole surgery, a large amount of fluid preload and prophylactic vasopressors intervention before anesthesia induction to prevent hypotension maybe not necessary in such patients. Careful cardiovascular monitoring is still recommended, particularly after the delivery of fetus and the use of oxytocin.

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Abstract #: T-83

Table 1 Main hemodynamic variables by time intervals for all patients (mean +/- SD) (n=10).

Time points	CO		CVP		HR		MAP		SV		SVR	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
T1	7.2	0.8	6.7	4.7	84.6	18.8	115.9	17.9	86.5	18.1	1233.7	246.1
T2	6.7	1	7.8	5.7	84.7	16.6	117.6	16.7	81.4	23.1	1336.3	321.5
T3	7	0.9	8.4	4.5	86	14.6	110.6	14.5	84.6	23.9	1183.3	242.3
T4	7.5	0.9	8.7	6.1	84.6	14.8	113.2	21.6	91.1	22.5	1133.9	277.6
T5	7.6	1.2	8.4	5.2	81.9	15.6	108.5	19.8	93	23.7	1081.2	285.8
T6	7.5	1	8.5	5.1	84.3	18.1	108	18.1	92.7	25.4	1077.5	250.4
T7	7.5	1	8.3	5	83.3	13.9	107.5	20.2	91.1	24.7	1078.3	256.1
T8	7.3	1.2	8	3.7	82.1	17.1	107.6	20.5	91.8	24.2	1129.9	397.1
T9	7.3	1.5	9.8	4.3	80.9	16.2	100.2	21.5	93.5	27.2	1031.1	268.3
T10	7.2	1.8	10.2	4.4	81.7	12.1	101.5	21.5	90.7	28.2	1072.8	319.9
T11a	8.6	1.7	9.2	4.5	96.3	10.8	91.3*	20.8	91.4	19	807.5*	280.9
T11b	7.9	1.2	10.7	3.9	88.2	11.6	97.5	19.1	89.6	19	893.6	189.8
T11c	8	1	9.5	3.4	87	12.3	94.8	22.3	93.6	18.1	856.0*	202.1
T12	7.4	1.3	8.2	3.5	80.9	16	98.8	12.5	94.2	26.2	1008.1	211.9

CO, cardiac output;

CVP, central venous pressure;

HR, heart rate;

MAP, mean arterial pressure;

SV, stroke volume;

SVR, systemic vascular resistance;

SD, standard deviation.

* Significant difference from baseline values ($P < 0.05$).

Abstract #: T-84

Epidural labor analgesia in a parturient with dwarfism: A case report

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Background: Parturient with short stature could become a challenge to anesthesiologists. Few literatures are available to guide the labor analgesia management for parturients of dwarfism.

Case Report: A 30-year-old woman, G1P0, was admitted into our hospital at 32 weeks gestation with fetal demise. She was a pituitary dwarfism (120cm/60kg) with normal intelligence, and her husband was an achondroplastic dwarfism. She was noted with fetal congenital achondroplasia and lethal dwarfism, based on the finding of fetal whole exon gene test and the results of fetal ultrasound and magnetic resonance imaging (MRI). A multidisciplinary consultation was conducted, and labor epidural analgesia was planned. Compared to the body trunk, the patient had short lower limbs and short neck. No pre-existing cardiorespiratory dysfunction and neurological abnormalities were found. However, MRI revealed the termination of the spinal cord was at the upper edge of L4 vertebral body. We identified L2-3 and L3-4 intervertebral space by ultrasound. A 19-gauge epidural catheter at L2-3 intervertebral space in the left lateral decubitus position. Labor analgesia was started using patient-controlled epidural infusion of 0.09% ropivacaine with 0.45ug/ml sufentanil at 1ml/h and patient-controlled bolus of 5ml with 15min lockout interval. Our staff evaluated her pain score every half an hour and adjusted the pump settings. Unfortunately, vacuum-assisted vaginal delivery failed. Decision was made to transfer the patient to the operating room to remove the fetus by destruction procedure under general anesthesia. The whole operation lasted 90 minutes with no intraoperative or postoperative complications.

Conclusion: Given the complexity and variety of presentations of dwarfism, multi-disciplinary based care is essential and critical to the care of such patient.

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Abstract #: T-85

Maternal, neonatal and surgical outcomes for placenta previa with or without history of cesarean delivery

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Background: Placenta previa is associated with increased morbidity and mortality for both mother and fetus. The aim of this study is to compare maternal, neonatal and surgical outcomes of placenta previa with or without the history of cesarean.

Methods: This retrospective case-control study consisted of 222 patients who underwent cesarean for placenta previa from January 2018 to December 2019 in the Partners Healthcare System. Relevant information was retrieved comparing outcomes in patients with or without the history of cesarean. The data were analyzed by using SPSS version 20.

Result: Among 32,016 total delivery, 222 (6.93%, 222/32016) patients were diagnosed with placenta previa. Of the 222 patients, 66 had the history of cesarean (Study group) and 156 not (Control group). Estimated blood loss (EBL) of study group was $1,615.30 \pm 1,372.58$ ml, which is significantly greater than the control group (990.9 ± 433.82 ml). The duration of operation between two groups were compared, 115.89 ± 83.72 versus 56.77 ± 18.17 minutes, there was significant difference ($P < 0.05$). In addition, rate of admit to intensive care unit(ICU), rate of blood transfusion, rate of hysterectomy and rate of preterm delivery in study group were 9.1%(6/66), 27.3% (18/66), 33.3% (22/66), 72.7% (48/66), respectively, and in the control group were 0.64% (1/156), 7.05% (11/156), 0.64% (1/156), 50.64% (79/156), respectively.

Discussion: The incidence of maternal complication rates increased in patients with placenta previa with history of cesarean. Placenta previa, especially with history of cesarean, are high-risk obstetrical conditions. For the surgical planning, the coordination of the multidisciplinary teams with obstetricians, anesthesiologists, pediatricians, interventional radiologists, vascular surgeons, urological surgeons, and both obstetrical and neonatal nurses, as well as the preparation of blood products, are essential.

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Abstract #: T-86

Comparison of programmed intermittent epidural boluses with continuous epidural infusion of ropivacaine for labor analgesia: A systematic review and meta-analysis

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Background: Maintenance of labor analgesia can be achieved with continuous epidural infusion (CEI), patient-controlled epidural analgesia (PCEA) and programmed intermittent epidural boluses (PIEB). With the development of bolus technique, PIEB is proposed as a better maintenance mode. Ropivacaine which has significantly less motor block, cardiotoxicity and neurotoxicity is used in labor analgesia in recent years. We aimed to compare PIEB with CEI of ropivacaine for labor analgesia from randomized controlled trials.

Methods: We searched PubMed, Embase, Cochrane Central Register of Controlled Trials (CENTRAL), and ClinicalTrials.gov from database inception to Dec 10, 2019. Randomized controlled trials in parturient with labor analgesia of ropivacaine by PIEB or CEI were included in the analyses. The studies that used another analgesic agent and did not clearly describe the methods of delivering the PIEB, CEI and PCEA and the protocols for maintaining labor analgesia were excluded. Two primary outcomes (motor block, instrumental delivery) and four secondary outcomes (cesarean, consumption of ropivacaine, duration of second labor course, patient satisfaction) were evaluated. The trials were assessed using the Cochrane risk of bias tool, trials at high risk of bias were also excluded. Two authors independently assessed studies and extracted data. The data were subjected to analyses using the random-effects model.

Results: We identified 446 citations and included 10 studies with data for 3574 participants. There was no significant difference between groups in the instrumental delivery rate (risk ratio = 1.03, 95%CI 0.74 to 1.43), cesarean delivery rate (risk ratio = 0.79, 95%CI 0.60 to 1.05), and patient satisfaction (risk ratio = 5.55, 95%CI - 9.51 to 20.62). Compared with CEI, the risk of motor block in PIEB group was significantly decreased (risk ratio = 0.51, 95%CI 0.31 to 0.48), and the duration of second stage of labor was significantly shorter (risk ratio = -1.05, 95%CI -1.93 to -0.18). PIEB also significantly reduced the consumption of ropivacaine (risk ratio = -0.52, 95%CI -0.83 to -0.21).

Discussion: Results indicate that PIEB may be superior to CEI in the consumption of ropivacaine, the risk of motor block and the labor duration. Although PIEB reduced the consumption of ropivacaine, there was significant heterogeneity among studies. There was no difference for patient satisfaction, but the 95%CI was wide. Since the dose of ropivacaine given in the included articles in the motor block comparison was not complete, we will continue to perform meta-regression to explore whether different doses have an impact on the risk of motor block. None of the included studies report on all outcome variables. Further studies in this area are warranted.

References:

1. Bullingham A, et al. B J Anaesth 2018

Abstract #: T-87

Physician Administered Rescue Labor Analgesia Predicts Failure to Activate Labor Epidural Catheter for Cesarean Delivery in a Community Setting: A Single-Center Retrospective Study

Presenting Author: Blake Maresh, M.S.

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Introduction : A previous systematic review found that number of physician rescue boluses, urgency of cesarean delivery (CD), and non-obstetric anesthesiologist providing care were associated with failed activation of labor epidurals for CD¹. There is a paucity of data from the community setting that examines the risk factors associated with failed labor epidural activation for CD. Our primary aim was to identify risk factors for failed activation of labor epidurals for CD in a community hospital.

Methods: Using our electronic medical record system, we searched for subjects who had labor epidurals activated for CD from January 1, 2014 to December 31, 2018 at a community hospital. Demographic information was collected along with number of epidural attempts, loss of resistance, whether the epidural catheter was replaced prior to activation, time/date of epidural placement, time/date of CD incision and end, whether the CD was emergent, and final anesthetic technique.

Results: 232 subjects met inclusion criteria and 14(6%) required conversion to general anesthesia. Demographic and clinical information is included in Table 1. A multivariate analysis that controlled for height, number of epidural attempts, loss of resistance, and time from epidural placement to skin incision found that the number of physician-administered rescue analgesia events predicted conversion to GA when a labor epidural catheter was activated for CD (odds ratio 3.126; 95% confidence interval 1.163 to 10.464, $p=0.0305$).

Discussion: In our study, a physician administered rescue labor analgesia event was associated with an approximately 212% increase in the likelihood that a subject would require GA when a labor epidural catheter was activated for CD. Urgency of CD was not associated with failed labor epidural activation and a comparison between obstetric and non-obstetric anesthesiologists was not applicable. In the community hospital we studied, an anesthetic technique other than labor epidural activation should be considered when a patient with a labor epidural that has required one or more physician administered rescue analgesia events requires a CD. Limitations of our study include small sample size and that data was collected from only one hospital.

References:

Bauer ME et al. Risk factors for failed conversion of labor epidural analgesia to cesarean delivery anesthesia: a systematic review and meta-analysis of observational trials. *Int J Obstet Anesth* 2012;21:294-309

Abstract #: T-87
Table 1. Demographic and Clinical Data

	Epidural Catheter Activation Successful N=218	Epidural Catheter Activation Unsuccessful N=14	P value
Maternal age (years)	Median 29, Range 16-42, N=218	Median 26, Range 20-36, N=14	0.148
Maternal weight (kg)	Median 84.8, Range 54.4-169.2, N=141	Median 91.4, Range 78.2-112, N=7	0.176
Maternal height (cm)	Median 160, Range 147-188, N=121	Median 165.1, Range 160-175.3, N=7	0.028*
Gravity	Median 1, Range 1-10, N=218	Median 1, Range 1-3, N=14	0.663
Parity	Median 0, Range 0-4, N=218	Median 0, Range 0-1, N=14	0.352
Gestational age (weeks)	Median 40, Range 35.1-42, N=218	Median 40.45, Range 38.3-41.7, N=14	0.200
Prior Cesarean Delivery	Yes=6, No=211	Yes=0, No=14	1.0
Multiple Gestation (Yes/No)	Yes=1, No=217	Yes=0, No=14	1.0
Number of epidural attempts	Median 1, Range 1-5, N=216	Median 1, Range 1-2, N=14	0.195
Loss of resistance	Median 6, Range 3.5-11.5, N=190	Median 5.5, Range 4.5-8, N=13	0.136
Epidural catheter replaced prior to activation for cesarean delivery? (Yes/No)	Yes=5, No=213	Yes=0, No=14	1.0
Time from epidural catheter placement to skin incision (minutes)	Median 467.5, Range 50-1203, N=218	Median 543, Range 125-811, N=14	0.663
Time from skin incision to wound closure (minutes)	Median=46, Range 22-167, N=218	Median=49, Range 31-76, N=14	0.539

Abstract #: T-88

Comparison of the effects of epidural injection for labor analgesia: continuous versus programmed intermittent bolus versus provider-given intermittent epidural bolus, a randomized controlled trial

Presenting Author: Soo Jung Park, MD

Presenting Author's Institution: Samsung medical center

Co-Authors: Duck Hwan Choi, MD, PhD - Samsung medical center

Doyeon Kim, MD, PhD - Samsung medical center

Background Programmed intermittent epidural bolus injection (PIEB) increases maternal satisfaction and reduces the incidence of breakthrough pain during labor. However, there was a lack of evidence in analgesic effect of low-rate *versus* high-rate epidural bolus injection. Thus, we compared the effect of epidural injection for labor analgesia among three methods, including continuous epidural infusion (CEI), PIEB, and provider-given intermittent epidural bolus (provider).

Methods This study was performed on 34 primigravid and full-term women scheduled for vaginal delivery. Participants were randomly assigned to one of the following three groups, depending on the type of labor analgesia: CEI group ($n = 14$, 10 ml hr⁻¹), PIEB group ($n = 10$, 10ml, 250 ml hr⁻¹), and provider group ($n = 10$, 10ml, 1200ml hr⁻¹). Patient controlled epidural analgesia (PCEA) were given boluses of 5 ml of ropivacaine 1.2 mg ml⁻¹ with fentanyl 1.8 mcg ml⁻¹ at a rate of 240 ml hr⁻¹. It was started 30 minutes after the CSE procedure and the lockout interval was set to 15 minutes. The primary outcome was the amount of epidural analgesia used per hour to delivery. The degree of sensory and motor blockade (Breen modified Bromage score), numerical rating (NRS) score 4h after labor analgesia, and percentage of bolus injections *versus* patient attempt were examined.

Results The hourly PCEA requirement did not differ among three groups (CEI: 9.03 ± 7.83 , PIEB: 11.04 ± 7.3 , provider: 9.22 ± 3.59 ; $P = 0.114$). There was a statistical difference in sensory blockade 4 h after labor analgesia (T 5.8 ± 0.63 , T 8.09 ± 1.97 , T 5.43 ± 1.51 ; $P = 0.031$). However, motor blockade, NRS score were comparable ($P = 0.182$, $P = 0.238$, respectively). The percentage of injections *versus* patient attempt was not significantly different ($P = 0.49$). No participants experienced any adverse effect including neurologic sequelae.

Conclusions The amount of epidural analgesia used for labor pain was not differ by injection method. However, because this research is still in progress, it needs to be re-analyzed of the effect of epidural injection method for labor analgesia.

References:

1. Chua, S.M. and A.T. Sia, Automated intermittent epidural boluses improve analgesia induced by intrathecal fentanyl during labour. *Can J An-aesth*, 2004. 51(6): p. 581-5.
2. Lange, E.M.S., et al., Effect of Epidural Infusion Bolus Delivery Rate on the Duration of Labor Analgesia: A Randomized Clinical Trial. *Anesthesi-ology*, 2018. 128(4): p. 745-753.
3. Klumpner, T.T., et al., An in vitro evaluation of the pressure generated during programmed intermittent epidural bolus injection at varying infusion delivery speeds. *J Clin Anesth*, 2016. 34: p. 632-7.

Abstract #: T-89

Survey of Academic Obstetric Anesthesia Clinical Productivity and Staffing: Delivery Size Matters!

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Introduction: In contrast to existing surgical anesthesia clinical productivity and obstetric (OB) anesthesia workforce surveys (1-3), a nationwide assessment of OB anesthesia clinical productivity is lacking. Further, surgical anesthesia surveys often exclude OB anesthesia cases. As part of the 2019 Survey of Clinical Productivity of academic anesthesiology departments, we performed a survey of OB anesthesia care to provide national benchmarking data for OB anesthesia work and staffing.

Methods: Through the Society of Academic Associations of Anesthesiology and Perioperative Medicine (SAAAPM), an electronic survey was sent to anesthesiology department chairs from March to June 2019. "Workload" data included facility type, annual deliveries, epidural analgesia (EDA), cesarean delivery (CD) following EDA, CD without EDA, cesarean hysterectomies, and tubal ligations (BTL). "Staffing" data included daily number and type of staff during the week and weekend/holiday, both for day and night shifts. Staff type was defined as anesthesiologist (non-resident), resident, nurse anesthetist (CRNA), and anesthesiologist assistant (CAA), the latter three grouped as midlevel clinicians. Four facility categories (small, low medium, high medium, or large) were identified based on reported deliveries, and groupings were compared to current American Hospital Association (AHA) definitions, EDA, or CD. CD and EDA rates were compared by delivery group by Kruskal-Wallis-H test. A p-value < 0.05 was considered significant. Results. Of 135 SAAAPM members, 54 submitted complete surveys for 68 facilities (40% response rate). 44 of 54 only had one facility providing OB anesthesia. Most (56%) centers had ≥ 2400 deliveries per year (Stratum I of AHA definitions). Trends showed lower CD rates in higher-volume centers, and higher EDA rates in high-volume centers, although CD and EDA did not differ statistically by delivery volume (CD by group, $H(3)=2.37$, $p=0.50$; EDA by group, $H(3)=1.11$, $p=0.77$). Median workload by delivery volume is shown in Table 1. Staffing characteristics as a percentage of facility type are shown in Table 2. While small facilities had highest percentage of no dedicated OB anesthesia staff and large facilities had dedicated OB staff for all shifts; medium facilities had higher dedicated daytime OB staff, but only 50% had anesthesiologist dedicated to OB at night.

Discussion: Smaller facilities trended lower EDA and higher CD rates compared to medium and large facilities. Dedicated OB anesthesia staffing varies by facility size. Current AHA definitions do not adequately characterize hospital variability within high-delivery volume hospitals and they may mis-estimate anesthesia staffing implications on obstetric outcomes. The impact of various staffing models on OB and anesthesia outcomes such as EDA and CD should be a point of further study.

References:

1. Anes Analg. 2003;96:802-12
2. Anesthesiology 2019;130:336-48
3. Anes Analg. 2016;122:1939-46

Abstract #: T-89

Table 1. Anesthesia clinical activities and physician anesthesiologist staffing according to delivery volume groups.

	All	Number of Deliveries/year			
		Small ≤1199	Low Medium 1200-2399	High Medium 2400-3599	Large ≥3600
	N=68	N=8	N=22	N=22	N=16
Total Deliveries	2,688	874	2,076	3,023	5,167
Total Epidurals	1,490	502	1,198	1,677	3,341
Total Cesarean	809	328	635	876	1,797
Total Cesarean with no epidurals	520	173	385	676	1,188
Total Cesarean with epidurals	253	120	169	321	590
Total Cesarean hysterectomy	2	0	2	4	5
Total BTL	52	0	35	90	129
% Epidurals	61%	56%	62%	59%	62%
% Cesarean	31%	38%	31%	30%	32%
% Anesthesia	83%	79%	84%	83%	85%
Number of MD daytime	1	0	1	1	2
Number of MD inhouse call	1	0	1	1	1

MD = anesthesiologist/faculty

Table 2. Clinical anesthesia staffing by type according to delivery volume groups.

	All	Number of Deliveries/year			
		Small ≤1199	Low Medium 1200-2399	High Medium 2400-3599	Large ≥3600
	N=68	N=8	N=22	N=22	N=16
Staffing during day: type of dedicated clinician(s)					
% no dedicated clinician	9%	63%	5%	0%	0%
% midlevel clinician, no MD	7%	13%	14%	5%	0%
% MD only	4%	25%	0%	5%	0%
% MD with any midlevel clinician	79%	0%	82%	91%	100%
Staffing during weekday night: dedicated clinician(s)					
% no dedicated clinician	13%	63%	5%	14%	0%
% midlevel clinician, no MD	25%	0%	41%	32%	6%
% MD only	4%	25%	5%	0%	0%
% MD with any midlevel clinician	57%	13%	50%	55%	94%

MD = anesthesiologist/faculty. Midlevel clinician = resident, CRNA, and/or CAA

Figures that could be used for the poster

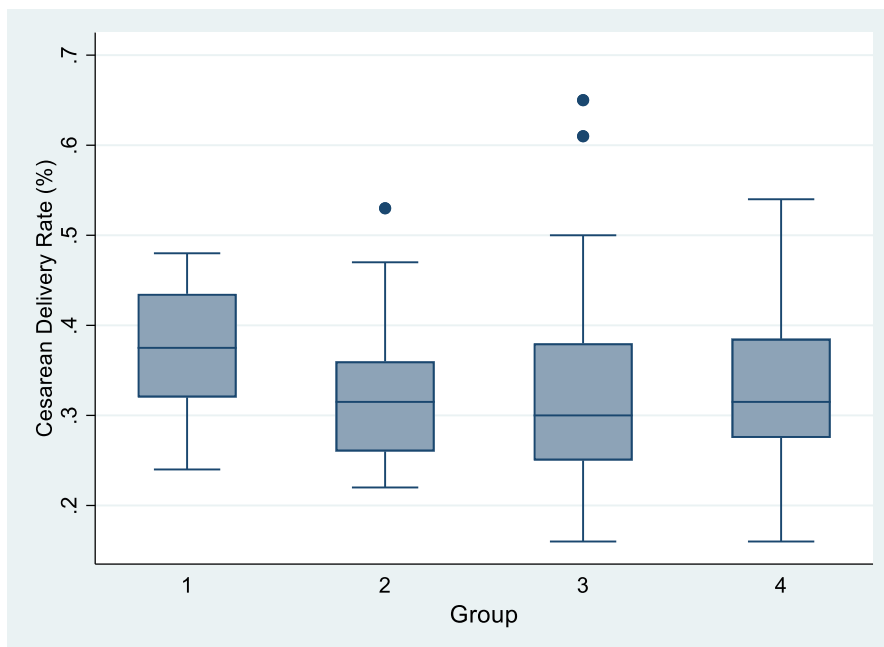


Figure 1. Cesarean delivery rate by delivery group. Median cesarean delivery rates trended lower in high-volume centers. There was no difference in cesarean delivery rates by hospital group. Group 1= ≤ 1199 deliveries; Group 2=1200-2399 deliveries; Group 3=2400-3599 deliveries; Group 4= ≥ 3600 deliveries

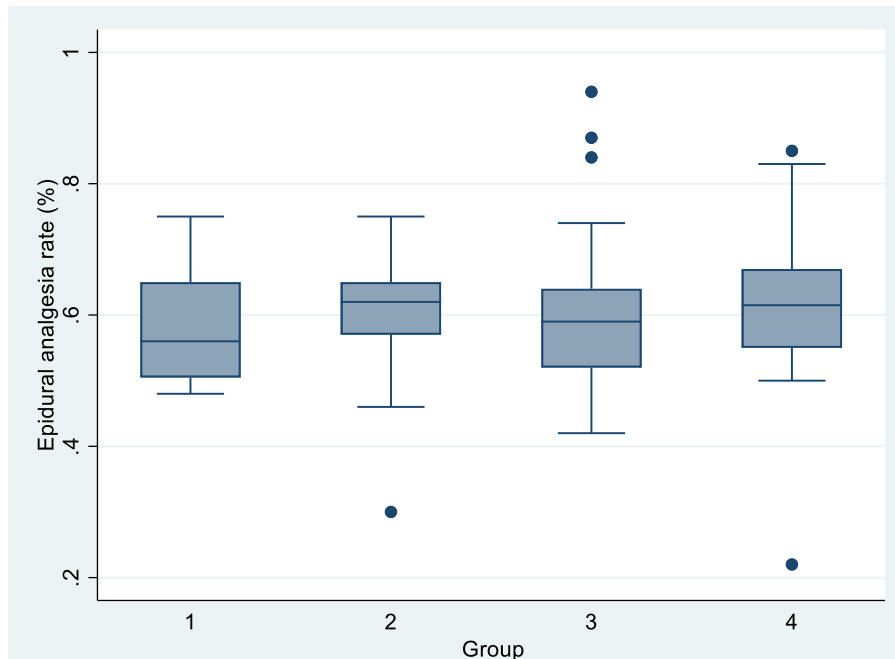


Figure 2. Epidural analgesia rate by delivery group. Median epidural analgesia rates trended higher in high-volume centers. There was no difference in epidural analgesia rates by hospital group. Group 1= ≤ 1199 deliveries; Group 2=1200-2399 deliveries; Group 3=2400-3599 deliveries; Group 4= ≥ 3600 deliveries

Abstract #: ERF1-01

Our Experience with EpiFaith® Syringe: A New Loss of Resistance Syringe for Locating the Epidural Space

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Introduction: The EpiFaith® syringe (Flat Medical, Taiwan) is a recently developed, spring-loaded, loss of resistance (LOR) syringe that can apply different degrees of constant syringe pressure while the operator is advancing the epidural needle, which releases when the epidural space is reached. Advantages of an epidural detection syringe compared to a traditional LOR syringe are the ability to advance the Tuohy needle with two hands, an objective sign of LOR and a potential teaching tool.¹ Only pre-clinical animal and phantom model studies of the device have so far been conducted. The aim of this study was to evaluate the EpiFaith® syringe in a clinical setting using a cohort of patients receiving neuraxial labor analgesia.

Methods: After obtaining IRB approval and written informed consent, 40 women requesting neuraxial labor analgesia were enrolled in this prospective study. Four experienced obstetric anesthesiologists participated in the study. Each were trained on how to use the syringe on a phantom model, and then performed 10 neuraxial procedures using the EpiFaith® syringe. Only combined spinal-epidural (CSE) or dural puncture epidural (DPE) techniques were performed to allow additional placement confirmation. Outcomes included: number of times (%) the EpiFaith® syringe detected the epidural space; the technique comparison score (-5 = absolutely worse, 5 = absolutely better, 0 = no difference) by the anesthesiologist to compare the EpiFaith® syringe with their regular LOR technique; and if any complications or technical issues were encountered.

Results: In 90% of the cases, a clear LOR endpoint was reported by the operator, and the epidural space was correctly identified. Air was used to detect LOR in all but 5 cases. In 50% of cases, the anesthesiologists reported a greater technique comparison score with the EpiFaith® syringe compared with their regular LOR syringe. No difference in the comparison scores were reported in 28% of cases, and in 22% of cases the EpiFaith® syringe had lower scores. There was no improvement in these scores with each subsequent use (Fig 1). In 4 cases, tension of the spring released prior to reaching the epidural space and the EpiFaith® syringe had to be re-loaded. Operators mentioned 2 cases in which there was a brief delay in the spring release when they entered the epidural space. There were no unintentional dural punctures or failed blocks.

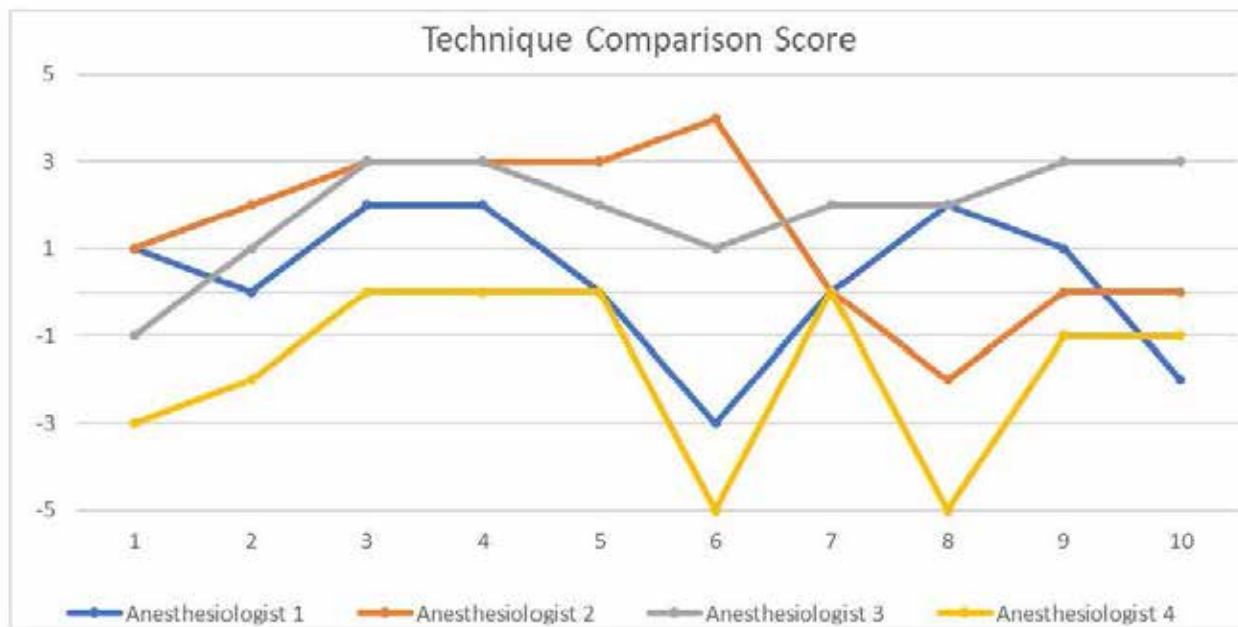
Discussion: The EpiFaith® syringe reliably detected the epidural space, and overall was preferred by experienced anesthesiologists over their regular LOR technique. Future large, randomized studies are required to compare the device to standard techniques to determine if a higher number of correct epidural space placements and a reduced incidence of unintentional dural puncture can be achieved.

References:

1. Anesth Analg 2008;106:541-3

Abstract #: ERF1-01

Figure 1: Technique comparison score (-5 = absolutely worse, 5 = absolutely better, 0 = no difference) by anesthesiologists that compared the EpiFaith® syringe with their regular LOR technique



Abstract #: ERF1-02

Implementation of an epidural blood patch (EBP) checklist after EBP inadvertently performed shortly after prophylactic LMWH dosing: Case Report and Quality Improvement initiative

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Co-Authors: Ruth Landau

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Background: The use of peripartum venous thromboembolic prophylaxis is increasing, with higher doses being prescribed.¹ The SOAP Consensus Statement on anesthetic management of obstetric patients receiving thromboprophylaxis or higher dose anticoagulants provides clear recommendations to avoid neuraxial procedures for 12 hours after once-daily dosing of enoxaparin 40mg to minimize risk of spinal epidural hematoma.^{2,3} Because the pre-anesthetic evaluation occurs antepartum, prior to epidural placement or anesthetic for cesarean, anesthesiologists performing epidural blood patches (EBP) for post-dural puncture headache (PDPH) may miss initiation of postpartum (PP) thromboprophylaxis. We describe a case of EBP 5h after subcutaneous enoxaparin 40mg dosing with subsequent implementation of an institutional EBP checklist to promote adherence to SOAP guidelines and enhance patient safety.

Case: A patient with 2 prior cesarean deliveries (CD) presented in labor for urgent CD at 38 weeks. She had a history of bilateral DVTs following abdominoplasty prior to pregnancy, for which she was on enoxaparin 40mg daily until transition to subcutaneous heparin at 36 weeks. A straightforward CSE was performed for CD, which was uncomplicated. She developed a typical PDPH the next day but initially declined EBP in favor of conservative management. The following day, she requested an EBP because symptoms prevented her from caring for her baby. In the midst of the procedure, with the Tuohy needle inserted at 5cm from skin, she reported receiving a dose of enoxaparin 5 hours earlier. The decision was made to complete the EBP (LOR was at 5.5cm) and 25ml of blood were injected with immediate resolution of PDPH. Disclosure was made to the patient, with close neurological monitoring over the next 24h. The next dose of enoxaparin was held until 19 hours after EBP. No sequelae were noted.

Quality Improvement: The anesthesiologist evaluating the patient for PDPH, who also performed the EBP the next day, was not aware that enoxaparin 40mg daily had been started between the 2 PP visits. Due to patient safety concern, a QA was triggered. Because there were no clear guidelines to perform a 'pre-procedural time out' before an EBP, or awareness that PP anticoagulation with LMWH may be initiated, we devised and implemented a specific checklist to be carried out prior to all EBPs. All anesthesiologists are also instructed to check anticoagulation status prior to any PP neuraxial procedure, including delayed epidural catheter removals, D&E for retained products, or tubal ligations.

Conclusion: The increased use of peripartum thromboprophylaxis at varying doses and schedules requires heightened vigilance by anesthesiologists. Institutions will benefit from establishing clear protocols, such as an EBP checklist with a pre-procedure time out, and from open communication with the obstetric and nursing teams.

References:

1. D'Alton, Anesth Analg 2016
2. Leffert, Anesth Analg 2018
3. Leffert, Anesth Analg 2017

Epidural Blood Patch Checklist

Review Potential Etiology

- Known unintentional dural puncture with 17G (wet tap)
- CSE procedure with unidentified dural puncture with 17G (unknown wet tap)
- CSE procedure with unidentified dural puncture with 17G (unknown wet tap) but catheter found to be intrathecal
- Spinal procedure (25G)

Evaluate Patient

- Headache characteristics (triggers, location, additional symptoms)
 - Postural (is it alleviated when absolutely supine)
 - Fronto-occipital ('helmet'), neck pain, migraine-type
 - \pm tinnitus, diplopia
- Headache time course
 - Present since neuraxial procedure/delivery
 - Worse in the last 24h
- Prior history of headaches (migraines, caffeine withdrawal, cluster headache, etc)
- Prior therapies attempted (NSAIDs, acetaminophen, oxycodone, caffeine, tryptans)

Coordinate Logistics

- Discuss need for EBP with OB attending
- Location (postpartum floor, labor floor vs recovery room or PACU) and timing based on acuity
- Inform charge nurse or floor nurse of plan

Consent Patient for EBP

- Written consent
- Check for recent anticoagulant use (SQ UFH or LMWH)

Gather Supplies

- Epidural cart or kit
- Blood draw: butterfly needles, tourniquet, syringes 20cc and 10cc, chloraprep sticks, sterile gloves
- Sterile towels or laps
- Hats and masks x4

Ensure all necessary personnel are available and in room

- Anesthesiology Attending
- Anesthesiology Fellow/Resident
- Nurse

Perform Procedure

- Time out must be performed (state timing of UFH/LMWH) and documented by nurse
- Anesthesiologist #1: Sterile prep and drape arm
- Anesthesiologist #2: Locate epidural space
- Nurse or other unsterile personnel: place tourniquet above field
- Anesthesiologist #2 injects sterile blood 5cc at a time up to 30cc or back fullness/discomfort
- Patient to sit or lay flat in bed at least 30 minutes, avoid valsalva
- Pillow under knees helps with back discomfort
- Return to bedside to assess/discharge after 1 hour
- Make sure patient has been given the PDPH information sheet

Documentation

- Epidural blood patch note
 - Eclipsis template – therapeutic vs prophylactic
 - Attending to co-sign note
- Update flowsheet in workroom

Abstract #: ERF1-03

A meta-analysis of the impact of enhanced recovery after cesarean delivery on maternal outcomes

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Presenting Author's Institution: Stanford University

Co-Authors: Lindsay Blake - UAMS

Brendan Carvalho - Stanford University School of Medicine

Nadir Sharawi - UAMS

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University School of Medicine

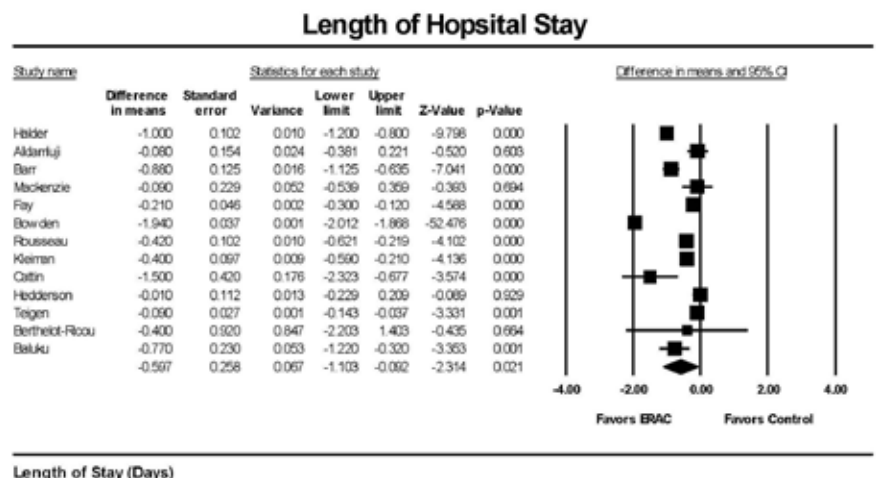
Introduction: In an effort to improve outcomes post cesarean delivery, institutions have increasingly started to adopt enhanced recovery after cesarean delivery (ERAC) protocols. The aim of this meta-analysis was to evaluate the impact of the ERAC protocols on maternal outcomes.

Methods: We undertook a literature search of articles published prior to August 2019, evaluating the efficacy of ERAC protocols. We supplemented the literature review with a manual review of abstracts from Society for Obstetric Perinatology (SOAP) and American Society of Anesthesiologists (ASA) meetings (2014-2019). Once the curated set was identified, we examined the studies for length of hospital stay (LOS), proportion of women discharged on day 1 postpartum, time to first mobilisation, time to catheter removal and maternal readmission rates following discharge. Primary outcome was LOS.

Results: 20 studies were included in this meta-analysis (7 articles and 13 abstracts). Combined, the studies included 15,300 patients (8,063 without ERAC implementation and 7,237 with ERAC implementation). Implementation of ERAC protocols were associated with a reduced length of hospital stay in 13 studies (n=13,338; mean difference (MD and 95% CI -0.60 [-1.10, -0.09] days; p=0.021). Proportion of women discharged on day 1 postpartum was increased within the ERAC group (OR 5.62 [2.41, 13.10]; p< 0.001), time to first mobilisation and urinary catheter removal were decreased within the ERAC group (MD -4.21 [-7.91,-0.50] hours; p=0.026 and -11.16 [-16.75, -5.57] hours; p< 0.001, respectively). Readmission rates were unchanged between the ERAC and non-ERAC group.

Conclusion: The implementation of ERAC protocols has been a recent development at many institutions. There is, however, no generally accepted ERAC protocol nor is their general impact known. We undertook to evaluate the available data regarding efficacy of ERAC protocols. There was a consistent trend among the published studies and abstracts demonstrating an association between the ERAC protocols and: reduced LOS, earlier time to mobilization, and urinary catheter removal. ERAC protocols do not affect maternal readmission rates and therefore should be adapted within institutions.

Figure 2. Forest plot of length of hospital stay with ERAC implementation



Abstract #: ERF1-04

A retrospective cohort study of the association between labour epidural analgesia and postpartum depression in primiparous women

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Introduction: The prevalence of postpartum depression (PPD) is 6.5-12.9% and it is a significant public health concern that affects the mother, her child, and the family unit.¹ PPD has been associated with the intensity of labour pain² and severity of acute postpartum pain³, making pain a potentially modifiable risk factor for PPD. Thus far in the literature, however, the relationship between labour analgesia and PPD is unclear.⁴ While some studies have reported an association between labour epidurals and reduced rates of PPD⁵⁻⁷, others have shown no association between the two^{8,9}.

Objective: To examine the association between labour epidural analgesia (LEA) and PPD among primiparous women undergoing vaginal delivery.

Methods: A retrospective cohort study was completed with institutional research ethics board approval, using a provincial perinatal database. The database was searched for all primiparous women who delivered a liveborn singleton infant between 2003-2018. Those women who experienced PPD following their first delivery were identified by searching for a history of PPD in the perinatal records of their second pregnancy. Relevant demographic, medical, obstetric, and anesthetic information was collected from the database. Odds ratios (OR) for the association between LEA and PPD were estimated with logistic regression to control for potential confounding variables.

Results: A total of 35,437 primiparous women were identified who had information about a history of PPD in the record of their second pregnancy. Of this total, 67.3% ($n = 23,862$) received LEA and 3.7% ($n = 1,296$) developed PPD. Women who received LEA had a slightly increased odds of developing PPD compared to women who did not receive LEA (OR 1.38, 95% CI 1.22 to 1.57). Further adjustment for other potential confounders (e.g. body mass index, pre-existing anxiety) did not affect the estimated OR.

Conclusions: This retrospective cohort study showed an association between LEA and PPD among primiparous women. The findings call into question the hypothesis that LEA decreases the risk for PPD and further illustrates the complexities of PPD.

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Table 1: The association between epidural use and PPD

	N	N cases (%)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
No LEA	11576	346 (2.9)	1.00 (ref)	1.00 (ref)
LEA	23862	956 (4.0)	1.38 (1.22 to 1.56)	1.38 (1.22 to 1.57)

*Adjusted for year of birth, maternal age

Abstract #: ERF1-05

Detection of Neuraxial Approach Using a Novel Force-Sensing Resistor Device

Presenting Author: Emery H. McCrory, MD

Presenting Author's Institution: Northwestern University

Co-Authors: Mahesh Vaidyanathan

Introduction: The standard of care for neuraxial procedures is landmark palpation to determine site of placement. Recently, practitioners have started using ultrasound (US) to assist with difficult procedures; however, this requires additional training. This research study aimed to test the preliminary feasibility of VerTouch™, a novel force-sensing resistor device (attached image), to identify landmarks for initiation of neuraxial procedures.

Methods: After IRB approval, patients were recruited at the time of labor epidural, or when consenting for spinal anesthesia for cesarean delivery at a single center. The clinical team used the device to create a pressure map image of the bony spine. If they felt confident, they used the device guide to make a mark on the patient's back. The proceduralist would then perform the neuraxial procedure per standard clinical practice at our institution. If the mark was used, total insertions and redirections, combined as passes, of the needle during the procedure were counted for secondary outcome analysis. Four prototype iterations were used throughout the study, and patients were recruited sequentially. Device success was defined as completion of the procedure at the site marked using VerTouch™ with less than a total of 2 insertions and 2 redirections, or a total of 4 passes.

Results: A total of 101 parturients were recruited to the study. Over the four prototypes, the provider felt confident making a mark based on the imaging in 96.9% of all cases. If the VerTouch™ mark was used, an average of 2.43 ± 1.96 passes were required for neuraxial placement. First-insertion success, where only one needle insertion was necessary for completion of the procedure, was achieved in 90.1% of all cases. Device success occurred at a rate of 91.4% across all groups with less than 4 total attempts.

Discussion: This feasibility study showed that the primary outcome, the provider using the device to make a mark, was successful. In addition, based on comparing passes with historical data (6.66 ± 4.47 passes using palpation and 2.77 ± 3.48 passes using ultrasound(1)), the Vertouch™ device showed promise for future use to minimize needle manipulation in neuraxial procedures. The first-insertion success rate was higher than the published rates of 62.9% and 43.6% for US and palpation, respectively(2). Limitations of this study were the lack of institutional control patients; therefore, a future randomized controlled trial is planned for the finalized prototype to compare Vertouch™ device success to palpation. Research funding was provided by Intuitap Medical, Chicago, IL.

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Abstract #: ERF1-06

A systematic review of studies that have evaluated trainees' progression and proficiency in placement of neuraxial labor analgesia

Presenting Author: Claire Naus, MD

Presenting Author's Institution: Columbia University

Co-Authors: Ruth Landau

Background: Placement of neuraxial labor analgesia requires extensive training to achieve proficiency and reduce neurological complications, including post-dural puncture headaches after accidental dural puncture (ADP). There are currently no standard approaches to teach trainees how to perform combined-spinal epidurals (CSE) for labor analgesia in U.S. teaching institutions, nor is there a systematic approach to evaluate their performance at the bedside with a universal scoring instrument. Studies that have evaluated trainees' progression and proficiency in neuraxial procedures in obstetrics have used different approaches. We conducted a review of all studies that report on trainees' proficiency and describe all outcome measures.

Methods: A PubMed search to identify all studies evaluating trainees' proficiency in placement of neuraxial labor analgesia was conducted (search terms: education, training, trainees, simulation, high-fidelity, low-fidelity, proficiency, technical skills, learning-curve, success, failure, cumulative sum analysis).

Results: We identified 10 studies published between 1996 and 2019; 4 observational studies and 6 RCTs testing different teaching tools (Table). Three studies used a binary metric - success or failure - to evaluate trainees' technical skills in performing neuraxial analgesia.¹⁻³ "Success" was generally defined as independent, technically adequate epidural placement. "Failure" was defined when a set number of attempts were exceeded, exceeding time without successful placement (e.g. 10min), an epidural failed to provide adequate analgesia requiring replacement, or with an ADP. Seven studies used a combination of objective skills checklist and subjective rating scale,⁴⁻¹⁰ of which 5 used or modified a checklist published in 2006,⁶ to evaluate trainees' technical skills and overall performance.

Conclusions: No standardized checklist or global assessment has been universally adopted to provide feedback and ensure proficiency in performing neuraxial labor analgesia. Since trainees in the U.S. are not expected to perform procedures independently without supervision, goals, criteria, and requirements to achieve proficiency in the placement of effective and safe neuraxial labor analgesia are likely to vary between U.S. and non-U.S. programs.

The success/failure metric is limited in that it does not evaluate each of the steps that goes into successful CSE placement nor does it provide a mean for assessing proficiency at a complex technical skill. Comprehensive checklists and competency scales may be used to create rubrics that will serve as benchmarks. They may be used longitudinally to measure individual trainee's progress, to compare trainees' proficiencies, and assess training tools.

Based on our findings, we suggest that checklists that include assessments of technical dexterity and the ability to provide analgesia within 10-15 minutes (e.g. skin to spinal dosing if CSE) should be adopted in training programs.

Abstract #: ERF1-06

Table: Studies evaluating trainees' progression and proficiency in placement of neuraxial labor analgesia

Study	Design (N= trainees)	Assessment	Outcomes
Binary (success/failure)			
Konrad ¹ 1998 Switzerland	Observational N=11 CA1s	Success = adequate technical performance without physical help from staff (maximum of 3 attempts or maximum time allowed of 10 minutes)	80% success after N=90 attempts 90% success after N=71 spinal (unclear if OB)
Naik ² 2003 Canada	Observational N= 11 CA1s	Success = independently placed epidural that provides some degree of analgesia Failure = ADP or physical assistance from staff (must ask for staff assistance after 3 unsuccessful attempts)	CUSUM (acceptable failure rate of 10%): The median number of procedures to achieve competency was 57 N=1 trainee failed to achieve competency after 75 cases
Vallejo ³ 2010 United States	RCT US-guided placement vs control N= 15 CA1s (370 patients)	Failure = failed analgesia 1. epidural requiring replacement during labor (early v. late) 2. incidence of epidural catheter replacement for failed analgesia 3. ADP	Number of epidural attempts (staff intervention occurred after > 6 attempts) The ultrasound group had fewer epidural catheter replacements and epidural placement attempts compared to the control group.
Global rating scale/Procedural checklist			
Kopacz ⁴ 1996 United States	Observational N=7 CA1s	Spinal = obtaining CSF (>95% non-OB) Epidural = obtaining anesthetic block (>95% non-OB) GA = end-tidal CO ₂ Success = defined on a 5-point scale	90% success after N=45 spinal N=60 epidurals
Birnbaach ⁵ 2002 United States	RCT - video review vs control N=22 CA2s	Procedural skills checklist 13 points - positioning, sterility, technical skills, patient interaction, subjective evaluation/grade of overall performance	Greater degree of improvement in overall grades for video review group for second half of study period (days 15-30)
Friedman ⁶ 2006 Canada	Observational N=6 CA1s	Skills checklist 27 points - positioning, preparation, sterility, technical skills, global rating form	Moderate to high degree of interrater reliability for checklist and global rating form
Friedman ⁷ 2009 Canada	RCT - low fidelity (banana) - vs high-fidelity epidural simulator N=24 CA2s	Manual Skill Checklist (0-54) & Global Rating Scale total score (7-35) at baseline (first epidural), middle (31-90 epidurals) and late (>90 epidurals) time points	There was no difference between the 2 groups at any time point
Lim ⁸ 2016 United States	RCT - low fidelity (banana) vs mental imagery N=20 CA1s	Checklist scores 21 points - modified from Friedman et al. and duration to task completion	No difference between low-fidelity and mental imagery training (time was reduced from 16 min at 1 st attempt to 13 min in subsequent attempts in both groups)
Kallidaikurichi Srinivasan ⁹ 2018 Ireland	RCT - proficiency-based training vs simulation training N=16 junior trainees	Procedure-specific metrics 12 points - compared to task specific checklist & global rating scale (from Friedman et al.) Failure = ADP, supervisor takeover, inadequate analgesia, abandonment of procedure	Data collected on 1 st 10 procedures Failure rate higher in simulation-only (28.7%) vs proficiency-based group (13.3%)
Nixon ¹⁰ 2019 United States	RCT - computer-enhanced visual learning tool (CVEL) vs control N=24 CA1s	Procedural checklist 49 points - modified from Friedman et al. for 1 st CSE attempt observed for each CA1	Primary outcome: duration of CSE procedure CVEL group = 22± 5 minutes Control group = 39± 7 minutes Higher overall checklist performance in CVEL group

CSE - combined spinal-epidural

CUSUM - cumulative sum analysis to determine the number of epidural attempts required to attain proficiency (success rate of 90%)

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Abstract #: ERF1-07

Mast cells are not required for neuraxial morphine-induced itch: evidence against the use of antihistamines for treatment of pruritus caused by neuraxial opioids

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Co-Authors: Grace Lim, MD, MS - University of Pittsburgh UPMC Department of Anesthesiology & Perioperative Medicine
Sarah Ross - University of Pittsburgh

Introduction: Antihistamines are frequently prescribed for the management of neuraxial morphine-induced itch. However, their therapeutic efficacy is controversial because the cellular basis for morphine-induced itch remains unclear (1). Degranulation of cutaneous mast cells has been observed following subcutaneous administration of some opioids (2). Nevertheless, the role of mast cells in neuraxial administration of opioids is understudied.

Objective: In this study, we tested whether mast cells are necessary for neuraxial morphine-induced itch in mice.

Methods: Experiments were conducted in mice ($n=5-9$, determined using a power analysis, *a priori*) to test the effects of peripheral and central morphine-induced itch. We modeled two forms of morphine induced itch: intrathecal (IT) and subcutaneous (SC) (300pmol). We assessed whether morphine could cause mast cell degranulation in a dose-dependent manner. We compared the reduction in IT and SC morphine-induced itch using antihistamines, loratadine and diphenhydramine (10mg/kg). Using genetically modified mice that are mast cell-depleted, we tested whether mast cells were required for IT or SC morphine-induced itch.

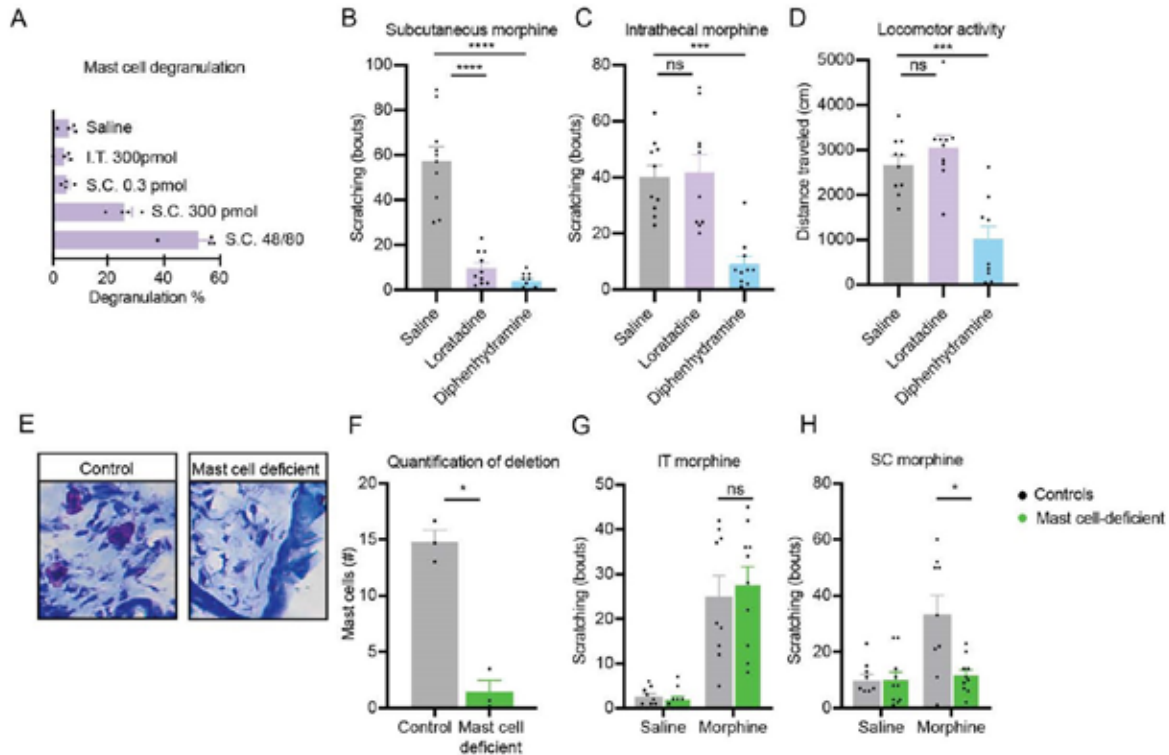
Results: We found that SC, but not IT morphine causes mast cell degranulation (**Figure 1A**). Both loratadine and diphenhydramine were effective for the treatment of SC morphine-induced itch, but only diphenhydramine reduced scratching caused by IT morphine (**Figure 1B, C**). Mice treated with diphenhydramine also exhibited depressed locomotor activity (**Figure 1D**). Animals lacking mast cells showed a reduction in SC, but not IT morphine-induced itch (**Figure 1E-H**).

Conclusion: Mast cells are required for SC, but not IT morphine-induced itch. Diphenhydramine causes a reduction in scratching caused by IT morphine, but this may be secondary to its sedating effects as evidenced by depressed locomotor activity observed in our animals. Thus our findings contrast with the widespread practice of treating neuraxial morphine-induced itch with antihistamines, which our results suggest could be both ineffective and unnecessarily harmful.

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Abstract #: ERF1-07



A. Quantifications of cutaneous mast cell staining. 300pmol of SC, but not IT morphine causes degranulation. **B.** Subcutaneous morphine causes itch that is reduced by both loratadine and diphenhydramine. **C.** Intrathecal morphine causes itch that is reduced by diphenhydramine, but not loratadine. **D.** Diphenhydramine causes a suppression of locomotor activity. **E.** Validation of mast cell deletion in mast cell-deficient mice. **F.** Quantification of E. **G.** Mice lacking mast cells still exhibit neuraxial morphine-induced itch. **H.** Mice lacking mast cells do not exhibit SC morphine-induced itch. Dots represent individual mice. Asterisks indicate the results of 1-way ANOVA, unpaired t-tests, or 2-way ANOVA. n.s. not significant, * $p < 0.05$, *** $p < 0.001$, **** $p < 0.0001$.

Abstract #: ERF1-08

Expression of the mu opioid receptor on spinal neurons is both sufficient and necessary for neuraxial morphine-induced itch

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Sarah Ross - University of Pittsburgh

Introduction: The mechanism by which neuraxial morphine causes itch is poorly understood. We have previously shown that mice lacking mast cells still exhibit itch following intrathecal administration of morphine. Our lab, as well as others, have shown that spinal inhibitory neurons normally function to inhibit itch (1-3). We tested the hypothesis that spinal neurons underlie neuraxial morphine-induced itch.

Objective: This study investigated whether a spinal mechanism could mediate neuraxial morphine-induced itch.

Methods: All experiments were performed in genetically- modified mice to test the sufficiency and necessity of the mu opioid receptor in a population of dynorphin-expressing spinal neurons (n=11-12, determined using a power analysis, *a priori*). We used a combination of molecular and genetic approaches (conditional deletion and ectopic expression), fluorescent in situ hybridization, electrophysiology, viral targeting, and behavior to determine whether the expression of the mu opioid receptor on dynorphin neurons in the spinal cord was necessary and sufficient for morphine-induced itch.

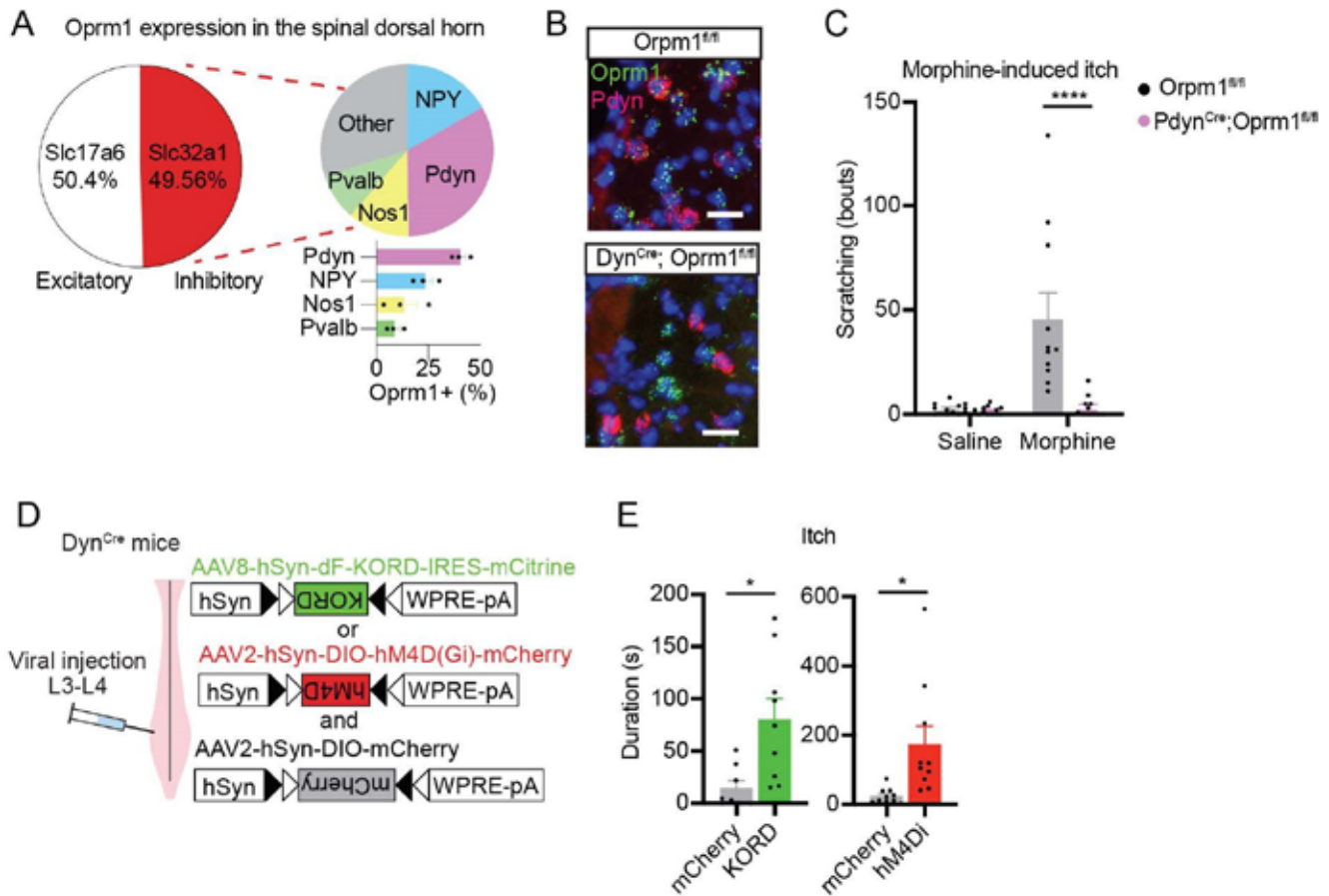
Results: We found that the expression of the mu opioid receptor was enriched in spinal dynorphin neurons (**Figure 1A**). We conditionally deleted the mu opioid receptor from these dynorphin neurons and found a complete elimination of morphine-induced itch (**Figure 1B, C**). Furthermore, we ectopically express the opioid receptor in dynorphin neurons and found that the inhibition of these neurons was sufficient to cause itch behavior (**Figure 1D, E**).

Conclusion: We provide evidence that neuraxial morphine causes itch through disinhibition --- inhibition of inhibitory spinal neurons. Specifically, through loss- and gain-of-function experiments, we determined that the mu opioid receptor on dynorphin neurons is both necessary and sufficient for morphine-induced itch. These findings are clinically significant because they indicate that dynorphin signaling may provide a useful target for the treatment of neuraxial morphine-induced itch.

References:

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Abstract #: ERF1-08



A. Quantification of the expression of the mu opioid receptor (*Oprm1*) in spinal neurons. **B.** Representative images of *Oprm1* in dynorphin neurons and the absence of the receptor in genetically modified animals. **C.** Mice lacking *Oprm1* in dynorphin neurons no longer exhibit neuraxial morphine-induced itch (n=12 per group). **D.** Intersectional genetic strategy to insert designer receptors to mimic the opioid receptor in the spinal cord. **E.** Activation of ectopically-expressed designer receptors is sufficient to phenocopy itch caused by neuraxial morphine (n=9-11 per group). Asterisks indicate the results of 2-way ANOVA or unpaired t-tests, * p<0.05, **** p<0.0001.

Abstract #: ERF1-09

Comparing 1% spinal chloroprocaine to low-dose bupivacaine using the epidural volume extension technique for post-partum tubal ligation

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Presenting Author's Institution: University of Alabama-Birmingham

Co-Authors: Michael Froelich, MD, MS - University of Alabama-Birmingham

Mark Powell, MD - University of Alabama-Birmingham

Introduction: Although neuraxial anesthesia is recommended for postpartum tubal ligations (PPTL),¹ adequately anesthetizing patients for the procedure can be challenging. Although the procedure is short, it requires anesthetizing nerve fibers to the T4 dermatome to allow manipulation of the fallopian tubes.² Recent evidence supports the use of low-dose bupivacaine with epidural volume extension (EVE) in achieving adequate anesthesia and reducing recovery time.³ The FDA recently approved 1% chloroprocaine for spinal administration, which is intended for short surgical procedures below the umbilicus. We sought to demonstrate the ability to anesthetize patients undergoing PPTL with 1% chloroprocaine utilizing the EVE technique and compare it to our standard technique of low dose bupivacaine with EVE.

Methods: IRB approval was obtained and all patients gave written consent. Patients were randomized to either receive 1 ml of spinal 0.5% isobaric bupivacaine plus 15 mcg fentanyl followed by 10 ml of epidural sterile saline (B) or 5 ml of spinal 1.0% chloroprocaine followed by 10 ml of epidural sterile saline (C) via a combined spinal-epidural (CSE). Both the researcher and patient were blinded. Data collected included sensory level to pinprick and motor blockade at 10 minutes and 60 minutes, supplemental anesthesia requirements, and time required to meet discharge requirements from the recovery room. The primary outcome was ability to obtain block height of T6 or above at 10 minutes.

Results: Twelve patients were randomized with 2 patients excluded due to failure to obtain the CSE. Data from 10 patients – N=5 in each group – were analyzed. In both groups, 80% of patients achieved at least a T6 level ($p > 0.99$). One patient in each group required epidural activation and subsequently achieved adequate anesthesia. No patient required general anesthesia. Mean time to meet recovery room discharge criteria in the B group was 37.8 minutes vs. 57.0 minutes in the C group ($p=0.4$).

Conclusion : Early results suggest no difference in the ability of spinal chloroprocaine to anesthetize to a T6 level or in recovery time when compared to low-dose bupivacaine using the EVE technique.

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Abstract #: ERF1-10

Intrapartum cesarean delivery in a morbidly obese patient with cystic fibrosis: a case report

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Presenting Author's Institution: Columbia University - New York, New York

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Ruth Landau

Introduction: There are relatively few cases reporting on the peripartum anesthetic management of women with cystic fibrosis (CF).¹ Anesthetic considerations should focus on optimizing lung function during delivery. Maternal co-morbidities include gestational hypertension, preeclampsia, gestational diabetes, and primary CD.²

We report on the case of an intrapartum CD in a woman with CF and morbid obesity.

Case: A 31-yo G4P1 with CF and BMI 42 was admitted for elective induction of labor at 38 weeks.

She had nearly continuous pulmonary infections (most recently on IV Piperacillin-Tazobactam), multiple bronchial artery embolizations for severe hemoptysis and a prior right lobectomy.

Her most recent FEV1 was 54%, and she was on chronic steroids. At home, she used intermittent oxygen therapy (2L via NC) and her functional status was relatively poor (exercise tolerance < 1 city block).

She received an early CSE for labor analgesia (spinal BUP 2.5mg + fentanyl 10mcg, followed by PIEB with BUP 0.0625% fentanyl 2mcg.ml, 8ml q45min). Twenty-three hours later, intrapartum CD was decided.

Epidural anesthesia was initiated with lidocaine 2% 20mL and fentanyl 100mcg. She was positioned using a troop elevation pillow as well as started on nasal O2 2L. Hydrocortisone IV 50mg was given q6h until 24hr postpartum. Delivery was uneventful (baby weight 3810g, APGAR 5, 8), and oxytocin 1UI bolus followed by 12UI/h was started. Throughout the delivery, her respiratory function and hemodynamics remained at baseline (Screenshot).

Opioid-sparing multimodal analgesia with epidural morphine 3mg, 30mg IV ketorolac, and q6h PO acetaminophen 975mg and PO q6h ibuprofen 600mg were given. The total in-hospital oxycodone use was 45mg (9 pills) over 72h.

Discussion: Optimizing peripartum respiratory function is key in women with CF as severe pulmonary dysfunction correlates with increased incidence of complications for both mother and fetus.³ Severe pulmonary dysfunction prior to pregnancy is the greatest predictor of maternal morbidity and mortality—with FEV1 < 50%, pulmonary hypertension, hypoxemia, frequent infections, and diabetes associated with the poorest outcomes.

In our case, use of neuraxial labor analgesia and successful conversion to anesthesia, allowed stress-free labor and CD, and although it was discussed to keep the epidural to optimize non-systemic opioid use, it was unfortunately removed at the end of the case. Nonetheless, the limited opioid use allowed to avoid respiratory depression, particularly in the setting of morbid obesity. While there have not been many reported cases of CF managed during labor and CD, our case illustrates successful neuraxial analgesia/anesthesia throughout the course of labor, delivery and postpartum in a morbidly obese woman with CF.

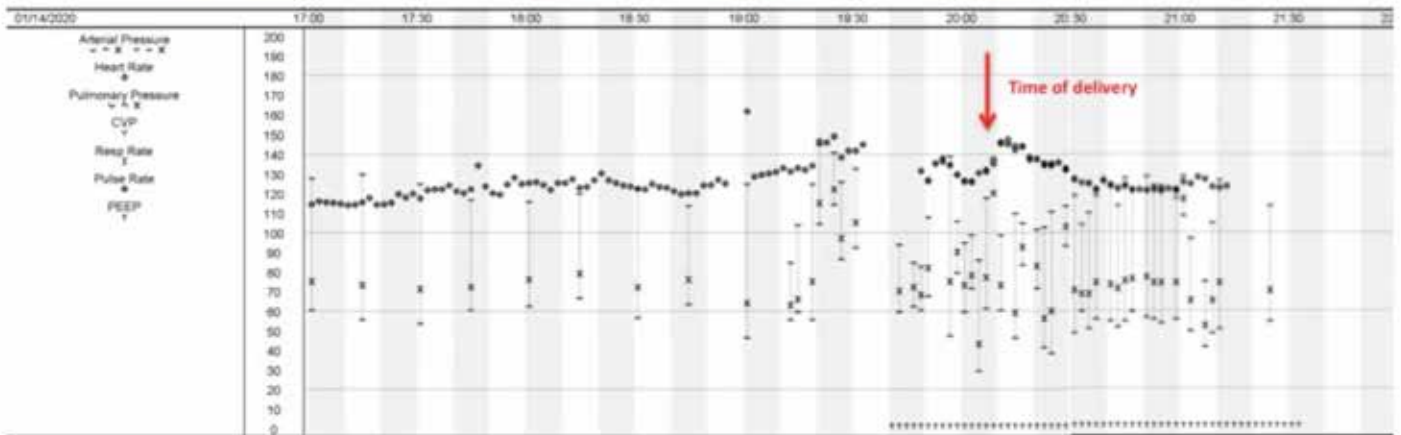
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Abstract #: ERF1-10

Figure. Screenshot of intrapartum and cesarean delivery hemodynamic trends – medication during cesarean delivery

20:08	Delivery	Div		
20:08	Pitocin	30 units/hr	IV-Infusion	30 units/500 mL
20:10	Phenylephrine Inf	100 microgram/min	IV-Infusion	20 mg/250 mL
20:12	Methylergonovine	0.2 mg	Intramuscular	
20:20	Tranexamic Acid	1000 mg	IV-Infusion over 20 min	
20:22	Sinus Tachycardia	ST		
20:23	Phenylephrine	120 microgram	IV-Bolus	
20:26	Morphine	3 mg	Epidural	
20:27	Phenylephrine Inf	150 microgram/min	IV-Infusion	20 mg/250 mL
20:32	Phenylephrine Inf	100 microgram/min	IV-Infusion	20 mg/250 mL
20:32	Pitocin	15 units/hr	IV-Infusion	30 units/500 mL



Abstract #: ERF2-01

The Incidence of Clinically Significant Respiratory Depression in Women with a Body Mass Index ($\geq 40\text{kg/m}^2$) Receiving Neuraxial Morphine Post-Cesarean Delivery: A Retrospective Chart Review

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Introduction: In healthy women, clinically significant respiratory depression attributable to low-dose neuraxial opioid for post-cesarean analgesia is approximately 1.08/10,000.¹ Obesity is implicated as a risk factor for respiratory depression; however, guidelines for respiratory monitoring following neuraxial opioid administration² in the obese obstetric population are based on small, limited studies.^{3,4,5} We investigated clinically significant respiratory depression in women receiving neuraxial morphine (NM) for post-cesarean analgesia with BMI $\geq 40\text{kg/m}^2$ compared to BMI $< 40\text{kg/m}^2$.

Methods: All patients who received NM for post-cesarean analgesia at our institution from 2000-2017 were included. Demographic data was collected for age, BMI, morphine dose, co-morbidities and concomitant administration of sedating medications. Charts of all patients meeting the definition of clinically significant respiratory depression within 24 hours of NM administration were manually reviewed (RD). Respiratory depression was defined as: (1)opioid antagonist administration, (2)rapid response team activation (following initiation 4/2010) or (3)intubation due to a respiratory event. For each event, NM was determined to be either causative, contributory, or unrelated to the respiratory event by 2 blinded authors (RD, BR), with discrepancies resolved through consensus by a 3rd and 4th author (SD, LS).

Results: Between 2000 and 2017, 11327 women delivered via CD and received NM – 1,945 women had a BMI $\geq 40\text{kg/m}^2$ and 9,382 women had a BMI $< 40\text{kg/m}^2$. Demographic and outcomes data are presented in the attached Table. Eighteen cases met the definition for respiratory depression, and the estimated rate was similar in women with BMI $\geq 40\text{kg/m}^2$ compared to women with BMI $< 40\text{kg/m}^2$ (25.7/10,000, 95% CI 11.0-60.0 vs. 13.8/10,000, 95% CI 8.1-23.7; $p=0.218$). There were no respiratory events where NM was causative in either group; however, women with BMI $\geq 40\text{kg/m}^2$ had higher rates of intubation unrelated to NM ($p=0.029$). There was no difference in distribution of all respiratory events (causative, contributory, not related) between groups ($P=0.615$). Women with BMI $\geq 40\text{kg/m}^2$ had higher comorbidity index scores and higher rates of OSA, gestational hypertension, and pre-eclampsia. Sedating medications were frequently administered in both groups [Table].

Conclusion: Clinically significant respiratory depression in women receiving NM for post-cesarean analgesia is similar between women with BMI $\geq 40\text{kg/m}^2$ and those with BMI $< 40\text{kg/m}^2$. Intubations unrelated to NM were higher in the BMI $\geq 40\text{kg/m}^2$ group, likely due to the higher incidence of co-morbidities. Women with BMI $\geq 40\text{kg/m}^2$ may be at higher risk of respiratory events independent of NM administration.

References:

1. Sharawi et al. *Anesth Analg* 2018; 127:1385-1395
2. Bauchat et al. *Anesth Analg* 2019; 129:458-74
3. Abouleish et al. *Reg Anesth* 1991; 16:137-40
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Abstract #: ERF2-01

	BMI ≥40 (n=1945)	BMI<40 (n=9382)	P-value
Demographics			
Age	28.6 ± 5.6	28.8 ± 6.0	P=0.369
ASA PS	2 [2,3]	2 [2,2]	P<0.001
CMI	1.03 ± 0.18	0.93 ± 0.19	P<0.001
OSA	29 (0.015)	13 (0.0014)	P<0.001
HTN	133 (0.068)	206 (0.022)	P<0.001
Gestational HTN	26 (0.013)	65 (0.007)	P=0.004
Pre-E	412 (0.212)	948 (0.101)	P<0.001
Medications			
High dose >0.15mg IT morphine	1036 (0.94)	5120 (0.93)	P=0.192
Low dose ≤0.15mg IT morphine	66 (0.06)	39 (0.07)	
High dose >3mg EPID morphine	62 (0.07)	180 (0.05)	P=0.014
Low dose ≤3mg EPID morphine	781 (0.93)	3690 (0.95)	
General anesthesia (sux/roc OR Y for GA)	48 (0.025)	315 (0.034)	P=0.411
Any sedative (meperidine, hydromorphone, diphenhydramine, haloperidol, morphine, prochlorperazine, lorazepam, gabapentin)	836 (0.43)	3867 (0.41)	P=0.151
Respiratory Events			
Respiratory Events – Type	#, Est, 95% CI per 10k	#, Est, 95% CI per 10k	P-value
Total	5, 25.7, (11.0, 60.0)	13, 13.8, (8.1, 23.7)	P = 0.218
RRT	1, 5.1, (0.9, 29.1)	7, 7.5, (3.6, 15.4)	P = 1.000
Intubation	2, 10.3, (2.8, 37.4)	0, 0.0, (0.0, 4.1)	P = 0.029
Naloxone	2, 10.3, (2.8, 37.4)	6, 6.4, (2.9, 13.9)	P = 0.633
Respiratory Events – NM Contribution	#, Est, 95% CI per 100	#, Est, 95% CI per 100	P = 0.615*
Causative	0, 0.0, (0.0, 43.4)	0, 0.0, (0.0, 22.8)	
Not contributory	4, 80.0, (37.6, 96.4)	8, 61.5, (35.5, 82.3)	
Possibly contributory	1, 20.0, (3.6, 62.4)	5, 38.5, (17.7, 64.5)	

All values are reported as mean±SD, median[IQR], or n(%) unless otherwise noted

Abbreviations: ASA (American Society of Anesthesiology Physical Status Classification), CMI (comorbidity index), OSA (obstructive sleep apnea), HTN (hypertension), Pre-E (pre-eclampsia), IT (intrathecal), EPID (epidural), sux/roc (succinylcholine/rocuronium), Y (case documented as “yes” for general anesthesia), RRT (rapid response team), NM (neuraxial morphine), CI (confidence interval)

*p-value calculated using 3x2 contingency table method evaluating distribution among three mutually exclusive categories

Abstract #: ERF2-02

Rotational Thromboelastometry for the Transfusion Management of Postpartum Hemorrhage after Cesarean or Vaginal Delivery: A Randomized Controlled Trial

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Introduction: Rotational thromboelastometry (ROTEM) during postpartum hemorrhage (PPH) has demonstrated that coagulopathy cannot be predicted solely by blood loss (1). Replacing formulaic massive transfusion with a ROTEM-based algorithm may lower the use of allogeneic blood products and improve transfusion-related patient outcomes after PPH (2), but a ROTEM-based PPH protocol has yet to be compared to empiric management in a randomized controlled setting. Here we report the impact of ROTEM on transfusion management of PPH after cesarean delivery (CD) or vaginal delivery. We hypothesized that ROTEM use during PPH would lower blood product transfusion number and transfusion-associated morbidity.

Methods: Women age 18-50 y with singleton or multiple pregnancy admitted for delivery with 1 major or > 2 moderate PPH risk factors were recruited [major risk: suspected placenta accreta, placenta previa, active bleeding, suspected abruption; moderate risk: multiple gestation, >4 prior vaginal births, prior PPH, uterine fibroids >5cm, 2nd stage of labor >3h, chorioamnionitis]. Women with a known coagulation defect, on anticoagulation, or refusing to accept transfusion were excluded. Patients were randomized if PPH occurred, defined as blood loss > 1000 mL. Patients had ROTEM testing when any routine PPH labs during PPH resuscitation were drawn. For patients in the ROTEM group only, physicians were provided real-time ROTEM results and a ROTEM-based algorithm. Incidence of coagulopathy (ROTEM Extem CT > 45 sec; Fibtem A10 < 12mm), transfusions, mode of anesthesia, blood loss, transfusion-associated circulatory overload (TACO), intensive care unit (ICU) and general length of stay, and hysterectomy were recorded. Continuous outcomes were compared between groups using Wilcoxon rank-sum tests and are presented as Hodges-Lehmann estimates of location shift with 95% confidence intervals (CI). Binary outcomes were compared between groups using simple logistic regression and are presented as odds ratios (OR) with 95% CIs.

Results: Demographics and results are shown in Table. There was no difference in total or individual blood products transfused in ROTEM vs. control groups, TRALI, ICU admission, or hysterectomy. Coagulopathy during PPH was relatively rare in both groups (15.4% vs 4.3%, $p = 0.216$).

Discussion: This is the first randomized controlled trial to our knowledge to evaluate the impact of ROTEM on PPH transfusion management. The incidence of coagulopathy during PPH was low, and despite individualized, targeted therapy with ROTEM, transfusion numbers and maternal outcomes were largely unchanged. Prior studies demonstrating benefit of ROTEM compared it to 1:1 massive transfusion, which may no longer reflect contemporary practice even in the absence of point-of-care data. More studies in patient subsets with coagulopathy and higher blood loss are warranted.

References:

1. McNamara et al. *Anaesthesia* 2019; 74:984-91
2. Mallaiah et al. *Anaesthesia* 2015; 70:166-75

Abstract #: ERF2-02

Outcome	Control	ROTEM	Effect size* (95% CI)	P value
Patient Demographics				
Age (y; mean \pm SD [min, max])	26 36.3 \pm 5.2 [26, 46]	23 36 \pm 5.2 [26, 46]		
BMI (kg/m ² ; mean \pm SD [min, max])	26 33.7 \pm 9.4 [20.5, 62.6]	23 30.7 \pm 6 [20.7, 45.9]		
Gestational age, mean \pm SD [min, max]	26 36.6 \pm 1.9 [32.4, 40.4]	23 36 \pm 2.3 [29.7, 39.1]		
Gravidity, median (Q1, Q3) [min, max]	26 3 (2, 4) [1, 8]	23 4 (2, 5) [2, 9]		
Parity, median (Q1, Q3) [min, max]	26 1 (1, 2) [0, 4]	23 1 (1, 2) [0, 3]		
Delivery Type				
Scheduled Cesarean	26 20 (76.9)	23 19 (82.6)		
Unscheduled Cesarean	5 (19.2)	3 (13)		
Vaginal	1 (3.8)	1 (4.3)		
Anesthesia type, n (%)				
CSE	26 14 (53.8)	22 14 (63.6)		
Epidural	4 (15.4)	3 (13.6)		
General	2 (7.7)	0 (0)		
Spinal	6 (23.1)	5 (22.7)		
Blood Products; (units; median (Q1, Q3) [min, max])				
PRBCs	26 2 (1, 2) [0, 10]	23 2 (0, 4) [0, 16]	0 (-1, 1)	0.853
FFP	26 0 (0, 2) [0, 9]	23 0 (0, 3) [0, 10]	0 (0, 0)	0.725
PLT	26 0 (0, 0) [0, 1]	23 0 (0, 0) [0, 3]	0 (0, 0)	0.288
Cryo	26 0 (0, 0) [0, 2]	23 0 (0, 0) [0, 2]	0 (0, 0)	0.888
Cell salvage	26 0 (0, 0) [0, 1.1]	23 0 (0, 0.7) [0, 4.7]	0 (0, 0)	0.028
Total blood products	26 2 (1, 4) [0, 22]	23 2 (0, 8.7) [0, 34.1]	0 (-1.6, 2)	0.968
Non-Blood Products (mL, median (Q1, Q3) [min, max])				
Albumin	26 0 (0, 0) [0, 500]	22 0 (0, 250) [0, 3000]	0 (0, 0)	0.089
Crystalloid	26 3000 (2000, 3500) [1250, 4569]	23 3000 (2000, 3400) [0, 4300]	0 (0, 0)	0.865
Morbidity Outcomes				
Coagulopathy, n (%)	25 4 (15.4)	23 1 (4.3)	0.24 (0.03, 2.31)	0.216
TRALI/TACO, n (%)	25 0	23 0	N/A	N/A
ICU admission, n (%)	26 1 (3.8)	23 2 (8.7)	2.38 (0.20, 28.1)	0.491
Hysterectomy performed, n (%)	26 14 (53.8)	23 13 (56.5)	1.11 (0.36, 3.45)	0.851
Length of stay, median (Q1, Q3) [min, max]	26 4 (4, 5) [2, 20]	22 4 (4, 9) [3, 38]	0 (0, 1)	0.303

*Effect sizes are Hodges-Lehmann estimates of location shift for continuous outcomes and odds ratios for binary outcomes.

Abstract #: ERF2-03

Obstetric anaemia: prevalence, management and prevention

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Anaemia in pregnancy is a common indirect cause of maternal and foetal adverse outcomes. Anaemic women are less tolerant to blood loss, increasing the risk of peripartum blood transfusion. At Queen Alexandra Hospital we perform over 5800 deliveries a year. The current treatment algorithm for antenatal anaemia (haemoglobin < 100g/dL at 28 weeks) recommends oral iron supplementation. No further follow-up or further intervention suggested; patients can therefore remain untreated or fail to receive correction of their anaemia due to compliance issues and the time required for oral iron to have effect. We aim to provide an alternative route of iron administration for obstetric patients and to revise the current treatment algorithm. The perioperative IV iron service at Portsmouth hospitals has successfully treated over 500 anaemic patients presenting for elective surgery with IV iron. We hope to include obstetrics in this service, aiming to reduce the prevalence and complications of anaemia in pregnancy and the need for peripartum blood transfusion. Method: hemoglobin levels were recorded from blood samples at 28-weeks and admission in labour for the first 199 births of 2019 at Queen Alexandra Hospital. Anaemia was defined as haemoglobin < 100g/dL at 28 weeks gestation and < 100g/dL at delivery. Results at these two time points, interventions and patient outcomes were compared. Results: of 199 women 6 were excluded due to pre-term labour/stillbirth. 49 women were anaemic at term, of whom 22 had been anaemic at 28 weeks. Of these, 8 had received oral iron therapy, 14 had not. 9 had post-partum haemorrhage (PPH); two required blood transfusion. 20 women were anaemic at 28 weeks but were no longer anaemic at term (seven had no sample at term). Of these, 14 had received iron therapy, 6 had not. Of these patients 10 suffered PPH; only one required blood transfusion. In the women who received oral iron, the average haemoglobin rise was 5g/dL (from 95g/dL to 99 g/dL). Without iron there was an average drop of 7g/dL (from 104g/dL to 97g/dL). Conclusions: oral iron is unreliably prescribed to anaemic patients. 8 women received oral iron but remained anaemic. 2 anaemic women required blood transfusion at the time of labour and delivery. IV iron may have benefitted these women; extrapolating these ratios, it could help almost 300 women per year. We have provided education about the prescription of oral iron and the need to re-check haemoglobin at 32 weeks and revised the guideline to include referral for IV iron treatment in patients that remain anaemic at this point. We have initiated the IV iron service and will review outcomes in three months.

References:

Pavord S et al. 2012. UK guidelines on the management of iron deficiency in pregnancy. *British Journal of Haematology* 156:588–600

Filippi, V et al. 2016. Levels and causes of maternal mortality and morbidity. *Reproductive, Maternal, Newborn, and Child Health: Disease Control Priorities*, 3(2). Word bank, Washington DC.

Abstract #: ERF2-04**The effect of epidural analgesia on intrapartum caesarean section rate and indications for cesarean section in Group 1 according to the 10-Group Classification System: a retrospective cohort study****Presenting Author:** Rong Lin**Presenting Author's Institution:** Shanghai First Maternity and Infant Hospital, Tongji University School of Medicine, Shanghai**Co-Authors:** Zhiqiang Liu - Shanghai First Maternity and Infant Hospital, Tongji University School of Medicine

Zhendong Xu - Shanghai First Maternity and Infant Hospital, Tongji University School of Medicine

Background: Association between epidural analgesia (EA) and intrapartum caesarean section (CS) rate in nullipara with spontaneous labour is a controversial question, and it is unclear whether EA is the risk factor of certain indications for CS in labour. This study was designed to investigate the impact of EA on intrapartum CS rate, and even indications for CS in nulliparous term women with spontaneous labour (Group 1) by using the 10-Group Classification System (TGCS).

Methods: Electronic medical records of all 8437 deliveries from Jan 1 to Jun 30, 2017 in our institution were reviewed in this retrospective, observational cohort study. Nulliparous women conforming to the categories of Group 1 based on the TGCS (Nullipara, ≥ 37 weeks, singleton, cephalic presentation, spontaneous onset) were enrolled. The intrapartum CS rates and the distribution of indications for CS in labour were compared between women with and without EA. Univariate and multivariate logistic regression analysis were applied to identify whether receiving EA affected certain indications for CS (fetal, dystocia or maternal request).

Results: A total of 2876 women were involved in the final analysis. Women with EA had a significantly lower intrapartum CS rate (16.0%[275/1722] vs 26.7%[308/1154], $P < 0.001$), higher rates of amniotomy (60.4% vs. 50.3%, $P = 0.015$) and oxytocin augmentation (79.4% vs. 67.0%, $P < 0.01$), and developed a higher incidence of intrapartum fever ($\geq 38^\circ\text{C}$) (23.3% vs. 8.5%, $P < 0.001$) compared to those without EA. With respect to intrapartum CS indications, there was a higher rate of dystocia/inefficient uterine action/inability to treat with oxytocin/overcontracting uterus (Dys/IUA/ITT/OC) (21.1%[58/275] vs. 10.7%[33/308], $P < 0.001$) and a lower probability of maternal request (24.4%[67/275] vs. 39.3%[121/308], $P < 0.001$) in those accepting EA. Use of EA was identified to decrease the risk of maternal request (adjusted odds ratio [aOR], 0.32, 95% confidence interval [CI], 0.23-0.44, $P < 0.001$). Intrapartum fever was related to a decreased risk of Dys/IUA/ITT/OC (aOR, 0.42; 95% CI, 0.20-0.89, $P = 0.022$).

Conclusion: In Group 1, EA administration was associated with lower intrapartum CS rates. EA contributed to reduce the possibility of maternal request, but did not influence other indications for CS.

References:

1. Robson, M.S., *The 10-Group Classification System-a new way of thinking*. Am J Obstet Gynecol, 2018. **219**(1): p. 1-4.
2. Lucovnik, M., et al., *Impact of epidural analgesia on cesarean and operative vaginal delivery rates classified by the Ten Groups Classification System*. Int J Obstet Anesth, 2018. **34**: p. 37-41.

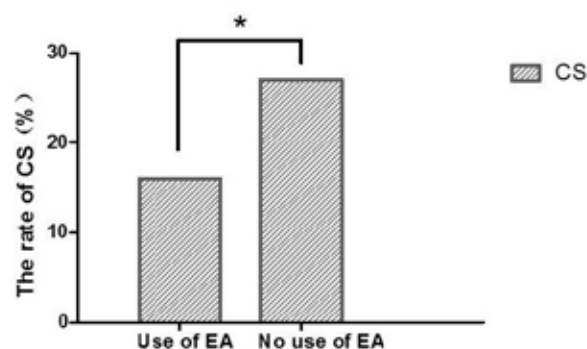


Figure 1. Comparison of CS rates between women with EA or without EA in Group 1. CS: caesarean section, EA: epidural analgesia. * P value < 0.001

Abstract #: ERF2-05

The effects of height and weight adjusted dose of local anesthetic compared to standard arbitrary dosing for spinal anesthesia in elective cesarean delivery

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Background: Spinal anesthesia is a common anesthetic technique for elective cesarean delivery (CD). A challenge anesthesiologists face is selecting a dose that provides adequate anesthesia to the parturient whilst minimizing harmful side effects. Our primary concern regarding side effects is hypotension as an effect of the spinal anesthetic as it may have harmful effects to both mother and fetus.¹

Objectives: Height and weight dependent dose adjustment have been studied in the past.² We hypothesized that a simplified dosing regimen of 0.75% hyperbaric bupivacaine would provide adequate surgical anesthesia for elective CD while decreasing the incidence of maternal hypotension and the use of vasopressors.

Methods: In this single centered, double blinded, randomized controlled trial, term parturients (n=170, ASA II, age 18-40, singleton, uncomplicated pregnancy) undergoing elective CD under spinal anesthesia were randomly allocated to receive either a fixed dose regime (1.6 mL or 12 mg 0.75% hyperbaric bupivacaine) or a height and weight adjusted dose regime (Table 1) along with fentanyl 15 mcg and preservative free morphine 100 mcg intrathecally. Systolic blood pressure of < 90 mm Hg or >25% decrease from baseline was defined as hypotension. Phenylephrine at interval doses of 100 mcg were given as needed. The primary outcome included maternal hypotension needing phenylephrine (1st line) or ephedrine (2nd line). Patient satisfaction, nausea, vomiting, pruritus, time to adequate surgical anesthesia and conversion to general anesthetic were secondary outcomes. Height and weight parameters were restricted between 150-180 cm and 50-110 kg, respectively.

Results: Characteristics between the adjusted (n=86) and fixed dose (n=84) groups were similar. The adjusted group experienced less hypotension needing statistically significant lower doses of phenylephrine (295±248 mcg vs 697±373; p 0.000) and ephedrine (1.3±3.3 vs 5.5±13.5 mg; p 0.008). The adjusted group experienced statistically significant reductions in nausea and vomiting. There was no difference in overall patient satisfaction, pruritus, and time to adequate surgical anesthesia (Table 2). In the adjusted arm, there was one conversion to general anesthesia.

Conclusion: Height and weight adjusted dose of bupivacaine provided adequate anesthesia and minimized maternal hypotension requiring vasopressor intervention. Additionally, there was significant reduction in nausea and vomiting, which are distressing side effects for the parturient.

References:

1. Corke B.C., Datta S., Ostheimer G.W., et al. Spinal anaesthesia for Caesarean section. The influence of hypotension on neonatal outcome. *Anaesthesia* 1982; 37:658-62.
2. Harten J.M., Boyne I, Hannah P. et al. Effects of a height and weight adjusted dose of local anaesthetic for spinal anaesthesia for elective Caesarean Section. *Anaesthesia*. 2005; 60:348-353.

Abstract #: ERF2-05
Table 1: Height and Weight Adjusted 0.75% Hyperbaric bupivacaine; shown in volume

Height (cm)	150	155	160	165	170	175	180
Weight (kg)							
50	1.2	1.3					
60	1.1	1.2	1.3	1.4			
70	1.1	1.1	1.3	1.3	1.4	1.5	
80			1.2	1.3	1.4	1.5	1.6
90			1.1	1.3	1.3	1.4	1.5
100			1.1	1.2	1.3	1.4	1.5
110				1.1	1.2	1.3	1.5

Table 2: Primary and Secondary Outcomes Data

	Fixed Dose Group (n=84)	Adjusted Dose Group (n=86)	95% CI: lower, upper	P value
Primary Outcome				
Phenylephrine (mcg)	697 (373)	295 (248)	306, 497	0.000
Ephedrine (mg)	5.45 (13.48)	1.31 (3.32)	1, 7	0.008
Secondary Outcomes				
Nausea (yes)	46	27		0.002
Vomiting (yes)	4	0		0.041
Pruritus (yes)	13	14		0.913
Patient Satisfaction D/N/S/CS	0/1/33/49	2/4/31/49		0.282

D/N/S/CS – Dissatisfied/Neutral/Satisfied/Completely Satisfied

Abstract #: ERF2-06

Do Antenatal Iron Infusions Improve Childbirth Outcomes? A Pilot Study

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Introduction: Anemia is a common problem in the obstetric population, affecting up to 40% of pregnancies, with iron deficiency as the most common etiology.¹ Peripartum anemia is associated with adverse neonatal outcomes including low birthweight, pre-term birth, and neonatal anemia. Iron infusion is a well-recognized treatment for iron deficiency anemia (IDA), particularly during late pregnancy.² However, a recent meta-analysis³ found that there is no strong evidence that intravenous iron is superior to oral administration for treating IDA in pregnant women. The primary aim of this study was to evaluate whether iron infusions administered in an anesthesia-led anemia clinic can improve maternal and neonatal outcomes.

Methods: We designed a single-center pilot retrospective cohort study to evaluate the outcomes of women with singleton pregnancies treated with an intravenous iron infusion (ferric carboxymaltose [Venofer®]) in an anesthesia-led anemia clinic and matched them in a 1:3 ratio with controls diagnosed with IDA who received usual care with oral iron supplementation. We extracted maternal data (hemoglobin, mode of delivery, length of stay) and fetal data (APGAR scores, neonatal intensive care unit admission, neonatal hemoglobin) for study patients from our institution's electronic data warehouse.

Results: The median (IQR) gestational age for women (n = 74) at the time of iron infusion with was 35.5 (31.9 to 37.4) weeks. Compared to matched controls (n = 229) the lowest antenatal hemoglobin (Hb) was 8.8 (8.1 to 9.7) g/dL in the iron infusion group compared with 9.9 (9.1 to 11.0) g/dL in the controls ($P < 0.001$). Prior to delivery Hb was 10.5 (9.5 to 11.3) g/dL in the iron infusion group and 11.0 (9.0 to 11.8) g/dL in the controls, difference -0.5 (95% CI -0.9 to -0.1, $P = 0.03$). The difference in length of stay adjusted for method of delivery was not different, -9 (95% CI -23 to 5) hours. Infants born to mothers who received iron infusions were equally as likely to be admitted to the neonatal intensive care unit (NICU) (10.8% vs. 16.4%, RR = 0.89 [95% CI = 0.77-1.05], $P = 0.25$), were of similar body weight, and had comparable APGAR scores. Notably, infants of infused mothers admitted to the NICU had clinically important higher median Hb values, 18.3 vs. 16.4 g/dL, difference 2.4 (95% CI 0 to 4.4, $P = 0.04$) g/dL. No women in either group received blood transfusions or had severe adverse reactions to iron therapy.

Conclusion: Our findings suggest that iron infusion administered in an anemia clinic in the 2nd or 3rd trimester of pregnancy represents a safe and viable modality for treating iron deficiency anemia, resulting in a higher neonatal Hb and a trend toward lower NICU admission rate. Future studies with larger samples are needed to determine both the short- and long-term benefits of this therapy.

References:

1. Esen UI. *J Obstet Gynaecol.* 2017;37(1):15-18.
2. Govindappagari S. *Am J Perinatol.* 2019;36(4):366-376.
3. Qassim A. *Med J Aust.* 2019;211(8):367-373.

Abstract #: ERF2-06

Parameter	Iron Infusion (n = 74)	No Iron Infusion (n = 229)	Difference (95% CI)	P value
Gestational age at iron infusion (weeks)	35.5 (31.9-37.4)	--	--	N/A
Lowest antenatal hemoglobin (g/dL)	8.8 (8.1-9.7)	9.9 (9.1-11.0)	-1.1 (-1.5 to -0.7)	<0.001
Hemoglobin prior to delivery (g/dL)	10.5 (9.5-11.3)	11.0 (9.0-11.8)	-0.5 (-0.9 to -0.1)	0.03
Hemoglobin improvement (g/dL)	1.1 (0.2-2.5) g/dL	0.6 (0.0-1.45)	0.5 (-0.1 to 1.1)	0.09
Gestational age at delivery (weeks)	39.2 (38.6-39.7)	39.1 (37.5-39.7)	0 (-0.3 to 0.3)	0.08
Estimated blood loss at delivery (mL)	250 (150-300)	250 (250-400)	0 (-100 to 50)	0.24
Length of stay, adjusted for mode of delivery (h)	82 (65-95)	91 (84-98)	-9 (-23 to 5)	0.23
Birthweight (g)	3284 (3005-3659)	3269 (2850-3570)	0 (-172 to 172)	1.0
NICU admission, n (%)	8 (11)	36 (16)	-5 (-14 to 4)	0.25
Neonatal hemoglobin (g/dL)	18.3 (16.3-19.7)	16.4 (11.2-19.0)	2.4 (0 to 4.4)	0.04
APGAR score at 1 minute	8 (8-9)	8 (8-9)	0 (-0.4 to 0.4)	1.0
APGAR score at 5 minutes	9 (9-9)	9 (9-9)	0 (-0.4 to 0.4)	0.10
NICU length of stay (h)	92 (11-151)	257 (80-658)	-141 (-368 to 85)	0.22

Data presented as median (1st to 3rd quartile) or n (% of column).

Abstract #: ERF2-07

Anesthetic Management for Patients with Severe Placenta Accreta Spectrum After Institution of a Protocol Allowing for Delayed Hysterectomy

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Background: Placenta accreta spectrum (PAS) describes the abnormal adherence of the placenta to uterine myometrium and includes accreta, increta, and percreta. The rate of PAS is increasing, and it is an important contributor to maternal mortality and morbidity¹⁻³. To reduce maternal morbidity and mortality from PAS, our institution implemented a protocol allowing for either immediate (IH) or delayed hysterectomy (DH) to manage cases of severe PAS. The anesthetic approach emphasized a combined general anesthetic with thoracic epidural for improved post-operative pain control. We sought to assess outcomes following protocol implementation.

Objective: To examine anesthetic care for cases of severe PAS managed with IH compared to those managed with DH.

Methods: We conducted a retrospective study of all patients with severe PAS at our large academic institution from January 1, 2012 to December 31, 2019. Severe PAS was defined by histologic confirmation of placenta increta or percreta. Following implementation of an institutional protocol, patients underwent a scheduled cesarean delivery at 34-35 weeks gestation and were managed with either IH or DH. Surgical plan was determined intraoperatively by a multidisciplinary surgical team. Patients in the DH group underwent subsequent hysterectomy at 4-6 weeks. We evaluated the availability of obstetric anesthesia trained faculty, case urgency, transfusion requirements, and post-operative pain control.

Results: We identified 42 patients with severe PAS during our study period (n=24 IH vs n=18 DH). Anesthetic for IH cases included neuraxial (n=3, 12.5%), neuraxial converted to general anesthesia (n=9, 37.5%), and general anesthesia (n=12, 50%). General anesthesia was performed in all DH patients. Obstetric anesthesiologists participated in 92% of IH, but only 67% of DH (Table). Following protocol implementation, massive transfusion protocol activation and post-op mean oral morphine equivalent (OME) requirements was reduced in both groups.

Conclusions: Following implementation of a protocol for the management of severe PAS, post-op opioid requirements and massive transfusion activations decreased. However, almost half of DH were performed urgently rather than as scheduled, presenting challenges to OB anesthesia staffing and adequate pain control.

References:

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2. Mogos MF, Salemi JL, Ashley M, Whiteman VE, Salihu HM. Recent trends in placenta accreta in the United States and its impact on maternal fetal morbidity and healthcare-associated costs, 1998-2011. *J Matern Fetal Neonatal Med* 2016;29:1077-82
3. Solheim KN, Esakoff TF, Little SE, Cheng YW, Sparks TN, Caughey AB. The effects of cesarean delivery rates on the future of incidence of placenta previa, placenta accreta, and maternal mortality. *J Matern Fetal Neonatal Med* 2011; 24:1341-6

Abstract #: ERF2-07

	IH (n=23)	DH (n=17)
Mean <u>OME</u> required, first 72-hours post-op (before protocol)	323.85	382.8
Mean OME required, first 72-hours post-op (after protocol)	96.88	243.25
Scheduled Case (%)	16 (67%)	10 (56%)
Non-Scheduled Case (urgent, emergent) (%)	8 (33%)	8 (44%)
Obstetric Anesthesiologist (%)	22 (92%)	12 (67%)
General Anesthesiologist (%)	2 (8%)	6 (37%)
Massive Transfusion Protocol Initiated	6 (25%)	2 (11%)

Table

Abstract #: ERF2-08

Using a Single Institution's Data from Induction of Labor to Model a Shift from Nighttime to Daytime Workload

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Background: The 2018 ARRIVE trial found that IOL in low-risk nulliparous women significantly reduced the frequency of cesarean sections.¹ We sought to analyze the impact of IOL timing on obstetric and anesthesia workload. A better understanding of the time course of labor inductions could help optimize predicted work force staffing and also potentially optimize delivery and anesthesia times at wakeful hours when more abundant resources are available.

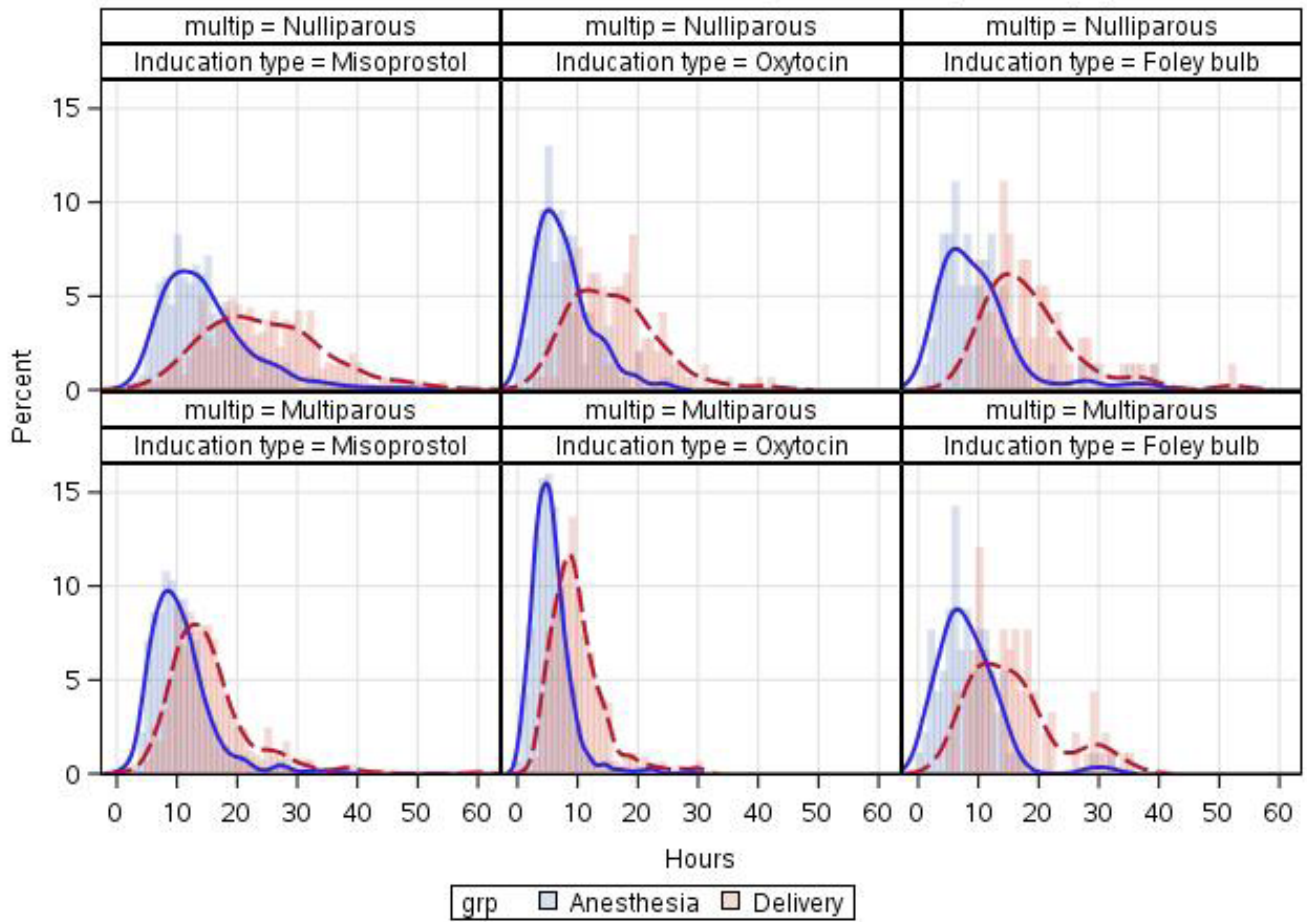
Methods: After Institutional Review Board approval, retrospective chart review of patients who had undergone IOL at a single center, were identified by an electronic medical record search between 7/2012 – 6/2017. Data collected included date of birth, race, BMI, gestational age, gravida, para, induction indication, number of prior cesarean deliveries, number of prior vaginal deliveries, time of induction, induction agent used, cervical dilation/effacement/fetal station on admission, calculated simplified bishop score on admission, time of anesthesia administration, time of delivery, delivery type, and complications. A multivariable linear regression was performed for delivery and anesthesia time. Time of initiation of IOL was calculated for various populations such that anesthesia and delivery tasks would occur during wakeful hours.

Results: There were 1,746 unique women who underwent IOL and met our inclusion criteria between 7/2012 – 6/2017. The three most common reasons for IOL were post-term gestational age, gestational hypertension, and comorbid maternal conditions. Current practice at our institution is to start most inductions between 8 and 10 am. In the multivariate model, the following were statistically significant for predicting time from induction to both delivery and anesthesia; age ($P=0.002$, $P<.001$), BMI ($P<.001$), prior vaginal deliveries ($P<.001$), gestational age in weeks ($P=0.018$, $P<.001$), simplified Bishop score ($P<.001$) and induction with oxytocin ($P<.02$). When accounting for nulliparous and multiparous patients and their induction agent, the modeled probability follows very closely to the observed curve (Figure 1). Inducing a nulliparous patient at 02:00am and a multiparous patient 04:00 or 05:00 am had the highest probability of the mother both delivering and having her first anesthesia encounter during wakeful hours. **Conclusions:** Studies have found an increased risk of adverse outcomes when deliveries occur outside of regular working hours.² With increasing use of IOL, time to anesthesia and obstetric tasks can be calculated and induction start times optimized to shift nighttime workload to the daytime.

References:

1. Grobman WA. N Engl J Med 2018;379:513–523.
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Times from induction to anesthesia and delivery in different patient populations



Abstract #: ERF2-09

Obstructive Sleep Apnea is Associated with Adverse Maternal Outcomes using a Multistate Database Cohort

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Introduction: Obstructive Sleep Apnea (OSA), a type of sleep disordered breathing involving intermittent episodes of upper airway collapse leading to hypoxia, has well described perioperative complications in the general population. Recently, there has been increasing interest surrounding OSA in the obstetric population, with previous studies suggesting an association between OSA and adverse maternal outcomes. The goal of this study was to use a large multistate administrative database to better characterize the relationship between OSA and maternal morbidity.

Methods: The State Inpatient Databases (SID), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality, was used to perform a retrospective analysis of patients ≥ 18 years old with inpatient deliveries from Florida, New York, California, Maryland, and Kentucky from 2007-2014. Patients were identified using ICD-9-CM discharge delivery codes. The primary predictor variable was the presence/absence of OSA. The main outcomes investigated through bivariate and multivariable logistic regression (controlling for a comprehensive list of patient-, hospital-, and delivery type-specific covariates) were: maternal morbidity, major organ system complications, and hospital length of stay (LOS) >5 days.

Results: The sample consisted of 6,911,916 parturients; 4326 parturients carried a diagnosis of OSA (0.06%). OSA patients were more likely to have a prior cesarean delivery, be obese, have pre-pregnancy hypertension, pre-pregnancy diabetes, and tobacco use. After a multivariate analysis patients with OSA were more likely to have increased adjusted odds ratios for cesarean delivery (aOR 1.95, 95% CI 1.81-2.11), early onset delivery (aOR 1.28, 95% CI 1.17-1.40), hysterectomy (aOR 1.72, 95% CI 1.13-2.64), LOS >5 days (aOR 2.40, 95% CI 2.19-2.64), receiving a blood transfusion (aOR 1.20, 95% CI 1.10-1.31), pulmonary edema (aOR 4.61, 95% CI 2.76-7.69), acute renal failure (aOR 1.70, 95% CI 1.12-2.58), wound complications (aOR 2.02, 95% CI 1.61-2.53).

Conclusions: Pregnant patients with OSA have a significantly higher adjusted odds of maternal morbidity compared to pregnant patients without OSA when controlling for patient-, hospital-, and delivery type- level covariates. Specifically, pregnancies of women with OSA had increased adjusted odds of delivery resulting in early onset delivery, cesarean delivery and the need for hysterectomy. This study suggests a strong, independent association between OSA and a number of adverse maternal outcomes suggesting the role for early diagnosis and management of OSA in this high risk population. A multidisciplinary approach to these patients including obstetrical anesthesia, obstetrics, and medicine should be considered.

References:

1. Carnelio S, Morton A, McIntyre J. J Obstet Gynaecol 2017; 37:170-8.
2. Louis J et al. Obstet Gynecol 2012; 120:1085e92
3. Bourjeily G et al. Sleep Med 2017; 38:50-7

Abstract #: ERF3-01

Maternal State-Trait Anxiety Assessment and Epidural Labour Analgesia

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Introduction: Anxiety has been shown to influence the perception of both acute and chronic pain. We sought to investigate the relationship between maternal state and trait anxiety, and epidural analgesia in patients undergoing term induction of labour using the State Trait Anxiety Inventory (STAI-Y) assessment. The STAI-Y is a forty construct questionnaire, twenty State and twenty Trait, with a score of 20 to 80 possible for each test respectively. The State constructs measure the respondent's feelings in the moment, while the Trait constructs measure anxiety as a long-standing characteristic.

Methods: This was an observational study of healthy primiparous women undergoing induction of labour at term and requesting epidural analgesia in labour. Upon recruitment to the study, prior to the onset of labour, and while on the antenatal ward, the patients completed the STAI-Y form. Following transfer to the labour ward, a lumbar epidural was sited at the patients' request. Pain scores and cervical dilation at the time of epidural request were recorded. Pain scores were recorded hourly thereafter until delivery. The number of PCEA demands requested and delivered, the requirement for clinician delivered rescue boluses, the total dose of levobupivacaine and fentanyl administered, and the mode of delivery was recorded. Patients who required a re-site of the epidural catheter within the first hour were excluded from the analysis. The maternal satisfaction score with a maximum value of 100 was recorded one day after delivery, specifically in relation to labour analgesia.

Results: Fifty-six mothers completed the STAI-Y assessment. Two patients failed to complete the Trait Anxiety Inventory and were excluded from the Trait Anxiety analysis. A cut-off score of 40 was used to distinguish between those women with high state and trait anxiety. There were no differences in age, weight or gestation between the groups. Twenty-two patients (40.7%) had a State Anxiety score ≥ 40 and 10 patients (18.5%) had a Trait Anxiety score ≥ 40 . There was no significant difference in primary and secondary outcomes (Table 1 and Table 2)

Conclusion: Although 40.7% of patients undergoing elective induction of labour had a high State Anxiety Score, this did not impact upon their pain scores prior to labour analgesia. Likewise, a high Trait Anxiety Score indicating a long-standing tendency toward anxiety did not influence pain in labour. In the setting of effective epidural labour analgesia, maternal state or trait anxiety per se does not influence the number of PCEA requests or the need for additional clinician administered boluses. Heightened levels of anxiety do not appear to influence labouring patients pain scores before or after epidural analgesia and should not influence anaesthesia-provider decision-making when assessing the efficacy of labour epidural analgesia.

Abstract #: ERF3-01
State Anxiety Inventory Results

	>40 (n=22)	<40 (n=34)	p
Age (years)	33 [30 – 39]	32 [28 – 34]	0.24
Weight (kg)			0.59
Gestation (weeks)	41 [39 – 42]	40 [39 – 41]	0.41
Mode of Delivery			0.49
<i>SVD</i>	7 (32)	15 (44)	
<i>Instrumental Cesarean Section</i>	7 (32) 8 (36)	8 (24) 11 (32)	
Baseline Pain Score (VAS 1-10)	7 [0 – 8]	6 [0 – 8]	0.87
PCEA Demand	10 [3 – 15]	6 [4 – 10]	0.32
PCEA Delivered	5 [2 – 9]	4 [2 – 6]	0.31
Clinician Rescue Bolus	10 (46)	8 (24)	0.14
Total Levobupivacaine (mg)	99 [74 – 113]	95 [71 – 122]	0.43
Total Fentanyl (mcg)	284 [226 – 314]	289 [239 – 306]	0.96
Maternal Satisfaction Score	95 [78 – 100]	97 [88 – 100]	0.56

Table 1. Values are presented as median [Interquartile Range] or count (%).

Trait Anxiety Inventory Results

	>40 (n=10)	<40 (n=44)	p
Age (years)	35 [31 – 40]	32 [26 – 34]	0.06
Weight (kg)	76 [58 – 103]	71 [67 – 91]	0.91
Gestation (weeks)	40 [40 – 42]	40 [39 – 41]	0.25
Mode of Delivery			0.30
<i>SVD</i>	2 (20)	19 (43)	
<i>Instrumental Cesarean Section</i>	4 (40) 4 (40)	11 (25) 14 (38)	
Baseline Pain Score (VAS 1-10)	5 [0 – 7]	7 [0 – 7]	0.25
PCEA Demand	10 [6 – 15]	6 [2 – 11]	0.14
PCEA Good	7 [4 – 8]	4 [2 – 6]	0.13
Clinician Rescue Bolus	5 (50)	12 (27)	0.26
Total Levobupivacaine (mg)	105 [75 – 136]	95 [69 – 118]	0.14
Total Fentanyl (mcg)	302 [233 – 373]	278 [236 – 302]	0.16
Maternal Satisfaction Score	95 [80 – 100]	97 [80 – 100]	0.90

Table 2. Values are presented as median [Interquartile Range] or count (%).

Abstract #: ERF3-02

Obstetric Standard Operating Room Set-up (OB SOS) Project: Standardizing Workstations for Optimal Emergency Obstetric Anesthetic Care

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Co-Authors: Rebecca Minehart

Jeremi Mountjoy, MD, MSc - Massachusetts General Hospital

Background: Anesthesia workspace organization in the operating room is critical for safe obstetric care. Literature supporting the standardization of anesthesia set-ups for general operating rooms¹ and trauma rooms² have been described to provide reliable access to essential equipment. Given the challenges inherent in providing emergency obstetric anesthesia and surgical care, we sought to evaluate our MGH obstetric operating room setup through a quality improvement (QI) initiative with the goal of facilitating expedient initiation of emergent general and neuraxial anesthesia.

Methods: We applied a standard Plan-Do-Study-Act framework for this QI initiative. To clarify major obstacles to providing care during obstetric emergencies, we administered an anonymous REDCap survey to all anesthesia providers involved in cases documented as unscheduled or emergent over 6 weeks from Dec 2019-Jan 2020. Multiple surveys regarding the same case were accepted if the survey was completed by separate providers in order to solicit multiple points of view. In addition to addressing specific concerns raised by providers, a standardized anesthesia set-up was developed, which included equipment, bundled medications, and cognitive aids. We are piloting the standardized setup and will resurvey to assess our intervention with the goal of further improvements at timed 3-month intervals.

Results: During the course of the initial survey period, 10 emergency cases were identified and 20 surveys were distributed. 16 surveys were returned for an 80% response rate. 14 respondents rated their cases as emergent, while 2 respondents considered their case urgent and were therefore excluded from analysis. Specific survey data is presented in Table 1. In 9/14 (64%) survey responses, the patient needed a general anesthetic. Survey respondents primarily noted that the lack of available medications, specialized airway equipment (specifically, close proximity of video laryngoscope) and patient monitors made care more challenging.

Discussion: In addition to standardizing obstetric operating room anesthetic equipment setup, we are working with our pharmacists to bundle emergency medications for both general and neuraxial anesthetic use. Respondents' comments also helped our focus turn toward other team members, such as housekeeping staff, who may inadvertently rearrange vital anesthetic equipment in the process of performing other necessary duties. By standardizing and then iterating upon our obstetric operating room setup we aim to improve patient safety.

References:

1. Grigg E, et al. *A&A* 2017; 124:1617-25
2. Faircloth A, Ford MB. *AANA* 2013; 81:43-49

Abstract #: ERF3-02

Table 1. Survey Summary

Survey No.	Indication	Initial Anesthetic Plan	Successful?	Alternative Plan	Problems Noted
1	Fetal	Epidural in-situ	No	GA	Airway Equip, Monitors, Pt positioning
2	Fetal	Epidural in-situ	Yes	NA	Medications, Ultrasound required
3	Fetal	Epidural in-situ	Yes	NA	Medications
4	Fetal	Spinal	Yes	NA	Airway Equip, Medications, Pt positioning
5	Maternal	GA	Yes	NA	Electronic blood checking and ordering system
6	Fetal	Epidural in-situ	Yes	NA	N/A: everything was perfect
7	Maternal and fetal	Epidural in-situ	Partially	GA	IV/IV fluids, Ultrasound
8	Maternal and fetal	Epidural in-situ	No	GA	Airway Equip, Medications, EMR access
9	Fetal	Epidural in-situ	No	GA	(Not enough time to achieve surgical level)
10	Maternal and fetal	Epidural in-situ	No	GA	N/A: everything was perfect
11	Maternal and fetal	Spinal	Yes	NA	Monitors; Ultrasound
12	Fetal	GA	Yes	NA	N/A: everything was perfect
13	Fetal	GA	Yes	NA	Airway Equip, Medications, Monitors
14	Fetal	Epidural in-situ	No	GA	Airway Equip, Medications, Monitors

Abstract #: ERF3-03

Anesthetic Management of Placenta Accreta Spectrum: A Retrospective Review

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Introduction: Placenta accreta spectrum (PAS) is a significant cause of maternal morbidity due to the hemorrhage risk. With the continuing rise in cesarean deliveries, an increase in PAS would be expected. There is, however, a lack of consensus on the optimal anesthetic management of women with PAS with both general and neuraxial techniques being reported in the literature. Our practice has seen an evolution in neuraxial technique from primarily using a lumbar combined spinal epidural technique (CSE) to more recently using a double catheter technique of a lumbar CSE with thoracic epidural catheter. The primary goal of this study is to report the anesthetic management and outcomes of PAS cases managed at a tertiary center over a seventeen-year period. The secondary aim is to compare outcomes associated with the CSE only technique versus the lumbar CSE with a thoracic epidural catheter.

Methods: Subjects with histologically confirmed PAS on the final pathology report from 2001 to 2018 were included in this retrospective analysis. The medical records were reviewed for demographic information, intraoperative management, anesthetic technique, and outcomes that included delayed hysterectomy, estimated blood loss (EBL), packed red blood cells (PRBC) transfusion requirements, and intensive care admission. Descriptive statistics are used.

Results: 86 cases of PAS were identified as meeting inclusion criteria. 53 (60.4%) cases were scheduled and 33 (39.5%) cases were unscheduled. General anesthesia (GA) was used to start 18 (20.9%) cases, of which 3 were hysterectomies after vaginal delivery with postpartum hemorrhage. 68 (79%) cases were started with neuraxial anesthesia, of which 28 (32.6%) cases required conversion to GA. 16 (18.6%) cases performed used a CSE technique with a thoracic epidural catheter. Table 1 details the neuraxial techniques used and associated outcomes (conversion to GA, ICU admission, hospital readmission, delayed hysterectomy, EBL, number of PRBC units, and postoperative length of stay) by scheduled and non-scheduled cases according to preoperative PAS identification. Conversion to GA occurred in 2 cases with the double catheter technique (12.5%) and in 11 patients with the CSE technique (34.4%). Neither of the double catheter conversions were due to patient discomfort whereas the CSE group had eight conversions due to patient discomfort. Other indications for conversion to GA included hemorrhage (CSE 2, double catheter 1) and hemodynamic instability (CSE 1).

Conclusion: Our institution has seen the evolution of PAS anesthetic management from primarily using a CSE technique to a CSE with thoracic epidural technique. The sample size is small; however, there seems to be less conversion to GA due to patient discomfort with the double catheter technique.

Abstract #: ERF3-03

Table 1. Anesthesia techniques divided by scheduled and unscheduled cases with known or unknown PAS					
Scheduled Case, Known PAS Antepartum n = 42 (79.2%)					
	General Anesthesia	Combined Spinal Epidural Anesthesia	Lumbar Epidural Anesthesia	Lumbar Technique & Thoracic Epidural	Single Shot Spinal Anesthesia
N =	2 (4.7%)	20 (47.6%)	5 (11.9%)	15 (35.7%)	0 (0.0%)
Converted to GA	N/A	5 (25%)	3 (60%)	2 (13.3%)	N/A
Reason & Timing for Conversion					
Patient Discomfort	N/A	3 (pre = 1, post = 2)	2 (pre = 1, post = 1)	N/A	N/A
Hemorrhage	N/A	1 (post)	N/A	1 (post)	N/A
Other	N/A	1 (post)	Heme positive catheter (pre)	1 (post)	N/A
ICU Admission	0 (0.0%)	2 (10%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Re-admission	0 (0.0%)	4 (20%)	1 (20%)	0 (0.0%)	N/A
Immediate Hysterectomy	0 (0/0%)	12 (60%)	3 (60%)	8 (53.3%)	N/A
Delayed Hysterectomy	2 (100%)	8 (40%)	2 (40%)	7 (46.7%)	N/A
Estimated Blood Loss (mL)	1100 ± 141	1763 ± 1337	1050 ± 654	1067 ± 498	N/A
PRBC units n (%) (mean ± SD)	None	7 (35%) 4.4 ± 3.3	1 (20%) 3	3 (20%) 1.7 ± 0.6	N/A
Length of Stay (days)	4 ± 1.4	4.1 ± 1.5	3.6 ± 0.5	3.6 ± 0.6	N/A
Scheduled Case, Unknown PAS Antepartum n = 11 (12.7%)					
	General Anesthesia	Combined Spinal Epidural Anesthesia	Lumbar Epidural Anesthesia	Lumbar Technique & Thoracic Epidural	Single Shot Spinal Anesthesia
N =	0 (0/0%)	5 (45.4%)	0 (0.0%)	1 (9.1%)	5 (45.4%)
Converted to GA	N/A	3 (60%)	N/A	N/A	4 (80%)
Reason & Timing for Conversion					
Patient Discomfort	N/A	3 (pre = 2, post = 1)	N/A	N/A	2 (post)
Hemorrhage	N/A	N/A	N/A	N/A	2 (post)
ICU Admission	N/A	3 (60%)	N/A	0 (0.0%)	1 (20%)
Re-admission	N/A	0 (0.0%)	N/A	0 (0.0%)	1 (20%)
Immediate Hysterectomy	N/A	5 (100%)	N/A	1 (100%)	5 (100%)
Delayed Hysterectomy	N/A	0 (0.0%)	N/A	0 (0.0%)	0 (0.0%)
Estimated Blood Loss (mL)	N/A	3360 ± 757	N/A	2500	2950 ± 1151
PRBC units n (%) (mean ± SD)	N/A	5 (100%) 4.8 ± 2.4	N/A	0 (0.0%)	4 (80%) 3.2 ± 2.5
Length of Stay (days)	N/A	4.6 ± 1.5	N/A	4	3.8 ± 0.4
Unscheduled Case, Known PAS Antepartum n = 15 (17.4%)					
	General Anesthesia	Combined Spinal Epidural Anesthesia	Lumbar Epidural Anesthesia	Lumbar Technique & Thoracic Epidural	Single Shot Spinal Anesthesia
N =	11 (73.3%)	4 (26.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Converted to GA	N/A	1 (25%)	N/A	N/A	N/A
Reason & Timing for Conversion					
Patient Discomfort	N/A	1 (post)	N/A	N/A	N/A
ICU Admission	4 (36.3%)	1 (25%)	N/A	N/A	N/A
Re-admission	3 (27.2%)	0 (0.0%)	N/A	N/A	N/A
Immediate Hysterectomy	6 (54.5%)	4 (100%)	N/A	N/A	N/A
Delayed Hysterectomy	5 (45.4%)	0 (0.0%)	N/A	N/A	N/A
Estimated Blood Loss (mL)	2691 ± 2867	3200 ± 1431	N/A	N/A	N/A
PRBC units n (%) (mean ± SD)	7 (63.6%) 7.3 ± 8.5	4 (100%) 4 ± 2.2	N/A	N/A	N/A
Length of Stay (days)	3.8 ± 0.8	4 ± 0.8	N/A	N/A	N/A
Unscheduled Case, Unknown PAS Antepartum n = 18 (20.9%)					
	General Anesthesia	Combined Spinal Epidural Anesthesia	Lumbar Epidural Anesthesia	Lumbar Technique & Thoracic Epidural	Single Shot Spinal Anesthesia
N =	5 (27.8%)	3 (16.7%)	6 (33.3%)	0 (0.0%)	4 (22.2%)
Converted to GA	N/A	2 (66.7%)	4 (66.7%)	N/A	4 (100%)
Reason & Timing for Conversion					
Patient Discomfort	N/A	1 (pre)	1 (pre)	N/A	3 (post)
Hemorrhage			3 (post)		1 (post)
Hemodynamic Instability		1 (post)			
Other					
ICU Admission	2 (40%)	0 (0.0%)	5 (83.3%)	N/A	2 (50%)
Re-admission	0 (0.0%)	0 (0.0%)	2 (33.3%)	N/A	0 (0.0%)
Immediate Hysterectomy	5 (100%)	3 (100%)	6 (100%)	N/A	4 (100%)
Delayed Hysterectomy	0 (0.0%)	0 (0.0%)	0 (0.0%)	N/A	0 (0.0%)
Estimated Blood Loss (mL)	3110 ± 1691	2167 ± 577	3500 ± 1049	N/A	4825 ± 2307
PRBC units n (%) (mean ± SD)	4 (80%) 5 ± 3.4	1 (33.3%) 2	6 (100%) 7.5 ± 3.7	N/A	4 (100%) 9.8 ± 7.2
Length of Stay (days)	3.8 ± 0.8	3.3 ± 0.6	4.7 ± 1.9	N/A	4.2 ± 1.5

Data are mean ± SD or n(%). Abbreviations: PAS = placenta accreta spectrum, PRBC = packed red blood cells, pre = pre-delivery, post = post-delivery

Abstract #: ERF3-04

Can the Addition of P6 Stimulation to Scopolamine Patch Further Reduce Nausea During Cesarean Section? A Randomized Controlled Trial.

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Introduction: Nausea is an unpleasant physical condition experienced by 73-80% of parturients having caesarean section (CS) under regional anaesthesia.^{1,2} Intraoperative vomiting causes additional challenges, such as inadvertent surgical trauma, increased risk of bleeding, and aspiration pneumonitis.^{3,4} Various prophylactic antiemetic medications have been utilized in the past, but they are not entirely effective and may have multiple adverse effects. One non-pharmacological technique, stimulation of P6 acupoint, has been found to be effective in reduction of intraoperative nausea^{1,3} and vomiting.¹ To our knowledge, no published clinical trial has investigated whether the addition of transdermal scopolamine patch to P6 stimulation could be even more effective in the reduction of intra-caesarean nausea.

Objective: The goal of our randomized clinical trial was to compare the effectiveness of reducing intra-CS nausea in parturients who receive the transdermal scopolamine patch versus those that receive P6 stimulation versus those that receive the combination of transdermal scopolamine patch with the P6 stimulation.

Methods: Following IRB approval and informed consent, 236 parturients undergoing elective CS under combined spinal-epidural anesthesia were randomly allocated into: Group I (n=80) - scopolamine patch group, Group II (n=78) - P6 stimulation group (Figure 1), and Group III (n=78) - scopolamine patch with P6 stimulation group. P6 stimulation and scopolamine patch were applied 1 hour prior to the CS and administered from that point and until the completion of the cesarean section. All groups were compared with the control group (no prophylactic antiemetic treatment) from our recent published clinical trial.¹

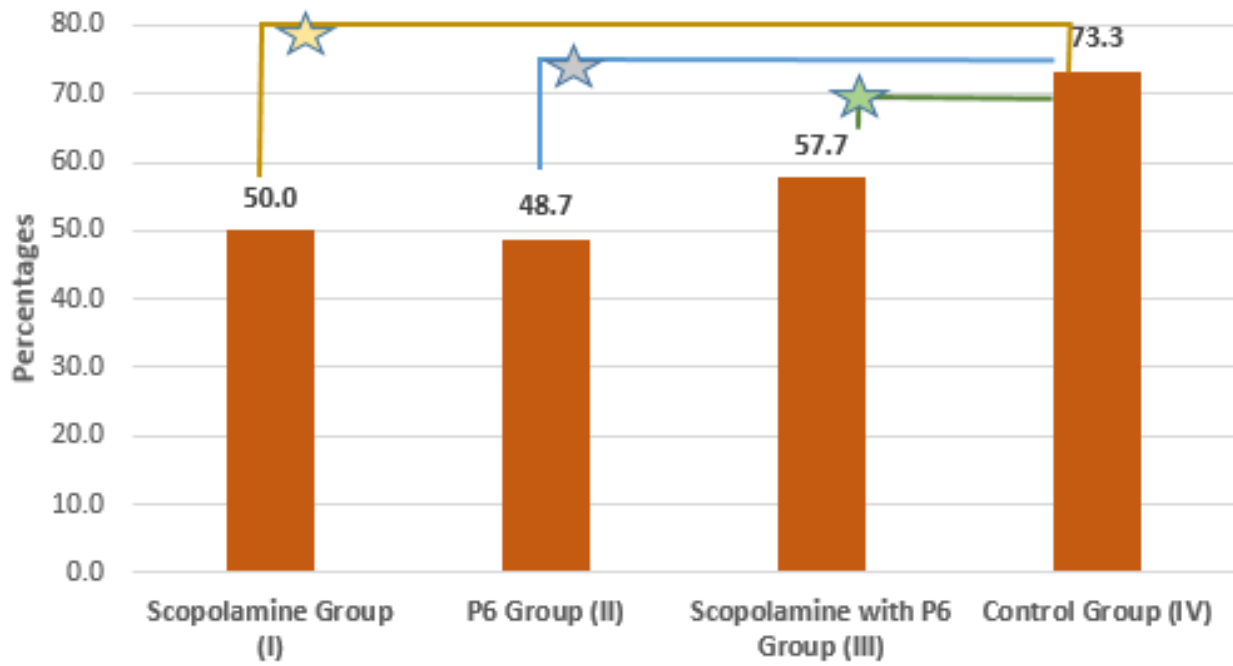
Results: Baseline characteristics were similar between the four study groups (Table I). There were statistically significantly fewer patients who experienced nausea in the study groups as compared to those in the control group (50%, 48.7%, 57.7%, vs 73.3%, p=0.02). However, there was no statistical significant difference between the percentages of patients who experienced nausea in the three study groups (Fig 2).

Conclusion: All three of our treatment groups experienced less nausea than in our control group. However, there does not appear to be an additive antiemetic effect of the combination of scopolamine patch with P6 stimulation. Our data suggests that transdermal scopolamine patch application and P6 stimulation are simple, effective alternative antiemetic treatments that could be of great interest to patients and obstetric anesthesiologists who prefer less invasive care with fewer side effects for CS performed under regional anesthesia.

References:

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2. Lussos SA, et al. *Reg Anesth.* 1992;17(3):126-130.
3. Griffiths JD, et al. *Cochrane Database Syst Rev.* 2012(9):Cd007579.
4. Bremner WG, et al. *Br J Anaesth.* 1993;71(2):296-297.
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Figure II. Parturients who Experienced Nausea



☆ *P values* were calculated using the Chi-square test, and *P-values* less than 0.05 were considered statistically significant.

I vs IV: $P = 0.005$; II vs IV: $P = 0.0004$; III vs IV: $P = 0.004$

Abstract #: ERF3-05

Obstetric and anesthetic management in parturients with peri-partum neurovascular abnormalities: a case series.

Presenting Author: Amanda McCormick, MD

Presenting Author's Institution: Mayo Clinic School of Graduate Medical Education

Co-Authors: Jeffrey Pasternak, MD - Mayo Clinic

Emily Sharpe, MD - Mayo Clinic

Tasha Welch, M.D. - Mayo Clinic

BACKGROUND: No definite guidelines exist for obstetric and anesthetic management of peri-partum neurovascular disorders. This case series offers a comparative approach to gravid patients with arteriovenous and cavernous malformations, aneurysms and other less frequently encountered central nervous system (CNS) vascular abnormalities.

METHODS: Information was gathered from a secure institutional database to include all pregnant patients evaluated by neurology and/or neurosurgery at a single institution between January 2000 and October 2019 for any central nervous system vascular abnormality. Patients were included if evaluation by neurology or neurosurgery occurred either before, during pregnancy or up to 6 months post-partum. Individual profiles were analyzed to collect unique neurovascular, obstetric and anesthetic considerations for each case.

RESULTS: A total of twenty-three patients were included, of which twenty presented for evaluation during pregnancy. Individuals presented often with symptoms – seizure, severe headache, neurological deficit – whereas two were asymptomatic undergoing routine examination. Thirty-five percent (n=8) were diagnosed with cavernous malformation, thirty percent (n=7) with cerebral arteriovenous malformation (AVM), and the remainder with aneurysm (n=3), dural AV fistula (n=2), venous angioma (n=1), carotid dissection (n=1), or moyamoya (n=1). Fourteen patients had a vaginal delivery and nine had cesarean delivery (CD). The presence of neurovascular abnormality was an indication for induction of labor in three individuals and for CD in twenty-two percent (n=5) of all deliveries. Parturients who labored received epidural (n=12), combined spinal-epidural (n=1) and no neuraxial (n=1) for labor analgesia. Parturients who had CD had a spinal (n=7), preexisting labor epidural (n=1), and general anesthesia (n=1) for neurologic indications. There were no complications from neuraxial anesthesia.

CONCLUSIONS: Diagnosis of CNS vascular abnormality in the peri-partum period is infrequent and poses unique challenges to obstetric and anesthetic management. Induction of labor or cesarean delivery may be indicated to prevent further complications; however, the decision to proceed with either is proposed on an individual basis. Neuraxial anesthesia and analgesia can be offered to women with CNS vascular abnormalities without abnormal neurologic symptoms. This case series demonstrates the largely untapped potential for future studies to establish practice guidelines for managing gravid patients with similar neurovascular abnormalities.

Abstract #: ERF3-06

A Quality Assurance Assessment of Variables Common to Patients with Surgical Site Infections Following Cesarean Delivery

Presenting Author: Anna Moldysz, MD

Presenting Author's Institution: University of Iowa Hospitals & Clinics

Co-Authors: Cynthia Wong

Introduction: Surgical site infections (SSI) and endometritis continue to cause morbidity following cesarean delivery. The incidence of SSIs ranges from 2-7% and endometritis 2-16%. Risk factors include obesity, previous cesarean delivery, hypertensive disorders, premature rupture of membranes, gestational diabetes mellitus, and emergency cesarean deliveries. The rate of infection in our institution is higher than expected (i.e., observed to expected ratio > 1). Identifying variables associated with infection may help guide management to target prevention of SSIs.

Methods: This quality assessment began with a review of data collected from 10 patients at our tertiary care center who developed SSI or endometritis following cesarean delivery within the past 6 months. Among the data collected were variables such as timing and type of antibiotic administration, time of day of operation, estimated blood loss (EBL), duration of procedure, location of procedure, and intraoperative temperature management. Extending data to a 1-year period, and collection of control data (patients who did not have an infection) are planned.

Results: Of the 10 patients with SSIs or endometritis, 4/10 had an antibiotic regimen that did not include cefazolin (most often clindamycin and gentamicin) due to report of a rash or urticaria to penicillin. 8/10 did not have intraoperative temperature measurement. 4/10 were elective cases, and 6/10 were performed during the night or weekend hours. Mean EBL was 1176 mL with a standard deviation of 620 mL. Mean duration was 1.07 hours.

Discussion: Patients at our tertiary care center who have developed SSIs or endometritis after cesarean delivery within the last 6 months frequently did not have intraoperative temperature monitored and often had alternate antibiotic regimens that are not considered first-line prophylactic therapy for cesarean delivery. Anesthesia-controlled variables such as timing of antibiotic administration and intraoperative temperature may be associated with infection. Adding a control group will allow us to further develop quality assessment to identify whether there is an association between intraoperative antibiotics timing and type, and temperature management and development of infections.

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1. Kawakita T, Landy HJ. Surgical site infections after cesarean delivery: epidemiology, prevention and treatment. *Matern Health Neonatol Perinatol.* 2017;3:12. Published 2017 Jul 5. doi:10.1186/s40748-017-0051-3
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Abstract #: ERF3-07

Anesthetic Considerations of Parturients with Ventriculoperitoneal Shunts: A Case Series

Presenting Author: Ashley Peterson, MD

Presenting Author's Institution: Mayo Clinic

Co-Authors: Jeffrey Pasternak, MD - Mayo Clinic

Emily Sharpe, MD - Mayo Clinic

Tasha Welch, M.D. - Mayo Clinic

Background: Ventriculoperitoneal shunts (VPS) are placed for multiple indications. Further study is needed to determine the safest mode of delivery and anesthetic management for parturients with VPS. Prior recommendations for delivery in women with VPS was cesarean delivery (CD); however, evidence now suggests vaginal delivery (VD) can be as safe (1). VPS malfunction is more common in pregnancy. Research shows neuraxial anesthesia is safe in women with normal VPS function (2). We present a case series of pregnant women with VPS who delivered at Mayo Clinic.

Methods: After institutional review board approval, an institutional database was queried to identify all pregnant women with VPS. Patient records were manually reviewed to assess VPS placement indications, neurologic symptoms during pregnancy, delivery mode, anesthetic type, and postpartum complications.

Results: Twenty-two patients were identified and 11 women were included. Patients were excluded if they did not have VPS during pregnancy. The most common indication for VPS placement was congenital hydrocephalus (n=4, 36%). Other indications included hydrocephalus of unknown origin (n=3), meningomyelocele (n=1), meningitis (n=1), intraventricular hemorrhage (n=1), and pseudotumor cerebri (n=1). Two women experienced neurologic symptoms during pregnancy and one of them required VPS revision for blurry vision and ataxia.

Five women had CD (2 repeat, 1 for arrest of descent, 1 for preeclampsia with severe features, and 1 for macrosomia). Six women had VD (5 normal spontaneous VD, 1 vacuum assisted, and 1 forceps assisted). The assisted vaginal deliveries were performed to decrease Valsalva in these patients. Of the women who had VDs, three had epidurals, two received IV opioid analgesia, and one requested no analgesia. Anesthesia for CD included spinal anesthesia (n=4) and general anesthesia (n=1) recommended by her anesthesiologist due to her history of VPS.

One of 11 parturients had complications during the postpartum period. The patient who required shunt revision during pregnancy had neurologic decline and distal shunt occlusion 11 days postpartum and required VPS removal. Her symptoms improved after VPS removal.

Discussion: Complications with VPS can occur during pregnancy and the postpartum period and any neurologic changes should be assessed. CD should be reserved for obstetric indications in patients with VPS. In our cohort, women with VPS received neuraxial anesthesia and analgesia without complication. Neuraxial anesthesia for CD and analgesia for VD should be offered to women with VPS without abnormal neurologic symptoms.

References:

1. Landwehr JB, Obstet Gynecol. 1994 Jan;83(1):134-7
2. Rajagopalan S. Int J Obstet Anesth. 2017 May;30:23-29

Abstract #: ERF3-08

Assessing near-infrared spectroscopy (NIRS) as a tool for evaluating adequate spinal anesthesia for cesarean delivery: Prospective observational study

Presenting Author: Ilai Ronel

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Background: Pain during cesarean delivery (CD) is a major concern (1), and objective modalities to evaluate whether spinal anesthesia (SA) will produce an adequate block for CD are lacking. Effective SA is expected to produce a sympathetic block, leading to vasodilatation, with increased tissue perfusion. Near-infrared spectroscopy (NIRS) non-invasively measures tissue oxygenation (StO₂), a surrogate for perfusion (2). NIRS has been previously used to monitor cerebral oximetry and lower limb ischemia during cardiac surgery (2,3). We hypothesized that NIRS monitoring can identify effective SA prior to CD.

Methods: NIRS was assessed in 25 women undergoing term elective CD, with a 1st pass SA. Sensors were placed on the thigh (Leg-SA) and ipsilateral shoulder (Arm-control). Baseline measurements (NIRS, blood pressure, heart rate) were recorded in supine position prior to SA. Intrathecal hyperbaric bupivacaine 10 mg, fentanyl 25 mcg and morphine 100 mcg were administered while co-loading with 1L Ringer's Lactate. Immediately after SA, a phenylephrine infusion was started at 50 mcg/min. Post-spinal NIRS measures at 3, 5, 10 and 20 min identified whether a change in Leg and or Arm perfusion occurred. Pain score (NPS, 0 to 10) was assessed at skin incision. Change over time for NIRS was analyzed using repeated measures analysis of variance (ANOVA), and comparisons to baseline analyzed using a paired test, $p < 0.05$ significant.

Results: All women reported 0 pain at surgical incision; mean(SD) age was 36(5.6), surgery duration 28.8(9.9) minutes. Leg/Arm baseline NIRS values were similar ($p=0.81$). ANOVA revealed a significant change of Leg NIRS, (Wilks-Lambda 0.262, $p < 0.0001$) and no change for Arm NIRS (Wilks-Lambda 0.683, $p=0.08$) over time (Figure). Leg NIRS increased significantly from baseline at all time points (Table). Arm NIRS did not change significantly from baseline at any time-point.

Discussion: In non-obese women, following SA, Leg NIRS values increased significantly, with no change in the Arm NIRS (control), indicating increased lower body perfusion from vasodilatation following adequate SA. Future studies will assess whether this non-invasive device can robustly discriminate between effective and ineffective SA, and reduce the likelihood for pain during CD.

References:

1. Einhorn et al. Canadian journal of anesthesia 2016
2. Prkic et al. Journal of clinical Anesthesia 2016
3. Serraino et al. BMJ open 2017

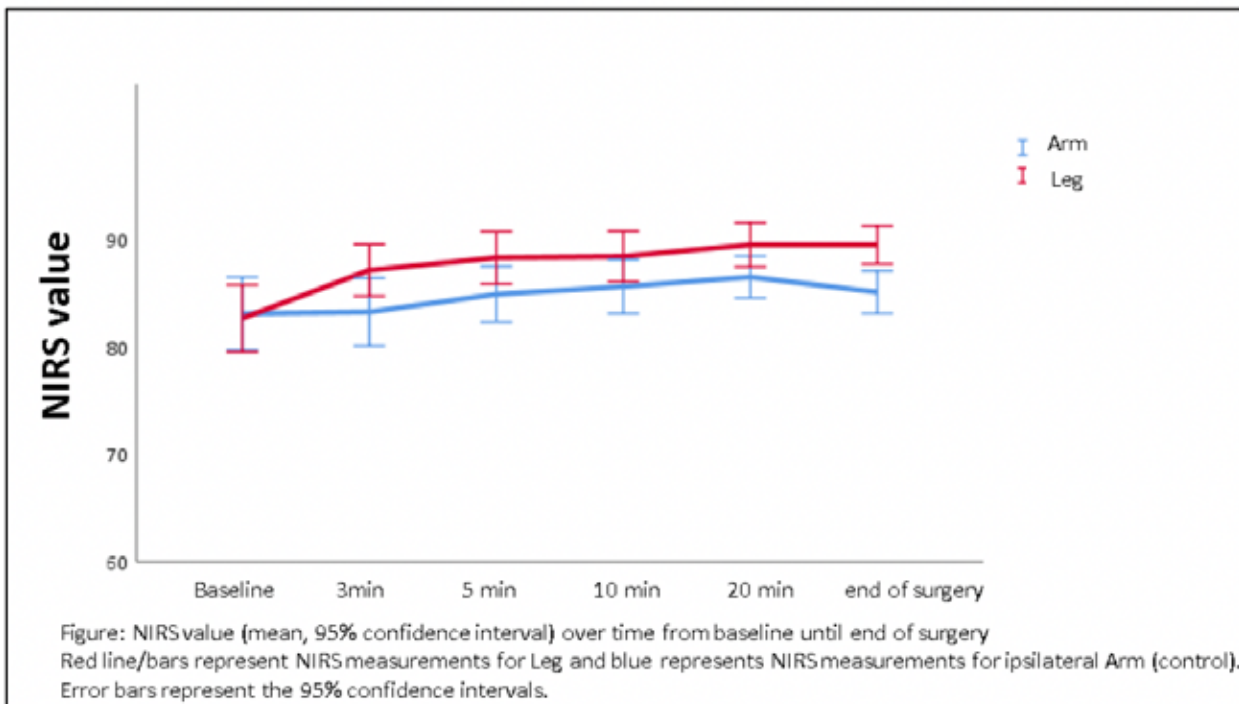
Abstract #: ERF3-08

Table: Measurements, n=25

mean(SD)	Baseline	3 mins	5 mins	10 mins	20 mins	End
Leg NIRS - (spinal anesthesia)	82.6 (7.6)	87.1 (5.8)	88.3 (5.9)	88.4 (5.7)	89.9 (5.0)	89.5 (4.3)
Leg NIRS change from baseline (p-value)	NA	P<0.001	P<0.0001	P<0.0001	P<0.0001	NA
Arm NIRS (control)	83.1 (8.2)	83.2 (7.7)	84.9 (6.3)	85.6 (6.1)	86.5 (4.7)	85.1 (4.8)
Arm NIRS change from baseline (p-value)	NA	P=1.0	P=1.0	P=0.60	P=0.09	NA
Systolic blood pressure (mmHg)	133 (15)	118 (19)	120 (18)	130 (15)	113 (16)	100 (16)
Heart rate (bpm)	94 (13)	91 (21)	80 (20)	72 (15)	78 (14)	82 (11)

Key: SD – standard deviation, mins – minutes, end – end of surgery, NIRS – near-infrared spectroscopy, bpm – beats per minute, NA – Not applicable, p-value – calculated using ANOVA with Bonferroni correction

Figure: NIRS change over time



Abstract #: ERF4-01

Obstetric Critical Care Anesthesiologists: Current State and Growing Need

Presenting Author: Kaitlyn Brennan, DO MPH

Presenting Author's Institution: Vanderbilt University Medical Center

Co-Authors: David Chestnut, MD - Vanderbilt University Medical Center

Introduction: The overall rate of severe maternal morbidity in the United States has increased nearly 200% from 1993 to 2014. The maternal mortality rate has increased accordingly, becoming the sixth leading cause of death among women aged 20-34 in the United States.¹ The increasing complexity of obstetric patients has prompted the development of scoring systems for both comorbidity burden and early warning signs of deterioration.^{2,3} The training of physicians in both obstetrics and critical care medicine (CCM) is a way to provide the highest quality care to this challenging patient population. Anesthesiologists have access to Accreditation Council for Graduate Medical Education (ACGME)-accredited fellowships in both CCM and obstetric anesthesiology. Obstetricians with subspecialty training in maternal-fetal medicine (MFM) also have access to ACGME-accredited fellowships in either anesthesiology CCM (ACCM) or surgery critical care (SCC). Anesthesiologists may obtain certification in ACCM from the American Board of Anesthesiology (ABA); currently there is no option for certification in obstetric anesthesia. MFM-trained obstetricians who obtain additional training in ACCM or SCC may seek certification from either the ABA or the American Board of Surgery (ABS), depending on the type of fellowship they complete.

Methods: We queried the ABA, the ABS, and the American Board of Obstetrics and Gynecology (ABOG) to determine the number of ABA and ABOG diplomates with certification in either ACCM or SCC. We also queried the ABA to determine the number of ABA diplomates who have completed ACGME-accredited fellowships in either obstetric anesthesia or ACCM, as well as the number who have completed both.

Results: Three anesthesiologists have completed ACGME-accredited fellowships in both obstetric anesthesia and ACCM. We anticipate an additional four completing dual training in the 2020-2021 cycle. This represents 0.4% of all ACGME-accredited ACCM trained anesthesiologists, and 1.7% of those who have completed an ACGME-accredited obstetric anesthesia fellowship. Ten ABOG diplomates have completed the MFM ACCM pathway over the last 10 years, and 16 have completed the MFM SCC pathway over the last 30 years.

Discussion: Optimal care of critically ill parturients requires physicians with specialized skill sets. Our data confirm that few physicians have obtained specialized training in both obstetrics (or obstetric anesthesia) and CCM. Anesthesiologists are uniquely positioned to care for these complex patients, and training in both obstetric anesthesia and ACCM holds potential to improve care of critically ill obstetric patients.

References:

1. Heron M. Natl Vital Stat Rep. (2019) 68:1-76.
2. Bateman BT. Obstet Gynecol. 2013. (5):957-65.
3. Mhyre Obstet Gynecol Neonatal Nurs. (2014) 6:771-779.

Abstract #: ERF4-02

Failed neuraxial anesthesia requiring conversion to general anesthesia during elective cesarean delivery: a retrospective cohort study

Presenting Author: Charles Prior, BSc, MBChB, FRCA

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Co-Authors: Cyrus Bhiladvala, BSc - BC Women's Hospital

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Ilar Tanha - BC Women's Hospital

Introduction: Neuraxial anesthesia (NA) is the contemporary gold standard for cesarean deliveries (CD). Benchmark figures for best practice have been proposed to keep general anesthesia (GA) conversions to < 1% and < 5% in elective and emergency CDs, respectively.⁽¹⁾ However, failed NA has also been reported to occur at 5-15% under spinal or epidural anesthesia, and in some cases, conversion to GA is necessary.⁽¹⁾ Nevertheless, GA conversions that occur during an elective CD may potentially be avoided. We hypothesized our rate of GA conversion due to failed NA is < 1% for elective CD.

Methods: Following exemption from institutional ethics review, departmental inpatient acute pain service database between January 1 and December 31, 2017 was reviewed. This database captures all parturients delivered via CD including the anesthetic technique used and urgency of delivery. For patients who received GA, paper charts were reviewed independently by two anesthesiologists to capture reasons and timing for GA. The primary outcome was rate of GA conversions due to failed NA in elective CD. The incidence of failed NA between elective vs. urgent/emergent CDs were compared using Fisher exact test.

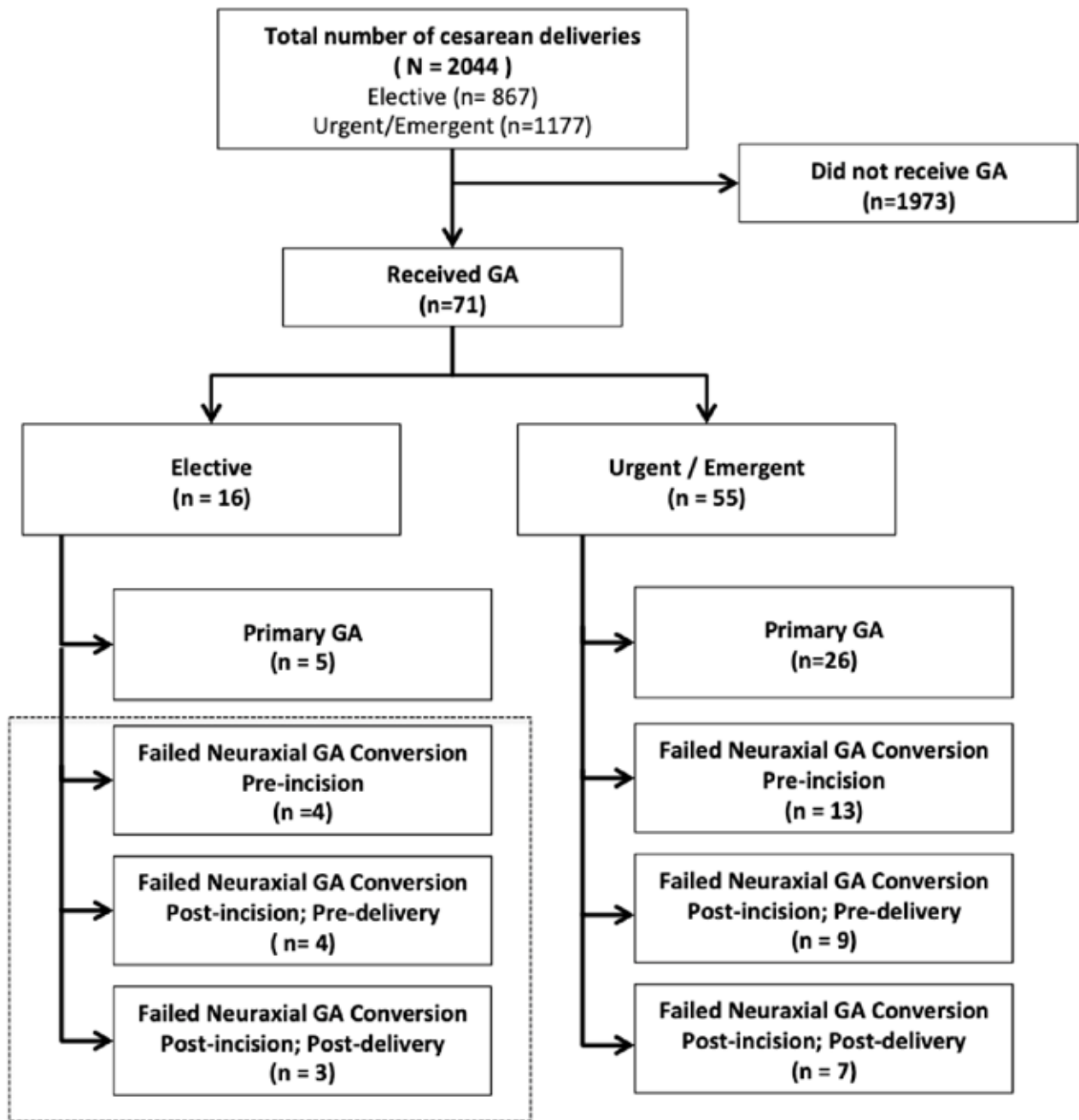
Results: There was a total of 2044 CDs during the study period, with an overall GA rate of 3.5% (71/2044), with 0.8% and 2.7% occurring in elective and urgent/emergent CDs, respectively. The overall rate of GA conversion was 2% (40/2013). When stratified for case urgency, the rate of GA conversion was 1.3% (11/867) and 2.5% (29/1151) for elective and urgent/emergent CDs, respectively. In elective patients who received GA, 8/16 (50%) of the NA block failure occurred pre-delivery and all eight patients had a history of either drug abuse or anxiety and a second neuraxial technique was not attempted. There was no significant difference between the rates of GA conversions due to failed NA in elective vs. urgent/emergent CDs (68.8 vs. 52.7%, p=0.39) (See Fig. 1)

Discussion: Our rate of GA conversion (1.3%) is outside the proposed benchmark target for elective CDs (< 1%).⁽¹⁾ However, analysis of the reasons for conversion suggest this target may be too restrictive as a quality marker as many GA conversions were deemed clinically appropriate. However, we found opportunities to further lower this rate, including better rescue protocol of failed NA. A more rigorous prospective evaluation is warranted.

References:

1. Purva M et al. A compendium of audit recipes, 3rd edn. Royal College of Anaesthetists 2012

Abstract #: ERF4-02



Abstract #: ERF4-03

An Interdisciplinary Maternal Hemorrhage Rapid Response ‘Code H’ Protocol: Process and Development of a Quality Improvement Initiative

Presenting Author: Bahaa E. Daoud, M.D.

Presenting Author’s Institution: Columbia University - New York, New York

Co-Authors: Ruth Landau

Laurence E. Ring, MD - Columbia University

Background: With the healthcare imperative to reduce maternal morbidity & mortality in the U.S., hospitals are urged to develop team-based, emergency response protocols centered around early identification & rapid stabilization. According to the AHA, rapid response teams in general populations improve patient outcomes. The ACOG Safe Motherhood Initiative (SMI) provided a framework to optimize maternal care during PPH.¹

An unexpected cesarean/hysterectomy with massive PPH and unavailable blood products triggered an RCA that identified 3 areas for improvement: 1) Clear communication between providers and specific roles for nurses, 2) access to blood products during MTP activation and 3) delays in lab tests processing. In response, an interdisciplinary taskforce was convened to develop and implement a team-based, rapid response ‘Code H’ protocol to address all possible scenarios of PPH (post-vaginal delivery, intra-cesarean delivery, delayed PPH), with the goal to approach PPH as cardiac arrests are, with defined roles and algorithms.

Methods: The taskforce included 3 obstetric anesthesiologists, 3 obstetricians, 2 nurses, a perinatal patient safety coordinator, and a QI expert. Using the RCA findings, weekly meetings over 2 months assessed all causes for delayed transfusion, and iterative conversations were needed to achieve consensus. The 1st step identified that different algorithms are needed based on patient location (labor room, intra-cesarean delivery or postpartum); The 2nd step was to agree on the triggers for ‘Code H’; objective measures were selected based on SMI PPH: Stage 2: ongoing bleeding < 1000ml (vaginal) or 1500ml (cesarean), or the use of > 2 uterotonics (excluding oxytocin). The 3rd step, was to create a ‘Code H’ emergency cart, which is to be brought into the patients’ room once triggered. The 4th step was to define specific nurses’ roles. The 5th step consisted of an in-situ simulation of PPH to test and validate the 4 steps.

Results: The taskforce produced a ‘Code H’ emergency cart, and 2 documents: a modified SMI PPH checklist that includes clinical status (Figure) and a chart with designated roles for 4 nurses (Table), with additional tasks if PPH occurs outside of the operating room.

Conclusions: Code H offers a structured process to guide nurses during PPH, optimize access to blood products in the setting of a remote blood bank, and provide a framework for obstetricians and anesthesiologists while managing PPH in or outside of the operating room.

Next steps will include audits that will evaluate whether ‘Code H’ was adequately triggered, nurses’ roles are sufficiently clear and well adopted, and whether time to blood products access is optimized. The checklists will be reviewed in 6 months.

References:

1. <https://www.acog.org/-/media/Districts/District-II/Public/SMI/v2/SMIHemorrhageChecklistREVISEDJUNE2019.pdf?d-mc=1&ts=20200203T1334309487>

[SMI Modified PPH Algorithm and Table with Nurses Roles.pdf](#)

Obstetric Hemorrhage Checklist

PLACE PATIENT LABEL HERE

Designate: Team leader _____ Checklist reader/recorder Primary RN

Stage 1: Blood loss >1000mL after delivery with normal vital signs and lab values.
Vaginal delivery 500-999mL should be treated as in Stage 1.

Initial Steps:

- Ensure 16G or 18G IV Access
- Increase IV fluid (crystalloid without Oxytocin)
- Insert indwelling urinary catheter
- Fundal massage

Medications:

- Ensure appropriate medications given patient history
- Increase oxytocin, additional uterotonics

Blood Bank:

- Confirm active type and screen and consider crossmatch of 2 units PRBCs

Action:

- Determine etiology and treat
- Prepare OR, if clinically indicated (optimize visualization/examination)

Oxytocin (Pitocin):
30 units per 500L solution

Methylergonovine (Methergine):
0.2 milligrams IM (may repeat);
Avoid with hypertension

15-methyl PGF₂α (Hemabate, Carboprost): 250 micrograms IM (may repeat in q15 minutes, maximum 8 doses); **Avoid with asthma; use with caution with hypertension**

Misoprostol (Cytotec):
800-1000 micrograms PR
600 micrograms PO or 800 micrograms SL

Tone (i.e., atony)
Trauma (i.e., laceration)
Tissue (i.e., retained products)
Thrombin (i.e., coagulation dysfunction)

Vitals Signs Reminder				
<input type="checkbox"/> Vitals q5 mins	<input type="checkbox"/> Vitals q5 mins	<input type="checkbox"/> Vitals q5 mins	<input type="checkbox"/> Vitals q5 mins	<input type="checkbox"/> Vitals q5 mins

QBL Tracker							
Time: _____	Time: _____	Time: _____	Time: _____	Time: _____	Time: _____	Time: _____	Time: _____
QBL: _____	QBL: _____	QBL: _____	QBL: _____	QBL: _____	QBL: _____	QBL: _____	QBL: _____

Call Code H at Stage 2

Stage 2: Continued Bleeding (QBL up to 1500mL OR > 2 uterotonics) with normal vital signs and lab values

Abstract #: ERF4-03

Stage 2: Continued Bleeding (QBL up to 1500mL OR > 2 uterotonics) with normal vital signs and lab values

Initial Steps:

- Mobilize additional help
- Place 2nd IV (16-18G)
- Draw STAT labs (CBC, Coags, Fibrinogen)
- Prepare OR

Medications:

- Continue Stage 1 medications; consider TXA

Blood Bank:

- Obtain 2 units PRBCs
(DO NOT wait for labs. Transfuse per clinical signs/symptoms)
- Thaw 2 units FFP

Action:

- For uterine atony --> consider uterine balloon or packing, possible surgical interventions
- Consider moving patient to OR
- Escalate therapy with goal of hemostasis

Tranexamic Acid (TXA)
1 gram IV over 10 min (add 1 gram vial to 100mL NS & give over 10 min; may be repeated once after 30 min)

Possible interventions:

- Bakri balloon
- Compression suture/B-Lynch suture
- Uterine artery ligation
- Hysterectomy

Huddle and move to Stage 3 if continued blood loss and/or abnormal VS

Revised June 2019

In OR: Hemodynamic Status Reminder:					
<input type="checkbox"/> Discuss q10 mins	<input type="checkbox"/> Discuss q10 mins	<input type="checkbox"/> Discuss q10 mins	<input type="checkbox"/> Discuss q10 mins	<input type="checkbox"/> Discuss q10 mins	<input type="checkbox"/> Discuss q10 mins

QBL Tracker							
Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:
_____	_____	_____	_____	_____	_____	_____	_____
QBL:	QBL:	QBL:	QBL:	QBL:	QBL:	QBL:	QBL:
_____	_____	_____	_____	_____	_____	_____	_____

Abstract #: ERF4-03

Stage 3: Continued Bleeding (QBL > 1500mL OR > 2 RBCs given OR at risk for occult bleeding/ coagulopathy OR any patient with abnormal vital signs/labs/oliguria)

Initial Steps:

- Mobilize additional help
- Move to OR
- Announce clinical status (vital signs, cumulative blood loss, etiology)
- Outline and communicate plan

Medications:

- Continue Stage 1 medications; consider TXA

Blood Bank:

- Initiate Massive Transfusion Protocol (If clinical coagulopathy: add cryoprecipitate, consult for additional agents)

Action:

- Achieve hemostasis, intervention based on etiology
- Escalate interventions

Oxytocin (Pitocin):

30 units per 500L solution

Methylergonovine (Methergine):

0.2 milligrams IM (may repeat);

Avoid with hypertension

15-methyl PGF2α (Hemabate, Carboprost): 250 micrograms IM (may repeat in q15 minutes, maximum 8 doses);

Avoid with asthma; use with caution with hypertension

Misoprostol (Cytotec): 800-

1000 micrograms PR

600 micrograms PO or 800 micrograms SL

Tranexamic Acid (TXA)

1 gram IV over 10 min (add 1 gram vial to 100mL NS & give over 10 min; may be repeated once after 30 min)

Possible interventions:

- Bakri balloon
- Compression suture/B-Lynch suture
- Uterine artery ligation
- Hysterectomy

In OR: Hemodynamic Status Reminder:

<input type="checkbox"/> Discuss q10 mins	<input type="checkbox"/> Discuss q10 mins	<input type="checkbox"/> Discuss q10 mins	<input type="checkbox"/> Discuss q10 mins	<input type="checkbox"/> Discuss q10 mins	<input type="checkbox"/> Discuss q10 mins
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QBL Tracker

Time: _____	Time: _____	Time: _____	Time: _____	Time: _____	Time: _____	Time: _____	Time: _____
QBL: _____	QBL: _____	QBL: _____	QBL: _____	QBL: _____	QBL: _____	QBL: _____	QBL: _____

Abstract #: ERF4-03

Table 1: Designated Nurse Roles During 'Code H'

Charge RN (N1)	Primary RN (N2)	Support RN (N3)	Blood Bank Coordinator (N4)
<ul style="list-style-type: none"> ▪ Delegates RN tasks ▪ Maintains situational awareness ▪ Brings in 'Code H' cart <p>Additional tasks If PPH in a labor room (vaginal)</p> <ul style="list-style-type: none"> ▪ Calls the scrub tech(s) to the OR 	<ul style="list-style-type: none"> ▪ SMI checklist reader/recorder <p>Additional tasks If PPH in a labor room (vaginal)</p> <ul style="list-style-type: none"> ▪ Announces every 5min <ul style="list-style-type: none"> ○ Vital Signs ▪ Announces every 10min <ul style="list-style-type: none"> ○ Blood loss ○ Patient status ○ Ongoing interventions 	<ul style="list-style-type: none"> ▪ On-going quantitative blood-loss calculation (QBL) <p>Additional tasks If PPH in a labor room (vaginal)</p> <ul style="list-style-type: none"> ▪ Places 2nd IV access ▪ Draws STAT labs <ul style="list-style-type: none"> ○ CBC ○ Coagulation Parameters ▪ Places urinary foley catheter 	<ul style="list-style-type: none"> ▪ Point of contact for blood bank ▪ Confirms most recent lab values ▪ Obtains 2 units PRBCs <ul style="list-style-type: none"> ○ If not crossmatched, obtains 2 units of emergency O-neg PRBCs ▪ Collaborates with OB resident for lab orders and blood products. ▪ Initiates MTP if called by Obstetric/Anesthesia attending(s) ▪ Coordinates with "runner"* to get the blood products from blood bank to L&D <p>*The "runner" can be a nurse, nurse assistant, student who knows how to get to the blood bank and back (18 min round trip walk)</p>

Abstract #: ERF4-04

Adrenalectomy during the second trimester in a patient with Conn's syndrome and congenital prolonged QT interval: Anesthetic considerations and management

Presenting Author: Cory Deburghgraeve, M.D.

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Co-Authors: Heather C. Nixon, M.D. - University of Illinois Chicago

Introduction: Primary hyperaldosteronism, Conn's Syndrome, is an endocrine disorder characterized by excessive secretion of aldosterone leading to retention of sodium and loss of potassium. The incidence of Conn's syndrome in pregnancy is unknown, a comprehensive literature review in 2016 found 40 case reports¹. It is associated with a high rate of pregnancy-related complications, particularly pre-eclampsia and pre-term delivery². Congenital long QT Syndrome (LQTS) is a disorder of myocardial repolarization and predisposes patients to an increased risk of sudden cardiac death secondary to arrhythmias. Conn's Syndrome may exacerbate LQTS as profound hypokalemia make these patients more prone to arrhythmias. We describe the optimization and peri-operative management of a pregnant patient with Conn's syndrome and LQTS for a second trimester adrenalectomy.

Case Presentation: The patient was a 25-year-old G2P0 at 21 wga with worsening chronic hypertension, LQTS, obesity (BMI 42) and newly diagnosed Conn's Syndrome who was admitted for coordination of care for a laparoscopic right adrenalectomy. PMH included an episode of ventricular tachycardia with cardiac arrest, defibrillation and ROSC after receiving IV ondansetron and workup revealing LQTS. In the weeks prior to admission she experienced worsening HTN and hypokalemia refractory to treatment, secondary to hyperaldosteronism, and adrenalectomy was planned to reduce the risk of development of severe complications in the peripartum period. An interdisciplinary meeting was held and optimization included initiation of beta blocker and targeted lab values of K > 4.0, Mg > 2.0 to assist in achieving a QTc of < 480 ms and reduce the risk of arrhythmia perioperatively. Baseline values were: K 3.0, Mg 1.6, and QTc 513 ms. Five days of aggressive electrolyte repletion and q8 hour labs with close telemetry monitoring ultimately achieved values of K 3.9, Mg 2.0, and QTc 492 by the day of surgery. Cardiac defibrillator pads were applied, QT prolonging medications were avoided, and cardiac resuscitation medications were immediately available. TIVA was utilized to reduce the risk of PONV in a patient with contraindications to several antiemetics. Surgery was uncomplicated and at 34 wga the patient returned for an uneventful vaginal delivery.

Discussion: Care for pregnant patients with primary hyperaldosteronism may be particularly challenging and coordination of adrenalectomy should consider severity and progression of electrolyte disturbances and worsening HTN. Although prolonged QT usually improves during pregnancy, severe disease may worsen with electrolyte imbalances. This case highlights how interdisciplinary communication and aggressive optimization prior to surgery led to a favorable outcome.

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Abstract #: ERF4-05

To Extubate or Not to Extubate? A Case of Ludwig’s Angina in Pregnancy

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Co-Authors: Christine McKenzie, MD - University of North Carolina Hospitals

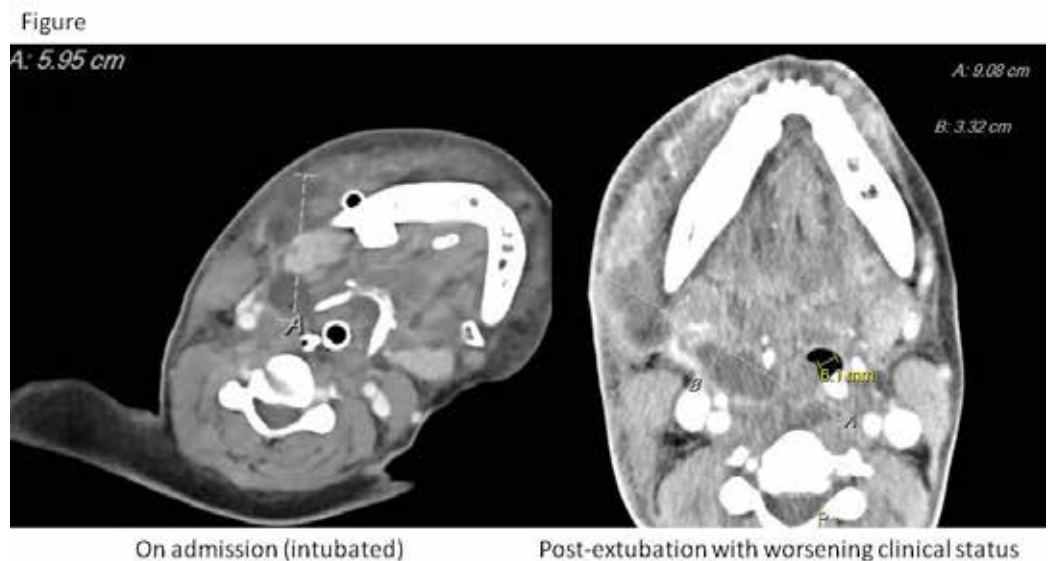
Introduction: An obstetrical (OB) patient with a critical airway presents an exceptional clinical challenge. Our case highlights the importance of multidisciplinary planning for a pregnant patient with Ludwig’s angina.

Case: A 38yo G7P6007 poorly controlled type 2 diabetic at 28w2d gestation age (GA) presented with Ludwig’s angina 3 days after wisdom tooth extractions. At an outside hospital, she required awake nasal fiberoptic intubation (FOI) prior to transfer for surgical management (Figure). Upon transfer, she had an incision and drainage (I&D) performed with continuous fetal monitor and an uneventful intraoperative course. She remained intubated postoperatively. Her postoperative course was complicated by superimposed preeclampsia with severe features (SIP-SF). A cuffleak was absent until POD 7, when the patient extubated. After extubation, a neonatal stress test was nonreactive and biophysical physical profile (BPP) of 4. OB Anesthesia was notified of extubation status and concerns for worsening fetal status. On exam, her airway was non-reassuring; Mallampati IV, small mouth opening, inability to protrude her jaw, and limited neck extension. On evaluation of maternal status, ABG reveal normal acid-base and hemoglobin of 7.4 g/dL. Given fetal status, the decision was made to perform a red blood cell transfusion. Fetal status was monitored closely throughout the day and improved (BPP of 8). Maternal and fetal status remained stable, however maternal airway status remained critical. On POD 11, there was increased swelling and wound drainage noted by surgical team requiring repeat CT imaging (Figure) and surgical management. An awake nasal FOI was performed, and the patient remained intubated postoperatively. A multidisciplinary meeting with OMFS, MFM, and OB Anesthesia was held to discuss projected course of Ludwig’s angina and delivery plan. Considerations for delivery timing included maternal and fetal status, and projected maternal wound healing in the setting of pregnancy. The decision was made to perform a repeat cesarean delivery (CD) prior to extubation on POD 4 from her second surgical debridement at 30w4d GA. CD indications included SIP-SF, fetal growth restriction, and critical airway status. She required an additional I&D and tracheostomy on POD7 from her 2nd I&D and postpartum day 3 and a final I&D on POD18 from her 3rd I&D/tracheostomy. She was ultimately decannulated on hospital day (HD) 47 and discharged to home on HD51 (POD6 from her final surgical intervention).

Discussion: Airway management in a patient with Ludwig’s angina can be challenging especially in the OB patient. Multidisciplinary planning is vital. Given airway concerns, persistent infection, and unclear benefit of continued pregnancy a preterm delivery was decided to be the best clinical option.

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Abstract #: ERF4-06

Management of cesarean delivery in a parturient with symptomatic intracranial lesions and increased intracranial pressure

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Background: Vaginal delivery is avoided in parturients with intracranial lesions and increased intracranial pressure (ICP) due to concern for increased ICPs during the second stage of labor. Even though regional anesthesia is preferred for cesarean delivery (CD), it is typically avoided due to risk of brain herniation in these patients.¹ Timing and planning can allow for safe delivery and outcomes for both mother and fetus.

Description: A 26-year-old G3P2 at 30 weeks of gestation of a twin pregnancy and neurofibromatosis type 2 presented with poor balance and shaking of left upper and lower extremities. On brain imaging, 2 new intracranial masses (left tentorium and left cerebellopontine angle) showed evidence of mass effect with midline shift (Figure 1). Her management included serial neurological exams and dexamethasone. After a multidisciplinary discussion, she was scheduled for CD under general anesthesia (GA) at 35 weeks of gestation.

Preoperatively, an arterial line was placed. GA was induced with lidocaine, propofol, remifentanyl, rocuronium and esmolol. Intubation was easily achieved with a Glidescope. Propofol and remifentanyl were used as maintenance. TAP block catheters were used for postoperative analgesia. The patient was extubated and transferred to the ICU for neuromonitoring. She subsequently underwent 3-staged intracranial tumor resections on post-partum days 5, 7, and 13. She was discharged with improving neurological symptoms. The twins had uncomplicated neonatal ICU stays. Two months later, imaging showed markedly reduced mass effect.

Discussion: Diagnosis of a new intracranial mass is devastating during pregnancy for both mother and fetus. Hence, a multidisciplinary approach by obstetricians, neurosurgeons and obstetric anesthesiologists was essential for planning of delivery and subsequent mass resection.

High-dose intravenous steroids controlled symptoms of increased ICP and allowed time to reach fetal lung maturation. With major concerns for increased ICP and neuraxial anesthesia, GA was agreed upon between teams. Close direct monitoring of the blood pressure and esmolol boluses were used to mitigate hypertension after airway instrumentation. Rocuronium was used to avoid the potential increase in ICP related to succinylcholine. Remifentanyl and propofol were used as maintenance instead of inhaled anesthetic to minimize risk for uterine atony and lower risk of neonatal respiratory depression. Post-operative multimodal analgesia including TAP catheters² was essential in anticipation of her upcoming neurosurgical course and the need to minimize post-operative opioid usage. Her interval craniectomy was planned once the physiological changes of pregnancy had normalized.

In conclusion, a multidisciplinary approach coupled with balanced general anesthetic allowed for the uneventful delivery of this patient and the subsequent surgical treatment of her neurosurgical condition.

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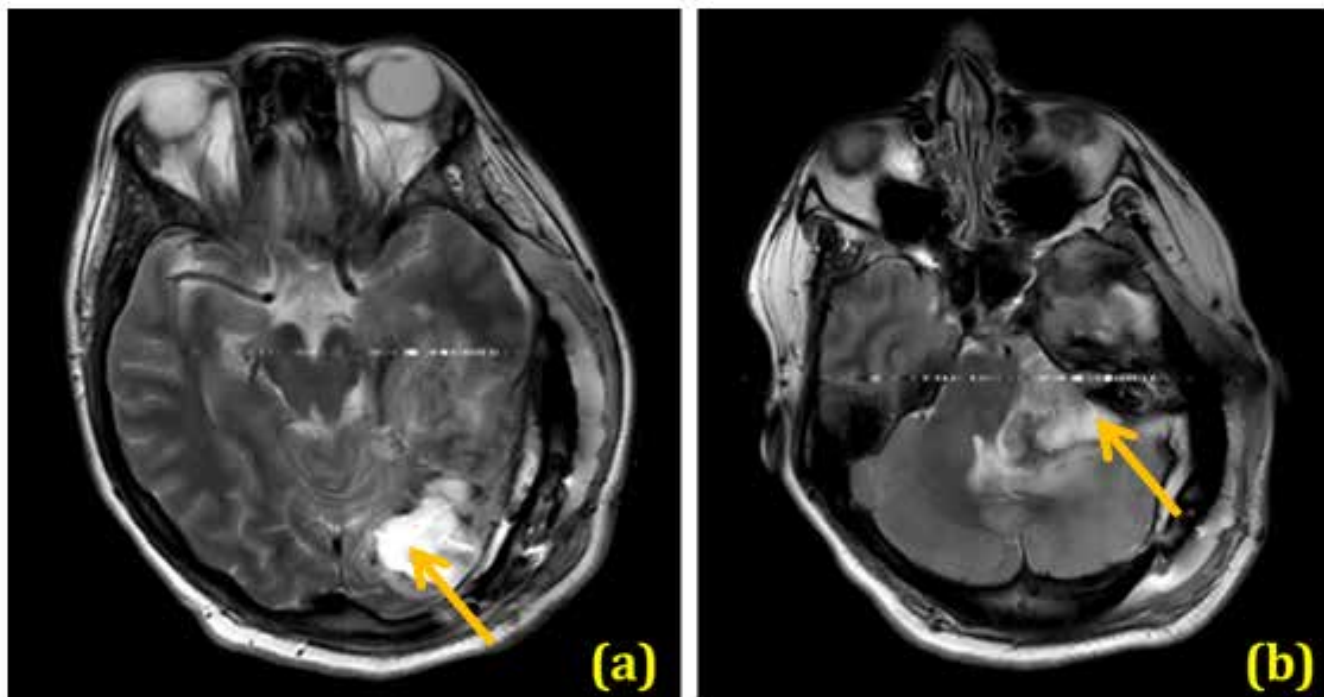


Figure 1: Masses in left tentorium and left cerebellopontine angle

Abstract #: ERF4-07

Comparison of cerebral hemodynamic changes induced by nicardipine and labetalol in preeclamptic patients presenting with neurologic symptoms

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Introduction: Preeclampsia may lead to severe neurologic complications such as vasogenic edema, eclampsia or intracerebral hemorrhage. Prevention of this morbidity is initially based on antihypertensive therapy and may be supplemented by MgSO₄. In France, either nicardipine or labetalol are recommended as first-line treatment. Our study aimed to assess the effect of these two drugs on cerebral hemodynamics.

Material and Methods: After ethical approval (RCB: 2018-A00689-46), we conducted a prospective observational study. All patient with severe preeclampsia associated with any neurologic symptom or epigastric pain (reflecting vasospasm) were included if nicardipine (N) or labetalol (L) was introduced intravenously, at physician discretion.

Intracranial pressure (ICP) was evaluated by optic nerve sheath diameter (ONSD) ultrasonographic measurements. The effect of ICP on cerebral blood flow was assessed by Pulsatility Index (PI) obtained with transcranial Doppler of the middle cerebral artery. A PI > 1.2 and an ONSD > 5.8 mm were considered pathological. Four time-points were predefined (just before introduction of the antihypertensive drug and after 30 minutes (M30), 2 hours (H2) and 6 hours (6H)) to assess these two parameters across time.

Pulse rate and blood pressure were also recorded during each measurement. As this is a pilot study with no previous data available, no number of subjects could be calculated. Data had parametric distribution and equal variances; thus inter-group comparison at each time was performed using Student t-test.

Results : Seven patients in group N and 6 in group L have been included yet (Table). Baseline characteristics were similar between the two groups. After antihypertensive therapy, there were no differences for mean arterial pressure but pulse rate was higher in group N ($p < 0.03$ at each time-point). MgSO₄ was implemented in 2 patients of each group. ONSD tended to decrease slightly and similarly in both groups (Table). However, PI tended to increase in group N whereas it tended to decrease in group L. At baseline, 2 patients in group L had pathological PI but none thereafter at M30, H2, H6. By contrast, at baseline, 1 patient in group N had pathological PI then 3, 4 and 2 patients at M30, H2, H6, respectively, had pathological PI.

Conclusion: Contrarily to labetalol, nicardipine seems to impair cerebral hemodynamics by raising PI in patients with severe preeclampsia. Labetalol could thus be a more suitable first-line treatment for preeclamptic patients presenting with neurologic symptoms. However, more data are needed to consolidate these preliminary results.

Abstract #: ERF4-07

	Nicardipine (n = 7)	Labetalol (n = 6)	P
PI baseline, mean (SD)	1.03 (0.19)	1.09 (0.28)	0.63
PI M30, mean (SD)	1.12 (0.2)	1.0 (0.17)	0.26
PI H2, mean (SD)	1.18 (0.2)	0.91 (0.17)	0.04
PI H6, mean (SD)	1.12 (0.28)	0.91 (0.15)	0.18
ONSD baseline in mm, mean (SD)	5.1 (0.77)	5.27 (0.43)	0.63
ONSD M30 in mm, mean (SD)	4.77 (0.94)	5.05 (0.36)	0.48
ONSD H2 in mm, mean (SD)	4.95 (0.85)	4.91 (0.43)	0.93
ONSD H6 in mm, mean (SD)	4.74 (0.79)	5.07 (0.68)	0.49

Abstract #: ERF5-01

The use of “WhatsApp” as a national obstetric anesthesia discussion forum in Israel

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Introduction: The use of social media has been gaining momentum in recent years; one of the most commonly used apps being WhatsApp (an application) for professional groups. A PUBMED search found 279 studies discussing WhatsApp (as of August 2019). WhatsApp is used for a variety of purposes: student or intern training, patient information transfer, patient-to-physician correspondence. Sometimes, members of a group of specific professionals convey professional information between them locally, nationally or internationally. We present our experience of the Obstetric (OB) Anesthesia WhatsApp group in Israel; members include anesthesiologist directors of labor units in Israel. We summarize our experience using the WhatsApp group for OB Anesthesia in Israel.

Methods: A review of all group participants and all the discussions held by the WhatsApp group since its establishment was performed. Data were assessed regarding: discussion topic; response time; number of participants in the discussion; number of responses to the discussion; type of discussion (clinical discussion, unit organization, specific patient, obstetric anesthesia literature and conferences). In addition, we performed a survey questionnaire of all WhatsApp group members regarding their satisfaction from the using the group.

Results: The WhatsApp group was established in March 2017. The group consists of 31 anesthesiologists from 19 (90%) of Israel hospitals. Over two years, 193 discussions occurred; reaction time until first response was mean 8.3 minutes. Median number of participants per discussion was 6 (2-19) anesthesiologists. The mean number of comments per discussion was 9.8. By segmenting the discussions by topic (some discussions included 2 topics), 62 discussions were classified as clinical discussion, 52 discussed unit organization, 16 were defined as specific case discussion, 31 discussed conferences, 67 discussed publications in obstetric anesthesia. A high level of satisfaction was found according to the questionnaire survey.

Conclusion: We describe a 2-year experience of correspondence using an OB Anesthesia WhatsApp group at a national level. Various topics were discussed and received a prompt response across several topic categories, from immediate clinical questions to unit organization, recent academic literature, forthcoming conferences, and equipment. In our experience, we recommend using similar groups to obtain rapid response in several domains of professional interest not just in OB Anesthesia, and extending similar groups to an international level.

Abstract #: ERF5-02

To Cut or Not Cut the Cord: The Lotus Birth and the Consequent Considerations for the Anesthesiologist

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Lotus birth is a ritualistic practice of umbilical cord nonseverance (UCNS), such that a neonate remains connected to the placenta until a natural separation occurs days after birth. The placenta is placed in a breathable bag and kept near the newborn until it necroses and separates spontaneously, usually by day six of life, with application of salt and herbs to dry and neutralize odors¹. Unbeknownst to our providers when a parturient presented in labor requesting a lotus birth, this practice has recently gained popularity in Western society through promotion as a holistic practice during home births¹. In fact, an Internet search of the term “Lotus Birth” reveals a wealth of content. Not surprisingly though, the literature, as well as our own experience, suggests a lack of awareness of the practice amongst health care professionals². Here we provide an introduction on lotus birth as a means to educate anesthesiologists that may come across this practice, as it has a spectrum of practical, safety, and ethical implications for maternal and neonatal care teams.

Concerns exist over the safety of the practice. As a form of delayed cord clamping, ACOG outlines emergencies where it is contraindicated, including active maternal hemorrhage, need for newborn resuscitation, and cases of abnormal placentation³. Additionally, the scientific community cites infection as the primary risk to the newborn, with ACOG, RCOG and the AAP stating the practice has no proven health benefits and places the infant at a higher risk of infection⁴. As the decaying placenta remains connected to the infant, reports of neonatal endocarditis, oomphalitis, and bacteremia have emerged¹.

Despite potential complications associated with the practice, the evidence is limited, and a pregnant patient with capacity has the right to refuse medically recommended medical treatment⁵. It is the responsibility of the care team to elicit the wishes and beliefs of the patient, while discussing the implications in an informative but non-coercive manner. A familiarization with this increasingly common practice is necessary to properly address and manage the request while respecting the patient's autonomy and proceeding in the safest manner possible.

Abstract #: ERF5-03

Successful Multidisciplinary Management of a Parturient with Adult Congenital Heart Disease

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Case Presentation: Our patient is a 24-year-old G1P0 female. She has a history of congenital rubella syndrome with sensorineural deafness, ventricular septal defect (VSD), pulmonic stenosis (PS), patent ductus arteriosus (PDA), and a subaortic membrane. At age 2, she had a VSD patch repair, PDA ligation, and subaortic membrane resection. She also had a balloon dilatation of the pulmonary valve followed by a pulmonic valve replacement with bioprosthetic material at age 11. During pregnancy, a TTE was significant for an EF of 61%, moderate to severe pulmonic regurgitation, moderate pulmonic stenosis, and a moderately dilated right ventricle with normal systolic function. She transferred to Mount Sinai Hospital for medical optimization and delivery planning.

A multidisciplinary meeting was held, and a detailed plan for peripartum care was designed. An ASL interpreter was present throughout the labor and delivery process. The patient had an induction of labor at 39 weeks gestation in the CICU (Cardiac Intensive Care Unit). An arterial line was placed for continuous hemodynamic monitoring, and a continuous lumbar epidural with bupivacaine 0.0625% and fentanyl 2 mcg/mL at a rate of 10 mL/hr with PCEA dosing was utilized for labor analgesia. Goal directed IVF therapy with concentrated Pitocin was employed to minimize fluid overload. The induction of labor was well-tolerated, and a cardiac operating room with CPB and ECMO capabilities was on standby during the second stage of labor. She tolerated pushing for one hour and delivered a healthy baby girl (APGAR 9/9) via normal spontaneous vaginal delivery. The patient had an uncomplicated CICU course for 36 hours postpartum. She never required diuresis or exhibited clinical signs or symptoms of heart failure. She was routinely discharged on postpartum day 2, and continues to feel well.

Discussion: Medical advancements over time have allowed many women diagnosed with complex congenital heart disease (CHD) to survive into their childbearing years. The physiologic changes associated with pregnancy and childbirth can often be dangerous and require meticulous interdisciplinary preparation in order to optimize maternal and fetal health and outcomes. Although a number of studies have published tools that can clarify risk prediction and medical management of CHD in pregnancy, only a few case reports that describe clinical care plans exist. This case report exhibits how multidisciplinary collaboration between specialists in obstetric anesthesiology, maternal fetal medicine, high-risk obstetrics, and cardiology resulted in a highly effective, individualized management plan for labor and delivery in our patient with complex CHD.^{1,2}

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Abstract #: ERF5-04

The conundrum of Paraganglioma – Unexplained Orthostatic hypotension in Pregnancy

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Introduction: Paraganglioma in pregnancy is a rare condition with a high maternal and fetal mortality rate. A multidisciplinary approach is important as it will influence the maternal and fetal outcome.

Case report: We present a 30-year-old African-American Gravida7Para3033 at 32 weeks' gestation who was admitted with unexplained syncopal episodes, sweating and shortness of breath on ambulation. Her past medical history was significant for seizures, migraines, fibromyalgia, alpha thalassemia carrier and recently diagnosed Idiopathic Thrombocytopenic Purpura (ITP).

The evaluation for syncope and hypoxia was very extensive. Due to the shortness of breath with hypoxia, pulmonology was consulted. Telemetry and Echo with bubble study were unremarkable. PFT shunt study was positive for 18% shunt fraction on 100% oxygen, suggesting some undetected shunt. CTA chest and CT head were unremarkable. V/Q scan did not suggest intrapulmonary/right-to-left shunt. Brain MRI was negative for Arteriovenous malformation (AVM). The obstetric anesthesiology team suggested an abdominal ultrasound to rule out AVMs in the abdomen. Found incidentally, there was a retroperitoneal mass and abdominal MRI confirmed a 4.3 cm Right extra adrenal mass with lateral displacement of the inferior vena cava (IVC). Biochemical evaluation was significant for elevated normetanephrines and therefore highly suspicious for paraganglioma.

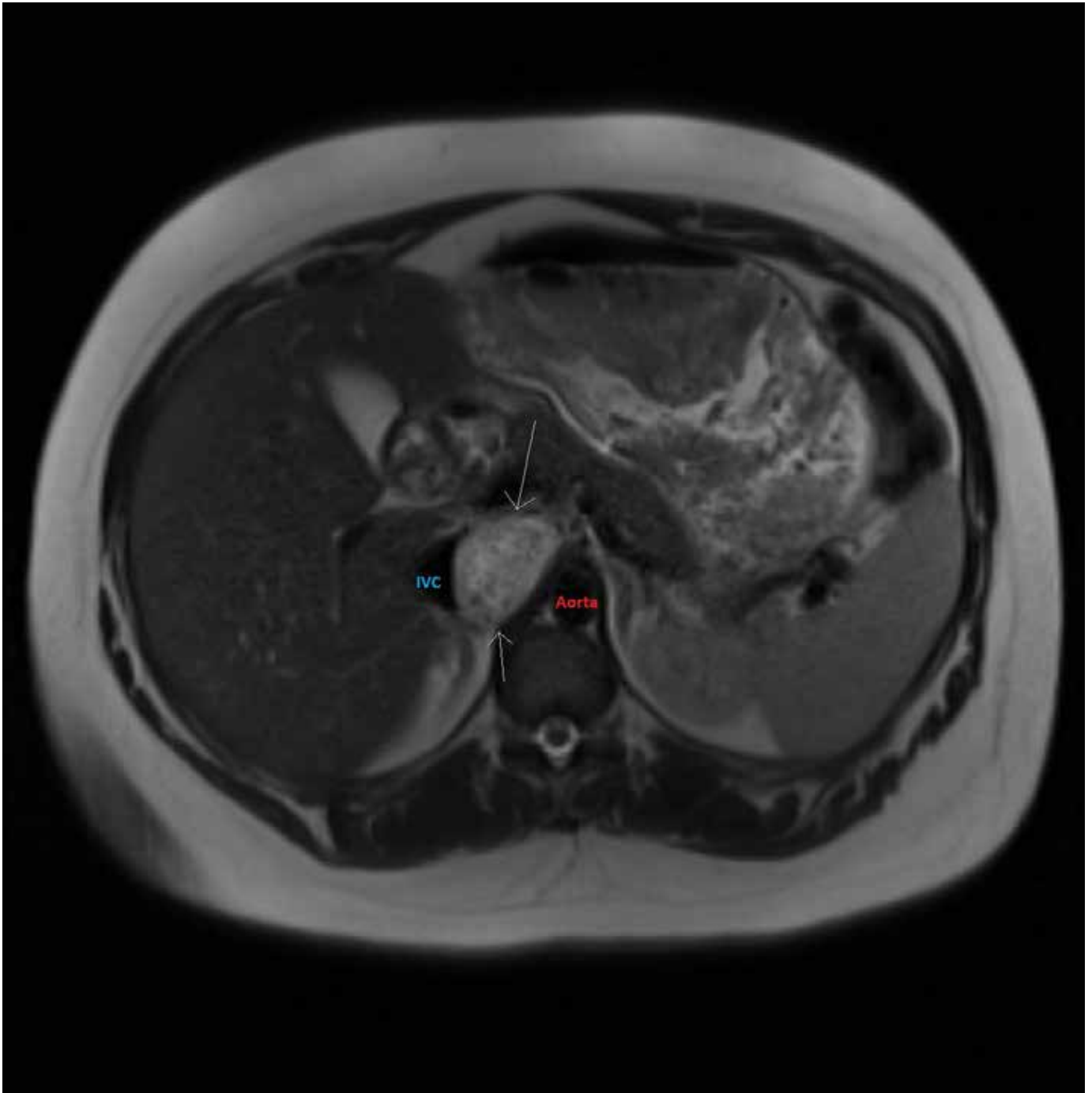
Preoperatively, non-invasive cardiac output monitoring showed lower than expected SVR values with high cardiac output and coincided with her orthostatic symptoms. Since the patient had already reached her third trimester of pregnancy, resection of the paraganglioma was postponed until after delivery. She was pretreated with alpha-adrenergic and beta-adrenergic receptor blockers. An elective Cesarean section was performed at 36 weeks under general anesthesia. General anesthesia was chosen due to her platelet count of 50000 at the time of delivery. The delivery was uneventful with stable hemodynamics.

The hallmark of presentation with these tumors is hypertension. We report the case of a pregnant women who presented with unexplained orthostatic hypotension. Diagnosis of a paraganglioma is similar in pregnant and non-pregnant patients and includes measuring plasma and urinary fractionated metanephrines(1). There are no specific recommendations for the treatment of paraganglioma during pregnancy and each case should be evaluated by a multidisciplinary team at centers with appropriate expertise(2).

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Abstract #: ERF5-04



Abstract #: ERF5-05

Successful Outcome of Pregnancy in a Parturient with Severe Pulmonary Arterial Hypertension

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Pulmonary arterial hypertension (PAH) is characterized by increased pulmonary arterial resistance leading to remodeling of the artery and ultimately resulting in right heart failure. (1) It is a deadly disease that affects four times the number of women than men. (2)

A 32-year-old G4P1 at 29 weeks was admitted to our tertiary care center for delivery planning in the setting of PAH, Type I and NYHA class III symptoms. She had been receiving intravenous epoprostenol and her last pulmonary artery (PA) pressures was 53/18/(36). After several multidisciplinary meetings, cesarean delivery (CD) under epidural anesthesia was planned at 33 weeks with veno-arterial (VA) ECMO sheaths placed prior to incision in the event of peri-procedural decompensation.

At 33 weeks the patient was brought to the cardiac catheterization lab where an epidural was placed without incidence. PA catheterization and arterial line placement had already been performed. High flow nasal cannula, FiO₂ of 1.0 was applied to provide continuous pre-oxygenation should emergent conversion to general anesthesia be required. In order to facilitate cannulation should it become necessary, 7 french venous and 6 french arterial sheaths were placed. The patient had one episode of bradycardia and hypotension that was treated with epinephrine boluses and dobutamine, thought to be the Bezold-Jarisch reflex. She recovered quickly, the CD proceeded, and a baby boy weighing 1625 grams was delivered. The PA pressures remained stable post delivery and vasopressors were down-titrated. Only a dobutamine infusion was left in place to provide right ventricular support post-operatively. Excellent hemostasis was achieved. The ECMO sheaths remained in place for 48 hours as well as the epidural for pain control. She was discharged home in stable condition on POD 4. On POD 6 she was seen by the OB team and was doing well with no cardiac complaints.

Maternal mortality rate from PAH in pregnancy is 9% to 30%, down from previous decades. Due to the patient's mWHO class IV (modified world health organization classification of maternal cardiovascular risk grade IV), her overall complication risk was 40-100%.^{3,4} Decreased trends may in part be due to advanced treatment and a common multidisciplinary approach to delivery planning including obstetrics, pulmonary hypertension specialists, and cardiac and obstetric anesthesiology. In this case, our team also included cardiothoracic and intensive care trained anesthesiologists with expertise with ECMO that contributed to an effective multidisciplinary plan for a safe delivery.

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Abstract #: ERF5-06

Cesarean while on Buprenorphine or Methadone Maintenance for Opioid Use Disorder: a Retrospective Cohort Study of Anesthetic Details & Analgesic Outcomes

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Background: The anesthetic care of women with opioid use disorder (OUD) having cesarean deliveries while maintained on buprenorphine or methadone poses several particular challenges. One of these is the limited data connecting specific anesthetic decisions with practical pain outcomes.

Methods: After IRB approval, chart reviews were done for OUD patients on daily buprenorphine or methadone who had cesarean deliveries from 2011-2018 at one hospital. The primary objective compared anesthetic details and analgesic outcomes (including pain scores and opioid consumption) between the buprenorphine/methadone groups. Secondary objectives included how analgesic outcomes differed by either anesthetic type (neuraxial versus general anesthesia) or buprenorphine/methadone daily dose.

Results: In 146 women (67.8%, n=99 on buprenorphine, median dose 16mg; and 32.2%, n=46 on methadone, median dose 110mg), both groups had similar types of anesthesia (table 1): spinal/CSE (73.7% vs 74.5% for buprenorphine vs methadone groups, respectively), epidural (15.2% vs 14.9%) and general anesthesia (11.1 vs 10.6%). Spinal/CSE anesthetics frequently included fentanyl (97.2%) and morphine (96.3%), and between groups the doses did not differ significantly (median doses fentanyl 15mcg and morphine 100mcg). Intrathecal epinephrine and clonidine were not commonly used (9.3% and 1.9%, respectively). Epidural anesthetics usually included morphine (90.9%), and the doses were similar (median 2mg both groups). Fentanyl was used in 54.5% of epidurals, but doses did not differ (median 100mcg both groups). Both groups had similar maximum daily pain scores and oxycodone equivalent use in each 24 hour period. Average maximum daily pain scores (8.3 vs 8.0 between buprenorphine/methadone groups) and average daily oxycodone equivalents (80.6 vs 76.3mg) were notably high in both groups. There was a weak correlation between methadone dose and oxycodone equivalent requirement ($p=0.03$, $R=0.32$), but not for buprenorphine dose. Those who had general anesthesia, versus neuraxial anesthesia, used more oxycodone equivalents in the first 24 hours post-operatively (median 156 vs 92mg, $p=0.004$) and had more frequent IV PCA use (63% vs 7%, $p<0.001$). Other analgesic outcomes did not differ between the anesthetic types.

Conclusions: This retrospective shows that cesarean patients on buprenorphine or methadone at one center had similar anesthetics and had similar, high pain scores and opioid consumption after delivery. Methadone but not buprenorphine dose was correlated with post-cesarean opioid requirement. General anesthesia was linked to higher early opioid and IV PCA requirement. This study helps connect specific anesthetic details with analgesic outcomes in OUD patients. It highlights details worth using in future trials to optimize post-cesarean analgesia in OUD.

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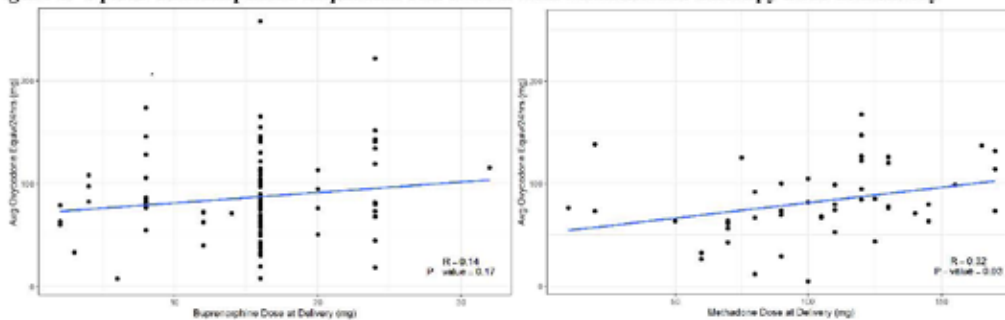
Table 1: Patient Characteristics, Anesthetic Type and Analgesic Outcomes

Results reported as median [25th percentile, 75th percentile] unless otherwise specified.

Variable	Buprenorphine (n=99)	Methadone (n=47)	P-value
Age (years)	28 [24, 31]	27 [24, 30]	0.300
Weight (kg)	76.2 [68.9, 91.6]	79.8 [69.9, 92.5]	0.548
Gravidity / Parity	4 [2, 5] / 2 [1, 3]	3 [2, 4] / 1 [1, 2]	0.015/0.044
Gestational Age at delivery (weeks)	39 [37, 39]	38 [36, 39]	0.010
Planned C-Section (n (%))	68 (69%)	23 (49%)	0.021
Buprenorphine/Methadone daily dose (mg)	16 [16, 16]	110 [80, 130]	-
Anesthetic Type (% Spinal/CSE vs Epidural vs General)	73.7% / 15.2% / 11.1%	74.5 / 14.9% / 10.6%	0.995/0.995/0.995
Delivery-to-Discharge interval (days)	3 [3, 4]	3 [3, 4]	0.555
Average Daily Oxycodone Equivs (mg)	80.6 [62, 108.3]	76.3 [63, 105]	0.694
Post-Op Day 0 (0-24h)	100 [75, 126.7]	83.3 [63, 158.3]	0.358
Post-Op Day 1 (24-48h)	80 [60, 115]	75 [50, 90]	0.185
Post-Op Day 2 (48-72h)	70 [40, 100]	75 [50, 92.7]	0.988
Post-Op Day 3 (72-96h)	60 [30, 90]	55 [43, 85]	0.736
Average Daily Max Pain Score (0-10)	8.3 [7, 9]	8 [7, 8.7]	0.518
IV PCA use (n (%))	8 (8%)	11 (23%)	0.010
Supplemental Nerve Block use (n (%))	4 (4%)	1 (2%)	0.553

Variable	Spinal/CSE/Epidural (n=130)	General (n=16)	P-value
Average Daily Oxycodone Equivs (mg)	79.6 [63, 105]	87.6 [70, 134.3]	0.222
Post-Op Day 0 (0-24h)	91.7 [70, 121.7]	156.1 [104, 221.7]	0.004
Post-Op Day 1 (24-48h)	80 [60, 110]	62.5 [48, 92.5]	0.210
Post-Op Day 2 (48-72h)	75 [45, 100]	75 [40, 90]	0.685
Post-Op Day 3 (72-96h)	60 [30, 90]	50 [43, 115]	0.620
Average Daily Max Pain Score (0-10)	8.3 [7, 9]	7.8 [7, 9]	0.931
IV PCA use (n (%))	9 (7%)	10 (63%)	<0.001
Supplemental Nerve Block use (n (%))	5 (4%)	0 (0%)	1.000

Figure 1: Opioid Consumption Postpartum correlation with Maintenance Therapy Dose at Delivery



Abstract #: ERF5-07

Urgent cesarean delivery in a patient with systemic right ventricle and severe post-traumatic stress disorder.

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Presenting Author's Institution: Stanford University, California

Co-Authors: Jessica R. Ansari, MD - Stanford University

Introduction: More patients with single ventricle physiology are surviving to achieve pregnancy. Maternal outcomes are overall favorable in well-compensated individuals despite increased rates of arrhythmia, postpartum hemorrhage, and preterm delivery (1). We describe a particularly complex patient with Fontan circulation who underwent urgent cesarean delivery at 31 weeks gestation for preterm premature rupture of membranes (PPROM) and placental abruption.

Case report: A 21 year old G2P0 with hypoplastic left heart, double outlet right ventricle (DORV) with moderately reduced function, severe atrioventricular (AV) valve regurgitation, and dextrocardia status post staged palliation with Glenn and Fontan circulation (Figure 1) presented at 21 weeks gestation. She was New York Hospital Association class II. Medical comorbidities included supraventricular tachycardia (SVT), morbid obesity with BMI 40, and stage III Fontan-associated liver disease. Pregnancy was complicated by PPRM at 31 weeks gestation and intrauterine growth restriction. The patient declined inpatient admission for monitoring and had late presentation for care due to severe hospital-associated post-traumatic stress disorder (PTSD). She consented to urgent Cesarean delivery. Psychiatry deemed the patient to have capacity to make these decisions.

A right internal jugular central venous catheter, brachial arterial line, and two large bore intravenous lines were placed. A combined spinal-epidural with narcotic only intrathecal dose was performed. Surgical anesthesia was achieved with incremental dosing of lidocaine 2% with epinephrine to avoid rapid sympathectomy. Cardiac surgeons were available in case extracorporeal membrane oxygenation was required. Defibrillation pads were applied. Epinephrine and vasopressin were available to counteract sympathectomy but were not required. Two intraoperative episodes of hemodynamically stable SVT with heart rates to 170 beats per minute were treated with amiodarone bolus and infusion. A viable fetus was delivered despite a large chronic placental abruption. The patient was admitted to the cardiovascular intensive care unit for close hemodynamic monitoring. Her postpartum course was uneventful. She ultimately left the hospital against medical advice on postpartum day 2.

Discussion: We describe a positive maternal outcome in a particularly medically and psychologically complex patient with Fontan circulation. This patient's systemic RV with moderate dysfunction, severe AV valve regurgitation, and SVT placed her at high risk of peripartum cardiac events (> 40% based on CARPREG II score 10). However, her prenatal, intrapartum, and postpartum care were most significantly impacted by hospital-related PTSD. Management of PTSD may prove particularly salient for patients with congenital heart disease who have multiple traumatic childhood hospitalizations, and has not been addressed in prior case series literature.

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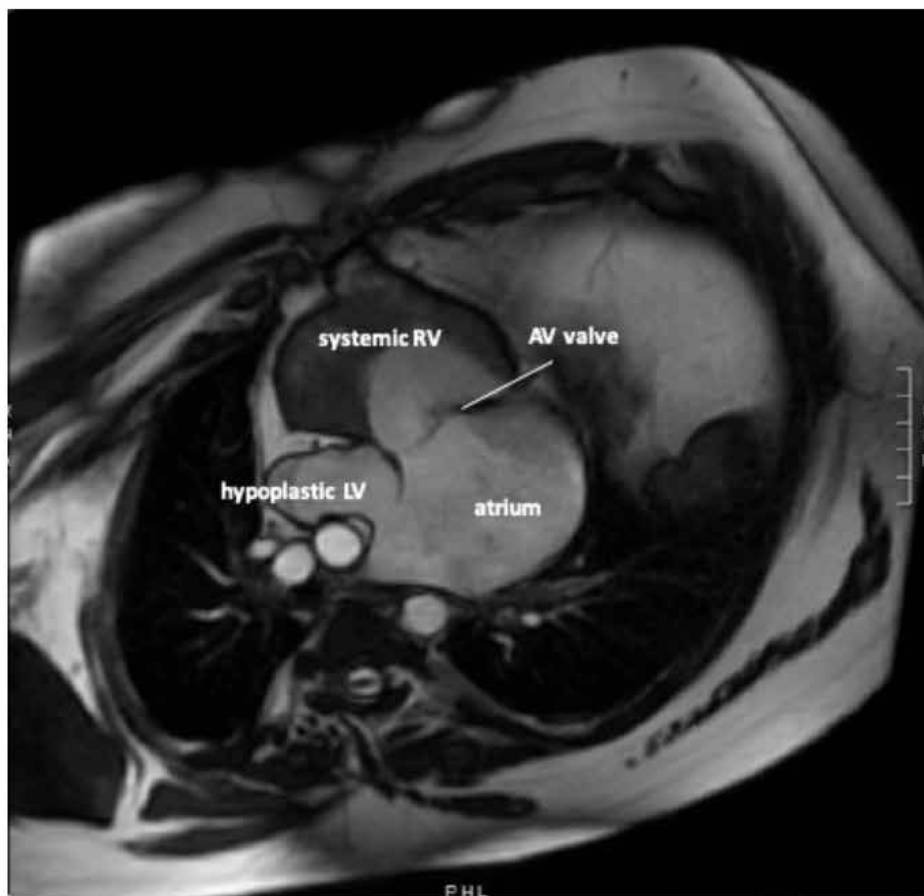


Figure 1: Cardiac MRI. Note an extremely enlarged atrium secondary to atrioventricular (AV) valve regurgitation, systemic right ventricle (RV), and rudimentary hypoplastic left ventricle (LV).

Abstract #: ERF5-08

Hyponatremia in Hypertensive Disorders of Pregnancy: A Retrospective Cohort Study

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Background: Hyponatremia is a clinically important electrolyte abnormality defined as serum sodium level less than 135 mmol/L.¹ Depending on the severity and acuity of the change, symptoms of hyponatremia may include altered mental status, nausea, emesis, seizures, cerebral edema and coma.² Hyponatremia associated with preeclampsia was first described in the 1980s and was thought to be a rare complication of preeclampsia.³ Case reports describe patients that lack symptoms related to the hyponatremia which is likely related to the rarity of it being reported.⁴ In a prior retrospective study the incidence of hyponatremia (serum sodium < 130 mmol/L) in preeclamptic women was found to be around 10%. Unfortunately, there was limited information about its association with maternal outcomes.⁵ The goal of this study was to measure the rate of hyponatremia in hypertensive disorders of pregnancy and identify changes in maternal outcomes related to hyponatremia.

Methods: We conducted a single center, retrospective cohort study of hyponatremic patients with a hypertensive disorder of pregnancy diagnosis. Electronic medical record was used to obtain data for all deliveries of women aged 18 to 60, from January 1st, 2014 to March 3rd, 2018. Subjects without a serum sodium within 48 hours of delivery were excluded. A chart review was completed for every patient to identify the type of hypertensive disorder of pregnancy at the time of delivery. Hyponatremia was defined as a serum sodium level below 130 mmol/L between admission and delivery. The primary outcome was maternal intensive care unit (ICU) admission. Factors associated with ICU admission were evaluated using a multivariable logistic regression model.

Results: We identified 4,655 patients that had a hypertensive disorder of pregnancy, of which 891 met inclusion criteria. After chart review, 790 subjects were included in our final analysis. A multivariable logistic regression identified BMI, multiple gestations, method of delivery, hypertensive disorders of pregnancy diagnosis and hyponatremia as independent predictors of ICU admission. In patients with hyponatremia, the odds ratio of having an ICU admission was 2.9 (95% CI 1.2 to 5.5, P=0.021). See Table 1 for additional results.

Conclusions: While hyponatremia was previously thought to be a rare complication of preeclampsia this study describes a similar rate to a prior retrospective review.⁵ To our knowledge, this is the first time a study has found a relationship between hyponatremia in preeclampsia and maternal morbidity. The increased rate of ICU admissions suggests that hyponatremia could be used as a marker of severity of preeclampsia and other hypertensive disorders of pregnancy.

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Abstract #: ERF5-08

Outcome	Value	95% CI
Rate of Hyponatremia	12.5%	10.3-15.0
Overall ICU Admission Rate	5.9%	3.3-8.6
ICU Admission Rate without Hyponatremia	4.9%	3.5-6.8
ICU Admission Rate with Hyponatremia	13.1%	7.8-21.2
Difference in ICU Admission Rates	8.2%	1.3-15.2

Table 1. Rate of hyponatremia and association with ICU admissions.

Abstract #: ERF5-09

Acute heart failure in a patient with MELAS syndrome necessitating pregnancy termination

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Presenting Author's Institution: Stanford University School of Medicine

Co-Authors: Pamela Flood, MD - Stanford University

Sapna Satyanarayan-Victor, MD, MPH - Stanford University

INTRODUCTION: MELAS syndrome is caused by the m.3243A >G mutation which leads to variable expression of a disease known as Mitochondrial Encephalopathy, Lactic Acidosis, and Stroke-like episodes. If the mother is affected, she passes the mutation to all offspring as they receive mitochondrial DNA from her.

MELAS patients are known to have a higher incidence of obstetric complications including preterm delivery, preeclampsia, and gestational diabetes (1). We report the anesthetic management of a patient with MELAS syndrome complicated by severe preeclampsia and acute heart failure.

CASE PRESENTATION: A 32-year-old G3P0020 at 23 weeks presented to L&D with elevated blood pressure, chest pain, and a new oxygen requirement (10L). Bedside echo revealed depressed biventricular function requiring transfer to the ICU for diuresis and invasive monitoring. On further work-up she was found to have reduced ejection fraction, severe mitral regurgitation, and pulmonary edema. She continued to deteriorate despite aggressive diuresis and afterload reduction.

Multidisciplinary meeting was held which included the patient and ethics committee to determine goals of care. Due to severe growth restriction, the fetus was determined to be pre-viable. The patient and her husband elected to terminate as they understood that continuing the pregnancy would likely worsen preeclampsia and heart failure. She took into consideration the mode of inheritance for MELAS syndrome and did not wish to subject her children to the debilitating disease.

The patient was brought to the OR from the ICU for dilation and evacuation. The cardiac surgery team was available on standby in case of further deterioration. Arterial line and PA catheter were used to monitor continuous blood pressure and cardiac output. Combined spinal-epidural was placed without difficulty; the spinal contained narcotic only to avoid sudden drops in SVR. The epidural was incrementally dosed with 2% lidocaine with epinephrine. Remifentanyl, midazolam, and dexmedetomidine were used for analgesia and sedation. She maintained stable hemodynamics throughout the procedure and gradually improved over the next few days.

DISCUSSION: MELAS patients are at increased risk of cardiovascular complications including concentric hypertrophic cardiomyopathy and conduction abnormalities (2). Severe preeclampsia augments the physiologic changes of pregnancy and can precipitate acute heart failure. Patients with mitochondrial disease are exquisitely sensitive to volatile anesthetics, but not at increased risk for malignant hyperthermia. It is prudent to maintain normothermia and normoglycemia. Succinylcholine, propofol infusions, bupivacaine, and lactate-containing fluids should be avoided (3). As such, carefully titrated regional anesthesia with sedation can be used to provide desired amnesia and hemodynamic stability.

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Abstract #: ERF5-10

Effect of Panniculus Retraction for Cesarean Delivery on Pulmonary Function

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Presenting Author's Institution: BIDMC/HMS

Co-Authors: Ricardo Aguayo, BS - BIDMC

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Philip Hess

Background: The obesity rate amongst pregnant women in the United States, classified as BMI >30, has increased to 25.6% (1). The risk of cesarean delivery increases proportionately with BMI (2), and the operation can be technically challenging and is associated with greater complication rates. Panniculus retraction is utilized to facilitate visualization of vital anatomic structures and delivery of the infant (3). Vital capacity has been previously shown to be dramatically lower in women with obesity compared to normal weight, which may be further reduced with panniculus retraction (4,5). Our objective was to quantify pulmonary function parameters before and after panniculus retraction in women with morbid obesity (BMI >40) undergoing cesarean delivery.

Methods: This is an interim analysis of the control arm in an open-label, randomized controlled trial comparing the use of the Traxi® device for panniculus retraction for women with morbid obesity undergoing cesarean delivery with standard panniculus retraction methods (use of medical tape or manual retraction). IRB approval was obtained prior to enrolling patients. Eligible women were approached for informed consent prior to non-emergent cesarean delivery of a singleton pregnancy. As a planned secondary outcome, participant spirometry data was collected. Using a handheld spirometer, functional vital capacity (FVC) and forced expiratory volume in one second (FEV1) were obtained in the operating room before and after panniculus retraction with the parturient in the supine position with left lateral uterine displacement using a 30° wedge under the right hip.

Results: Twelve participants in the control arm had spirometry data performed. The average BMI of participants was 48.2 ± 4.6. The FVC and FEV1 of the women prior to panniculus retraction was significantly lower than that predicted by sex, age, height, and weight (**Table**). Panniculus retraction reduced FVC by 12%, though this was not statistically significant. FEV1 was not changed by panniculus retraction. The FEV1/FVC ratio was above the cut off for obstructive disease (70%) pre-retraction and did not change post-retraction.

Conclusions: Women with morbid obesity positioned for cesarean delivery exhibit a restrictive lung physiology with reduced FVC and FEV1 and normal FEV1/FVC ratio. Standard methods of panniculus retraction may further reduce FVC to a small degree (~10%).

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Table

	Predicted	No retraction	P	After retraction	P*
FVC (L)	3.36 ± 0.44	2.59 ± 0.60	0.01	2.30 ± 0.66	0.59
FEV1 (L)	2.8 ± 0.4	1.97 ± 0.5	0.003	1.89 ± 0.6	0.70
FEV1/FVC	84%	76%	0.03	78%	0.75

Values reported as mean ± standard deviation or percent.

*Comparison of pre-retraction to post-retraction

Abstract #: ERF5-11

Anterior Mediastinal Mass and Superior Vena Cava Syndrome in Pregnancy: A Case Report

Presenting Author: Cassandra Mendonca

Presenting Author's Institution: University of Ottawa

Co-Authors: Wesley Edwards - University of Ottawa

Arthur Wong - University of Ottawa

Background: The perioperative management of a symptomatic anterior mediastinal mass (AMM) is complex, especially in a parturient. Standard fluid resuscitation in pregnancy is in direct conflict with superior vena cava syndrome (SVCS). These cases are rare and the management of potential perioperative complications for this population is not well studied.

Case Report: A 39 year-old G3P0 at 31 weeks gestation presented with stage IV NSCLC with large anterior mediastinal lymph nodes and some findings of SVCS. Clinically, she had severe orthopnea, tachypnea and required supplemental oxygen. Her chest computed tomography showed bilateral hilar adenopathy encasing the trachea and hilar airways resulting in right middle lobe atelectasis and bilateral pleural effusions. The superior vena cava tapered at the cavoatrial junction to 5mm [Figure 1].

A multidisciplinary team was assembled to organize an urgent Cesarean delivery and facilitate post-partum chemotherapy. Preoperative thoracentesis resolved her respiratory symptoms. Large bore intravenous was established in upper and lower limbs, but intraoperative fluids were limited. A titrated low-thoracic epidural was chosen to avoid airway obstruction and minimize hemodynamic instability. The patient was maintained in semi-recumbent position for the entire surgery.

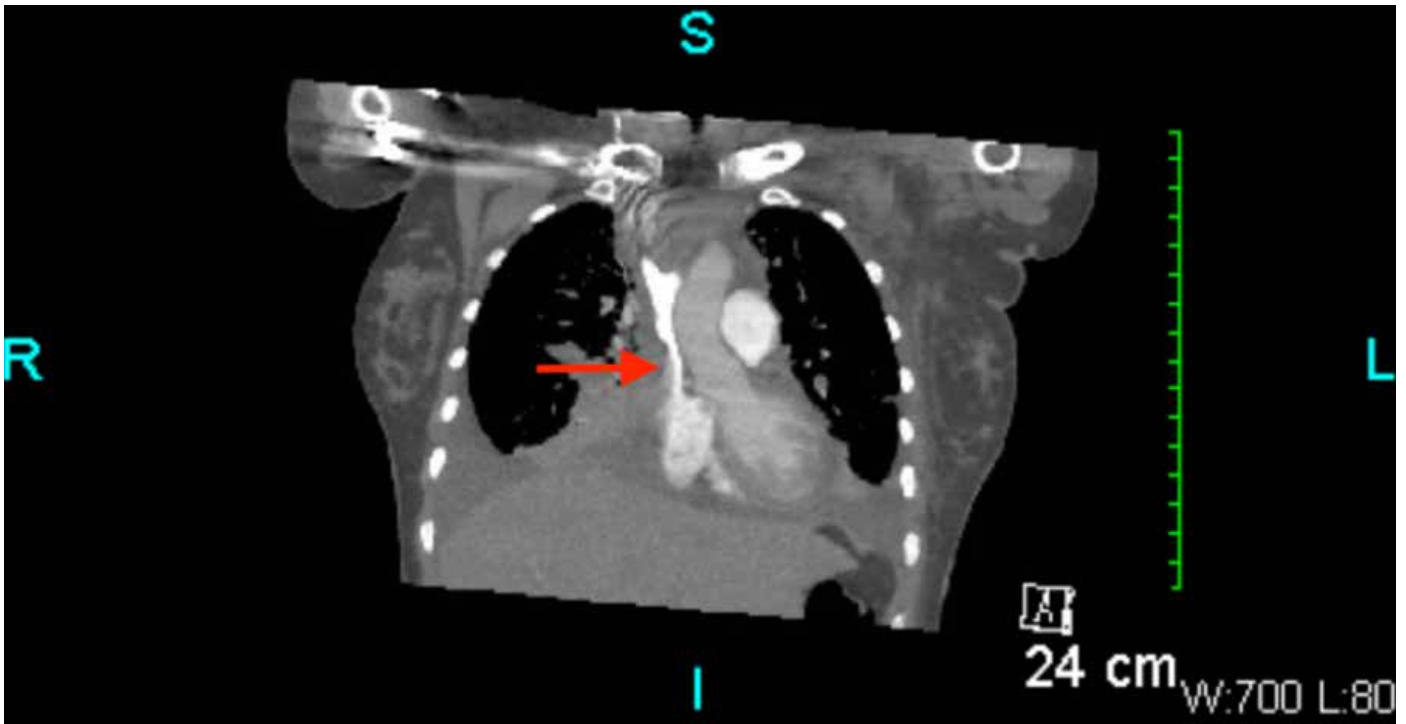
While there were no intraoperative complications, on post-operative day 1 she developed respiratory distress requiring diuresis and thoracentesis for a reaccumulated pleural effusion. She started chemotherapy on post-operative day 6 and discharged home soon after.

Conclusions: Perioperative management of parturients with symptomatic AMM requires a multidisciplinary approach. In particular, how to manage a pregnant patient with SVCS provides a difficult conundrum. This patient was optimized preoperatively from a cardiorespiratory perspective and it was deemed safe to proceed with a titrated epidural. This plan mitigated the risk of developing airway obstruction and cardiovascular instability. Lastly, post-delivery auto-transfusion and fluid retention can result in respiratory compromise as these patients may have limited cardiorespiratory reserve.

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Abstract #: ERF5-11



Abstract #: BCPS-01

Prophylactic co-administration of oxytocin-ergonovine or oxytocin-carboprost versus oxytocin alone at cesarean delivery for labor arrest: A randomized controlled trial

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Background: Women with labor arrest have a higher predisposition to postpartum hemorrhage during cesarean delivery (CD) compared to non-laboring women, due to desensitization of oxytocin receptors from prior exposure to oxytocin during labor.¹ The objective of our study was to compare the efficacy of prophylactic administration of oxytocin-ergonovine (OE) vs. oxytocin-carboprost (OC) vs. oxytocin alone (O) at CD for labor arrest.

Method: This was a prospective, double-blind, randomized controlled study on women undergoing CD for labor arrest under epidural analgesia. Women who received at least 4h of oxytocin for labor augmentation were included. They were randomized into 3 groups and prophylactically administered the study drugs after fetal delivery: OE group received IV oxytocin 5IU + IV ergonovine 0.25mg and IM placebo (1mL NS); OC group received IV oxytocin 5IU and IM carboprost 0.25mg (1mL); and O group received IV oxytocin 5IU and IM placebo (1mL NS). Intravenous drugs, diluted in 10 mL saline, were administered over 1 min. Immediately after the study drugs were administered, an infusion of oxytocin 40mU/min was started in all groups. The obstetrician was asked to rate the uterine tone as satisfactory, equivocal or unsatisfactory at 3, 5 and 10 min after delivery. Additional uterotonics, if needed, were given, as per a planned regimen. The primary outcome was intraoperative need for additional uterotonics. Secondary outcomes included uterine tone, calculated blood loss and side effects. Multivariate logistic regression model was used to predict the need for additional uterotonics after adjustment of covariates. Linear regression was used to develop a predictive model of calculated blood loss and uterine tone was assessed using generalized estimating equations.

Results: A total of 100 women were recruited (OE=33, OC=32, O=35). They had similar baseline demographic and obstetrical characteristics. The mean (SD) duration of oxytocin infusion during labor was 13 (7) h and the maximum rate was 16 (8) mU/min. Additional uterotonics were required in 35% cases after a mean (SD) of 9 (5) min after delivery, and did not differ across groups ($p=0.94$) (Table 1). The blood loss was not different across groups. There was a trend towards higher incidence of hypotension in O group (40%) compared to OE (15%) or OC (25%) ($p=0.07$), with significantly higher need for phenylephrine in O compared to OE group (adjusted $p=0.004$). Incidence of nausea and vomiting was not different across groups, however, there was a trend towards higher nausea in OE and OC groups than O group ($P=0.06$).

Conclusion: We do not recommend the prophylactic use of combination of uterotonic drugs. Side effects were high in all groups, perhaps owing to high bolus doses of oxytocin. We suggest that oxytocin should be used as an infusion in appropriate doses and additional uterotonics used only as required.

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Table 1. Primary and secondary outcomes across the study groups

Outcomes	Oxytocin+ Ergonovine (n=33)	Oxytocin+ Carboprost (n=32)	Oxytocin (n=35)	P value
Need for additional uterotonics (n%)	11 (33.3%)	11 (34.4%)	13 (37.1%)	0.943
More than one rescue uterotonic (n%)	6 (18.2%)	4 (12.5%)	2 (5.7%)	0.270
Rescue oxytocin (n%)	11 (33.3%)	11 (34.4%)	13 (37.1%)	0.943
Rescue ergonovine (n%)	4 (12.1%)	2 (6.3%)	0 (0.0%)	0.079
Rescue carboprost (n%)	4 (12.1%)	2 (6.3%)	2 (5.7%)	0.652
Rescue misoprostol (n%)	2 (6.1%)	2 (6.3%)	0 (0.0%)	0.387
Time (min) for first rescue (oxytocin) after delivery; mean (SD)	5.9 (2.9)	8.6 (6.3)	10.3 (5.3)	0.116
Time (min) for second rescue after delivery (ergonovine or carboprost); mean (SD)	12.3 (3.8)	18.0 (4.2)	24.0 (5.7)	0.104
Satisfactory uterine tone at 3 min after delivery (n%)	19 (57.6%)	21 (65.6%)	22 (62.9%)	0.814
Satisfactory uterine tone at 5 min after delivery (n%)	23 (69.7%)	24 (75.0%)	23 (65.7%)	0.707
Satisfactory uterine tone at 10 min after delivery (n%)	24 (72.7%)	25 (78.1%)	29 (82.9%)	0.656
Uterine massage (n%)	12 (36.4%)	9 (28.1%)	9 (25.7%)	0.629
Calculated blood loss, mL; mean (SD)	1145 (596)	1242 (609)	1180 (504)	0.789
Side effects				
Hypotension (< 20% baseline; n%)	5 (15.2%)	8 (25.0%)	14 (40.0%)	0.068
Phenylephrine amount (mg/mL; median [IQR])	0.0* [0.0 to 0.2]	0.2 [0.0 to 0.4]	0.2 [0.0 to 0.6]	0.006
Hypertension (> 20% baseline; n%)	5 (15.2%)	7 (21.9%)	6 (17.1%)	0.805
Tachycardia (> 30% baseline; n%)	11 (32.3%)	17 (53.1%)	17 (48.6%)	0.242
Chest pain (n%)	2 (6.1%)	1 (3.1%)	0 (0%)	0.311
SpO ₂ < 90% (n%)	0 (0.0%)	3 (9.4%)	2 (5.7%)	0.234
Shortness of breath (n%)	1 (3.0%)	1 (3.1%)	1 (2.9%)	1.000
Nausea (n%)	25 (75.8%)	21 (65.6%)	17 (48.6%)	0.059
Vomiting (n%)	8 (24.2%)	13 (40.6%)	7 (20.0%)	0.149
Need for antiemetics (n%)	19 (57.6%)	20 (62.5%)	17 (48.6%)	0.500
Headache (n%)	3 (9.1%)	3 (9.4%)	0 (0.0%)	0.161
Flushing (n%)	4 (12.1%)	4 (12.5%)	2 (5.7%)	0.598

*Significant difference ($P = 0.004$) in phenylephrine administered post-delivery between oxytocin and oxytocin+ergonovine study groups.

Abstract #: BCPS-02**A randomized trial of an alternate dosing protocol of magnesium sulfate in obese preeclamptic women**

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Co-Authors: Brendan Carvalho - Stanford University School of Medicine

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Abbie Vinson, MD - Oregon Health & Science University

Introduction: Pharmacokinetic (PK) modeling and retrospective data have suggested that magnesium disposition is altered by maternal body habitus. The aim of this prospective randomized trial was to evaluate whether a higher magnesium sulfate dosing protocol in obese women results in more frequent therapeutic serum levels for eclamptic seizure prevention but without incurring more maternal or neonatal harm.

Methods: Between July 2016 - January 2019, 89 women with preeclampsia and a BMI > 35 kg/m² were approached, and 67 consented and randomized to either Zuspan regimen of magnesium sulfate (4g IV loading dose - > 1g/hr infusion) or to alternate increased dosing (6g IV loading dose - > 2g/hr infusion) protocol. Women diagnosed with preeclampsia with severe features had serum magnesium levels obtained at baseline, 4 hrs after administration of magnesium sulfate, and again at delivery. Univariate and multivariate analysis were utilized to compare the proportion of preeclamptic women in each protocol group who had therapeutic serum magnesium levels (> 4.8 mg/dL) at 4 hours after administration and at delivery. A decision analytic model was used to compare the two protocols.

Results: There were no baseline differences (maternal age, race, multiple gestation, BMI, parity, creatinine) between the two groups. Women in the alternate dosing group had significantly higher serum levels at 4 hours and time of delivery compared to women in the Zuspan group ($p < 0.001$; Table). A significantly greater proportion of women in the alternate protocol had therapeutic serum magnesium levels at 4 hours (37% vs. 0%; $p=0.011$) and time of delivery (73% vs. 8%; $p=0.003$) compared to women administered the Zuspan protocol (Table). Multivariate logistic regression controlling for creatinine and age demonstrated that women who received the alternate protocol were 32 times more likely to have a therapeutic serum magnesium at the time of delivery compared to the Zuspan protocol (OR [95% CI] = 31.8 [2.02, 501.5]; $p=0.014$). There were no significant differences in maternal side effects, and neonatal outcomes (individual or composite neonatal morbidity) were similar. A decision analytic model comparing the two protocols suggests increasing the dose of magnesium for obese women with preeclampsia resulted in lower costs and higher effectiveness.

Conclusion: Women with a BMI > are significantly more likely to achieve therapeutic serum magnesium levels for eclampsia prophylaxis when administered a 6g IV loading dose - > 2g/hr maintenance dose compared to women receiving 4g IV - > 1g/hr without additional maternal side effects or neonatal morbidity. This alternate higher dosing protocol should be considered for obese preeclamptic women requiring magnesium sulfate eclamptic seizure prophylaxis.

References:

1. Brookfield KF, Su F, Elkomy MH, Drover DR, Lyell DJ, Carvalho B. [Pharmacokinetics and placental transfer of magnesium sulfate in pregnant women](#). Am J Obstet Gynecol. 2016 Jun;214(6):737.e1-9.

Abstract #: BCPS-02

Table. Parameters for serum magnesium levels at 4 hours and time of delivery for two magnesium sulfate dosing groups in women with BMI ≥ 35 .

	4g -> 1g/hr N = 18	6g -> 2g/hr N = 19
Mean serum level 4 hrs (mg/dL)	3.53	4.41
Mean serum level delivery (mg/dL)	3.73	5.44
Therapeutic at 4 hrs (%)	0	37
Therapeutic at delivery (%)	8	73

Therapeutic = serum magnesium level of ≥ 4.8 mg/dL

Abstract #: BCPS-03**The 2014 New York State Medicaid expansion and maternal health outcomes.****Presenting Author:** Jean Guglielminotti**Presenting Author's Institution:****Co-Authors:** Ruth Landau

Guohua Li, MD, DrPH - Columbia University Vangelos College of Physicians and Surgeons

Morgan Uriell, Student - Columbia University Mailman School of Public Health

Background: The 2014 Affordable Care Act (ACA) allowed states to relax the Medicaid income eligibility threshold for pregnant women (1). States that expanded Medicaid coverage under the ACA have experienced a decrease in the proportion of uninsured pregnant women and an increase in prenatal care utilization (2,3). However, it is not clear whether the Medicaid expansion is associated with improved maternal outcomes. This study examined the effectiveness of the 2014 New York State Medicaid expansion on maternal morbidity.

Methods: Delivery-related discharges were abstracted from the New York State Inpatient Database, 2006-2016. Discharge records for 2014 were excluded (washout) and the analysis was restricted to discharges in uninsured, Medicaid beneficiaries, and privately covered women. The primary outcome was maternal morbidity using the CDC ICD-9 (until September 2015) and ICD-10 algorithms before (2006-2013) and after (2015-2016) the expansion. The secondary outcomes were severe morbidity and the composite of preeclampsia/eclampsia (PEC). Severe morbidity was morbidity associated with death, excess hospital stay, or patient transfer. Adjusted odds ratios (aOR) and 95% confidence intervals (CI) of adverse outcomes associated with the expansion were estimated using the difference-in-differences (DID) approach with adjustment for patient- and hospital-level characteristics and time trends.

Results: Of 2,292,527 delivery-related discharges included, 19.3% were after the expansion. The 2014 implementation of the Medicaid expansion resulted in: 1) a reduction in the proportion of uninsured parturients from 4.7% to 1.7% ($p < 0.001$); 2) an increase in the proportion of parturients covered by Medicaid from 44.5% to 50.1% ($p < 0.001$); and 3) decreased risks of severe morbidity (aOR 0.92, 95% CI 0.84-0.99) and PEC (aOR 0.87, 95% CI 0.84-0.91) in women who were uninsured or covered by Medicaid compared with privately insured women (**Table**).

Conclusions: The 2014 New York State Medicaid expansion is associated with increased insurance coverage and improved maternal health outcomes among socioeconomically disadvantaged women. It may help curb the ongoing increase in severe maternal morbidity observed in the United States. We cannot exclude that the changes for PEC are related to the 2013 redefinition.

References:

1. Sommers B. N Engl J Med 2017;377:586-593.
2. Daw J. JAMA 2018;319:579-587.
3. Clapp M. Obstet Gynecol 2019;134:1066-1074.

Abstract #: BCPS-03

Table: Comparison of changes in adverse maternal outcomes before and after the 2014 Medicaid expansion in women covered by private insurance and in Medicaid beneficiaries or uninsured. The DID estimates the changes in maternal outcomes in Medicaid beneficiaries and uninsured relative to the changes in privately insured women.

	Private insurance				P ^a	% change ^b (95% CI)	Medicaid beneficiaries and uninsured				P ^a	% change ^b (95% CI)	DID estimator (95% CI)
	Before 2006-2013 (N = 940,710)		After 2015-2016 (N = 212,873)				Before 2006-2013 (N = 909,880)		After 2015-2016 (N = 229,064)				
	N	Incidence (%)	N	Incidence (%)			N	Incidence (%)	N	Incidence (%)			
Maternal morbidity	16,482	1.75%	4347	2.04%	< 0.001	+16.6% (+12.7 to +20.5)	22,185	2.44%	6421	2.80%	< 0.001	+15.0% (+11.9 to +18.1)	0.97 (0.93-1.02)
Severe maternal morbidity	4820	0.51%	1222	0.57%	< 0.001	+12% (+5.0 to +19)	7073	0.78%	1828	0.80%	0.032	+2.7% (-2.6 to +8.0)	0.92 (0.84-0.99)
Preeclampsia and eclampsia	36,229	3.86%	10149	4.77%	< 0.001	+23.6% (+20.9 to +26.3)	43,884	4.82%	12101	5.28%	< 0.001	+9.5% (+7.4 to +11.6)	0.87 (0.84-0.91)

Abbreviations: CI: confidence interval; DID: Difference-in-differences; N: number

^a P-value is from Chi-square

^b The % change is the difference between the proportion in 2015-2016 and the proportion in 2006-2013 divided by the proportion in 2006-2013.

Abstract #: BCPS-04

Novel Artificial-Intelligence-Powered Algorithm to Personalize Hemodynamic Management in Patients Presenting for Cesarean Delivery Under Spinal Anesthesia

Presenting Author: Vesela Kovacheva, MD PhD

Presenting Author's Institution: Brigham and Women's Hospital/Harvard Medical School

Co-Authors: Katherine Andriole, Ph.D. - MGH&BWH Center for Clinical Data Science

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Introduction: Optimal maternal hemodynamic management is important for the well-being of mother and fetus. Hypotension after spinal anesthesia occurs in up to 74.1% of cesarean deliveries (CD)¹ and the current guidelines recommend starting phenylephrine infusion prophylactically². Due to the fast and often profound hemodynamic changes, under- or over-treatment is a frequent event. Using artificial intelligence (AI) methods, we created an algorithm able to predict the systolic blood pressure (SBP) and determine the phenylephrine dose needed to maintain hemodynamic stability in healthy parturients after spinal anesthesia.

Methods: We created a cohort of 1400 patients who presented for CD under spinal anesthesia at our tertiary care center. Patients with history of hypertensive disorders, syncope or cardiovascular medications were excluded. The accuracy of the records was assured by a research assistant who was present and acted as a scribe during the CD. For this study, the target SBP window was 90-150 mmHg. We used partial differential equations with seven hyperparameters to inject physiological information into a model for SBP prediction. With the forecast of the patient's SBP, the model itself is subsequently used to predict the amount of phenylephrine to achieve a target SBP. The overall model was validated with 5-fold cross-validation.

Results: Using 300 retrospective records of patients who were not used in the model, the model was able to predict SBP < 90 mmHg with sensitivity 0.997 and specificity 0.965. The area under the curve of the overall model was 0.869 (Fig.1). Using this model, we developed a software application for clinical use that generates predictions for the SBP and phenylephrine dose every minute. Due to the inherent nature of our methods, we are able to demonstrate the decision making of the algorithm and adjust a range of parameters to empower the physician to take care of patients even with conditions that were not present in the training cohort. For example, patients with preeclampsia can be optimally managed by increasing the model's sensitivity to phenylephrine as demonstrated using retrospective records.

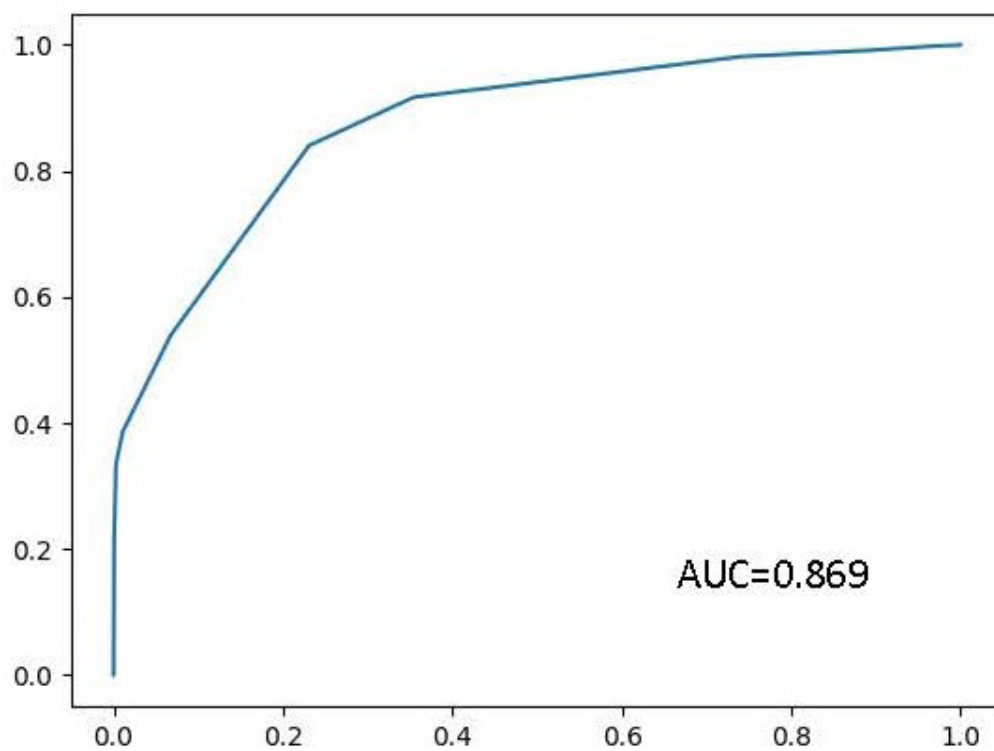
Discussion: We were able to create an algorithm able to generate highly accurate predictions for the maternal SBP and phenylephrine needs using well-established methods in computer science,. We envision connecting our model directly to the anesthesia monitor to receive vital signs and then drive an infusion pump, thus automating the titration of infusions.

Conclusion: In sum, our AI-powered algorithm has the potential to increase the safety and well-being of millions of mothers and babies annually. In the long run, adding more medications (for example propofol, insulin) and input parameters will create an automated system able to deliver personalized drug infusions, thus increasing safety, decreasing cost of care and, ultimately, innovating the way we perform anesthesia.

References:

1. Kloor et al, 2010
2. Kinsella et al. 2018

Figure 1. Predictive accuracy of the overall model.



Abstract #: BCPS-05

The Frequency of Difficult Intubation in Obstetric Patients: A Study from the Multicenter Perioperative Outcomes Group Research Consortium

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Co-Authors: Michael Aziz - Oregon Health & Science University

Brian Bateman

Melissa Bauer, DO - University of Michigan

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Background: Estimates for the frequency of failed intubation in obstetrics vary widely (1:200 to 1:1,200) and are based on older studies, single centers, or centers outside the US.¹ This study aims to describe the frequency of difficult and failed intubation in obstetrics in a contemporary sample of deliveries in the US, drawn from the 49 hospitals that comprise the Multicenter Perioperative Outcomes Group (MPOG).

Methods: This is a multicenter, observational study utilizing the MPOG database. We first identified patients aged 15-44 who had general anesthesia (GA) for cesarean delivery between January 1, 2000 and July 1, 2018 at all MPOG sites. We defined difficult intubation as: direct or video laryngoscopy with a Cormack-Lehane view ≥ 3 , intubation attempts ≥ 3 , fiberoptic intubation, surgical airway, supraglottic airway, or failed intubation. We defined failed intubation as any attempt at intubation without successful endotracheal tube placement. We performed an electronic search of the database and subsequent manual chart review for patients meeting the criteria for difficult intubation. We calculated frequencies and associated 95% confidence intervals (CI) and assessed for univariate associations between several patient characteristics and the risk of difficult intubation among parturients receiving GA for cesarean delivery.

Results: We identified 14,805 cases of cesarean delivery performed under GA in the MPOG database. There were 268 cases of difficult intubation; the frequency of difficult intubation was 1.81% (95% CI 1.61, 2.04). There were 12 cases of failed intubation; the frequency of failed intubation was 0.081% (95% CI 0.046, 0.142).

Of difficult intubations, 84.8% (95% CI 79.7, 88.9) were classified as difficult solely due to a direct or video Cormack-Lehane grade 3 or 4 view; the remainder required 3 or more attempts at intubation. Of the 12 failed intubations, all were rescued by supraglottic airway placement. One case additionally had a failed flexible bronchoscopy attempt and a subsequent successful surgical airway. No patients in the difficult or failed intubation cohorts died.

Increasing age, BMI and Mallampati score were all associated with an increased odds of difficult intubation. Compared to age < 35, women age 35-39 had an OR of 1.37 (95% CI 1.02, 1.85) and women age >40 had an OR of 1.28 (95% CI 0.74, 2.21). Compared to BMI < 25, women with a BMI of 25-39.9 had an OR 2.61 (95% CI 1.27, 5.36) and women with a BMI >40 had an OR of 4.72 (95% CI 2.23, 9.98). Compared to a Mallampati score of 1 or 2, a Mallampati score of 3 had an OR of 1.94 (95% CI 1.34, 2.81) and a Mallampati score of 4 had an OR of 5.61 (95% CI 2.93, 10.73).

Conclusions: In this large, multi-center, contemporary study, we examined the frequency of difficult intubation in over 14,000 general anesthetics for cesarean delivery; we observed a risk of difficult intubation of 1:55 and a risk of failed intubation of 1:1,250.

References:

1. Kinsella IJOA 2015

Abstract #: BCPS-06

Labor epidural analgesia and the risk of autism spectrum disorder in offspring

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Jane Lin - Kaiser Permanente Southern California Research and Evaluation

Chunyuan Qiu - Kaiser Permanente Baldwin Park Medical Center

Jiaxiao Shi - Kaiser Permanente Southern California Research and Evaluation

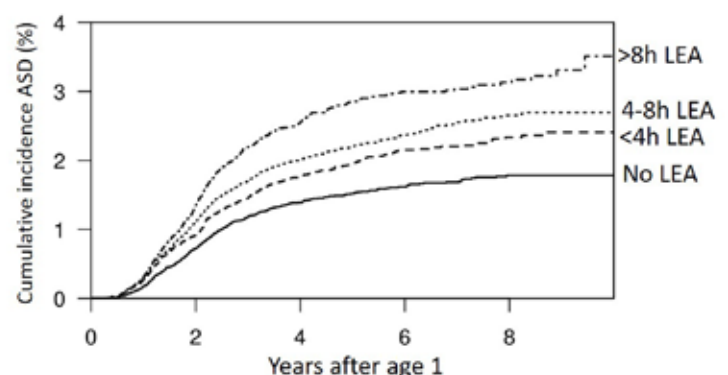
Anny Xiang - Kaiser Permanente Southern California Research and Evaluation

Introduction: Labor epidural analgesia (LEA) is associated with maternal intrapartum fever and oxytocin exposure. In animal models and some human epidemiology, fever and to a lesser extent, oxytocin, have been associated with neurodevelopmental effects, including autism spectrum disorders (ASD) on the baby. We examined the association between LEA and ASD in a large longitudinal cohort.

Methods: The institutional IRB approved this retrospective study. Data from 147,895 singleton vaginal deliveries from a large multicenter integrated healthcare system were obtained. The primary exposure of interest was LEA, and the duration of exposure was calculated as placement time to delivery. Additionally, fever $\geq 38^{\circ}\text{C}$ at any time after LEA initiation and oxytocin use (yes/no) was determined. The primary outcome was ASD diagnosis, defined by ICD-9 or internal diagnosis codes; age of diagnosis was recorded, and followup continued until any of the following: diagnosis of ASD, health system disenrollment, death of the child, or 12/31/2018. All children in the system are screened at least twice for ASD between 18-30 months of age and multiple specialists must agree on the diagnosis. Multivariable logistic regression and inverse weighted propensity score weighting (IPSW) was used to control for 19 potential confounders. Sensitivity analyses included exclusion of preterm delivery, of children with any birth defect, and the IPSW model. Hazard ratios and 95% CI for LEA were calculated by Cox regression where the time variable was child's age-1.

Results: 147,895 children were born to 119,973 mothers, 74.2% of whom received LEA. Many covariates differed between LEA and no-LEA groups but IPSW resulted in a well-balanced covariate distribution (standardized differences < 0.1 for all variables). Fever (11.9% vs. 1.3%) and oxytocin use (68.1% vs. 26.9%) were more common with LEA (chi square, $P < .0001$), and fever was more common with longer LEA exposure. LEA was strongly associated with development of ASD. After adjusting for covariates, the HR for LEA was 1.40 (1.24-1.57). Excluding preterm delivery or birth defects did not significantly change the estimates. Inclusion of fever, oxytocin, and LEA resulted in one model showed no effect of fever or oxytocin but persistent effect of LEA. Using IPSW to control for variables associated with LEA also showed a persistent effect (HR 1.35 [1.20-1.51]). Increased duration of LEA exposure appeared to increase the risk of ASD (Fig). In the fully adjusted model, compared to no LEA, the HR for ASD was 1.36 (1.19-1.57) for $< 4\text{h}$, 1.40 (1.23-1.60) for 4-8h, and 1.50 (1.28-1.75) for $> 8\text{h}$. The test for linear trend did not reach statistical significance (1.05 [0.97-1.13]).

Discussion: LEA exposure is associated with an increased risk of ASD in the child, after controlling for multiple confounding factors. Whether this effect is the result of intrapartum fever and fetal neuroinflammation should be targets for further investigation.



Abstract #: BBSP-01

Predictive, Multi-Omic Changes in Third-trimester Pregnancies That Predict the Onset of Labor

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Co-Authors: Nima Aghaeepour - Stanford University School of Medicine

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Introduction: Pre-term birth is the world's most common cause of mortality in children under the age of five, and our ability to predict and prevent is currently limited. The aim of the study was to do multi-omic profiling of blood samples collected during the third trimester of pregnancy to identify the molecular and cellular events that predict the onset of labor.

Material and Methods: Peripheral blood and plasma samples were collected weekly between the 24th and 40th gestational week until they went into labor spontaneously. Whole system peripheral immune responses were analyzed using a high-dimensional mass cytometry immunoassay. A multiplex, aptamer-based protein detection platform was used to determine plasma protein levels, and metabolic and lipidomic analytes were detected using high-throughput mass spectrometry.

Results: 51 women were enrolled and a total of 144 samples collected. Mean \pm SD gestational age at labor onset was 39 weeks and 1 day \pm 1w5d). A Lasso regression model predicted the difference between the day of sampling and the onset of labor with high accuracy ($r=0.8511$, $p < 0.0001$, Figure 1A) and identified a striking molecular shift occurring 24 days before the onset of labor (Figure 1B). The most informative features of the multi-variate model included the STAT1 signaling responses in CD56loCD16+ NK cells, IL-33-receptor IL1R4, inflammation marker Cystatin C, Progesterone, and angiogenic Angiopoietin-2 and anti-coagulant Antithrombin III.

Conclusion: The multi-omic assessment of maternal blood revealed a multivariate model of cellular and molecular events that accurately predicted the spontaneous onset of labor in healthy term pregnancies. The results provide the foundation for testing the generalizability of the model for the prediction of preterm labor, identified potential targets for therapeutic interventions, and show divergent mechanisms that drive the premature onset of labor.

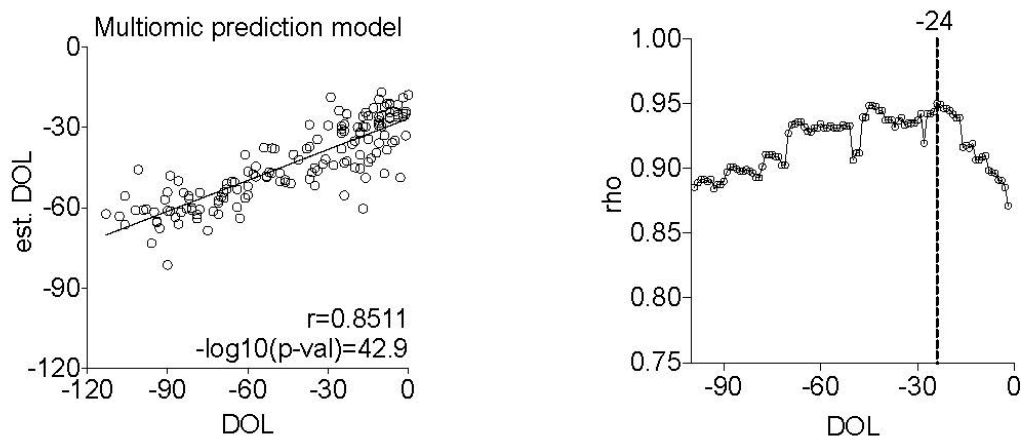


Fig. 1 Third-trimester dynamics predict time to delivery and reveal a multi-omic switch to onset of labor

Abstract #: BBSP-02

Use of high resolution thermography as a validation measure to provide “personalized” epidural anesthesia in mice.

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Galel Yakobi, MD - Hadassah Hebrew University Medical Center, Jerusalem

Introduction: Sympathetic deafferentation following epidural local anesthesia causes segmental vasodilation. In humans, skin temperature and photoplethysmography have shown epidural-induced vasodilation of feet with dose-dependent vasoconstriction of hands. Our lab studies the effect of epidural-induced sympathectomy on animal preeclampsia models; in particular placental perfusion, fetal growth, fetal brain injury and maternal preeclampsia. For those studies, we need a validation tool to confirm the intervention (segmental vasodilation). We used high resolution thermography to measure temperature in the lower body (rear paws and tail) and the upper body (front paws and ears). Thermography is used primarily for industry and security, but is increasingly applied to biology.

Methods: We anesthetized 10 non-pregnant male and female C57BL/6 mice with isoflurane. We used a surgical microscope to insert a PU-10 catheter into the epidural space at T11-12 by midline incision, using the technique described by Poon. We recorded baseline temperature of the front and rear paws, tail and ears, using a thermal camera (E75, FLIR Systems, Wilsonville, OR) which has a thermal sensitivity of $\pm 0.05^\circ\text{C}$ and a pixel resolution of 320x240 pixels with spatial resolution 200 μm . We allowed the mouse to emerge from anesthesia and then measured thermography at baseline and at repeated intervals after an epidural bolus dose of either 50 μL bupivacaine 0.25% or 50 μL saline. We used video to record thermal images in unrestrained animals and scrolled back to obtain images of regions of interest. Data were analyzed using FLIR scientific software and Excel; for statistical analysis we used repeated measures ANOVA (SPSS).

Results: Thermal images are presented in Fig 1 for a single illustrative mouse after epidural bupivacaine, showing progressive warming of the tail and rear paws, with progressive cooling of the ears and no change in the front paws. Pooled data is shown in Fig 2. There was a pronounced warming of the rear paw and tail by 3-4 $^\circ\text{C}$, with minimal change in the hands and ears. The difference over time between the lower versus the upper body was significant ($p < 0.001$). Effect returned to baseline by 15 min in most cases. There was no effect of epidural saline.

Conclusion: Thermography is a useful tool to confirm epidural placement, particularly in animals where subjective measures are impossible. This approach allows us to provide “personalized” therapy for laboratory animals in neuraxial anesthesia research. If segmental sympathectomy is not apparent following a 50 μL bolus dose, the dose is repeated once; if no effect is observed after the second dose, then the epidural is considered a technical failure and the animal replaced. Similarly, the dose rate of epidural infusion is titrated to maintain segmental vasodilation with temperature gradients between lower body (rear paws and tail) and the upper body (front paws and ears).

References:

Poon et al. J Neurosci Meth. 2011;[200](#):36-40

Abstract #: BBSP-02



Fig 1

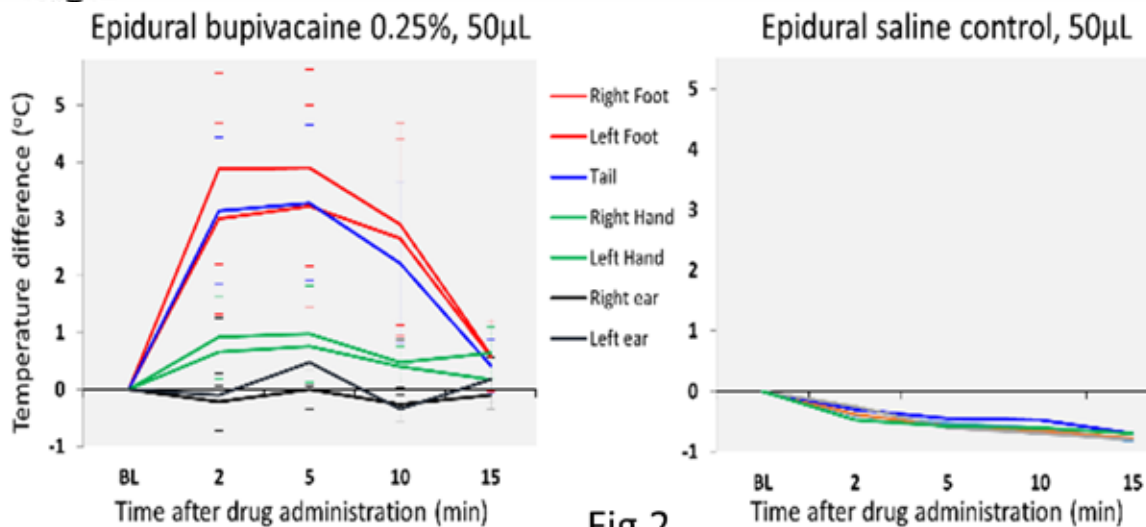


Fig 2

Abstract #: BBSP-03

Genome-Wide Association Study (GWAS) of Patients with Postpartum Hemorrhage Identifies Genetic Loci Related to Immunity and Cell Interactions

Presenting Author: Vesela Kovacheva, MD PhD

Presenting Author's Institution: Brigham and Women's Hospital/Harvard Medical School

Co-Authors: Brian Bateman

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Kathryn J. Gray, MD PhD - Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Brigham and Women's Hospital and Harvard Medical School

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Introduction: Postpartum hemorrhage (PPH) is the leading cause of maternal mortality in the US and worldwide. While a host of clinical risk factors have been identified (i.e., preeclampsia, multiple gestation, chorioamnionitis), the molecular mechanisms of PPH are not well understood. Epidemiologic studies showed that 41% of PPH risk is familial with 18% attributable to maternal genetic factors, but associated genes have not yet been identified. ICD codes have high specificity at identifying patients with PPH. Therefore, we undertook a genome-wide association study (GWAS) to identify novel genetic variants associated with increased postpartum hemorrhage risk using ICD 9/10 codes in the UK Biobank.

Methods: Study participants were obtained from the UK Biobank, a large population-based prospective cohort of over 500,000 participants designed to study determinants of disease. We identified 1424 PPH cases (by ICD 9/10 codes 666.* / O72.*) and 4272 matched controls of European ethnicity with at least one live birth and no PPH. Standard quality control was performed at the sample and SNP level. Genetic ancestry was determined by principal component (PC) analysis and compared to reported ethnicity. Data analysis was performed using BOLT_LMM v2.3 linear mixed models and an additive genetic model adjusted for age, 10 PCs, genotyping array, and genetic correlation matrix, a measure of relatedness in the sample.

Results: This maternal PPH GWAS identified three genetic loci at genome-wide significance ($< 5 \times 10^{-8}$). The top SNP was near the *LGALS3BP* gene that modulates cell-cell and cell-matrix interactions and the immune response associated with natural killer (NK) and lymphokine-activated killer (LAK) cytotoxicity. The other significant loci were near *CHST15* (that encodes a sulfotransferase for chondroitin sulfate) and *MIIP* (that encodes a protein inhibiting cell migration). Two additional loci of suggestive significance were near *TNS3* and *TRIM34*, genes that regulate cell migration and response to interferon, respectively.

Discussion: In this maternal PPH GWAS, we identify several putative novel genetic loci near genes involved in cell interactions and immunity. There is growing evidence regarding the role of the immune system in placentation and maintenance of normal gestation. More research is needed to elucidate the mechanisms by which inflammation and immunity may influence hemorrhage risk. Future studies will focus on replicating these findings in larger cohorts and functionally characterizing biologic pathways with implicated PPH-related genes.

Conclusion: Here we report the first maternal PPH GWAS, identifying several potential novel genetic loci associated with PPH risk for further replication and evaluation. Understanding the underlying pathophysiology of PPH may facilitate the development of novel predictive methods and treatment options for PPH.

Abstract #: BBSP-04

Kappa opioid signaling provides a target for the treatment of neuraxial morphine-induced itch in mice and non-human primates

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Presenting Author's Institution: University of Pittsburgh School of Medicine

Co-Authors: Huiping Ding - Wake Forest School of Medicine

Mei-Chuan Ko - Wake Forest School of Medicine

Grace Lim, MD, MS - University of Pittsburgh UPMC Department of Anesthesiology & Perioperative Medicine

Sarah Ross - University of Pittsburgh

Introduction: Morphine-induced itch is a common and debilitating side effect that limits the use of neuraxial morphine for obstetric patients. Nalbuphine (Nubain), a mixed mu antagonist and kappa agonist is frequently prescribed for the treatment of pruritus caused by neuraxial opioids (2).

Objective: In this study, we tested whether a selective kappa agonist, nalfurafine, could treat morphine-induced itch in mouse and non-human primate models.

Methods: Non-human primates (n=5) and mice (n=8-9, determined using a power analysis, *a priori*) were used in this study to test the efficacy of nalfurafine for the treatment of neuraxial morphine-induced itch. After receiving neuraxial morphine, animals were randomly assigned to experimental (nalfurafine, 300ng in primates and 40ng in mice) or control (saline) groups. After the observation of scratching behavior, animals were subjected to nociceptive testing to assess the effect of nalfurafine on analgesia.

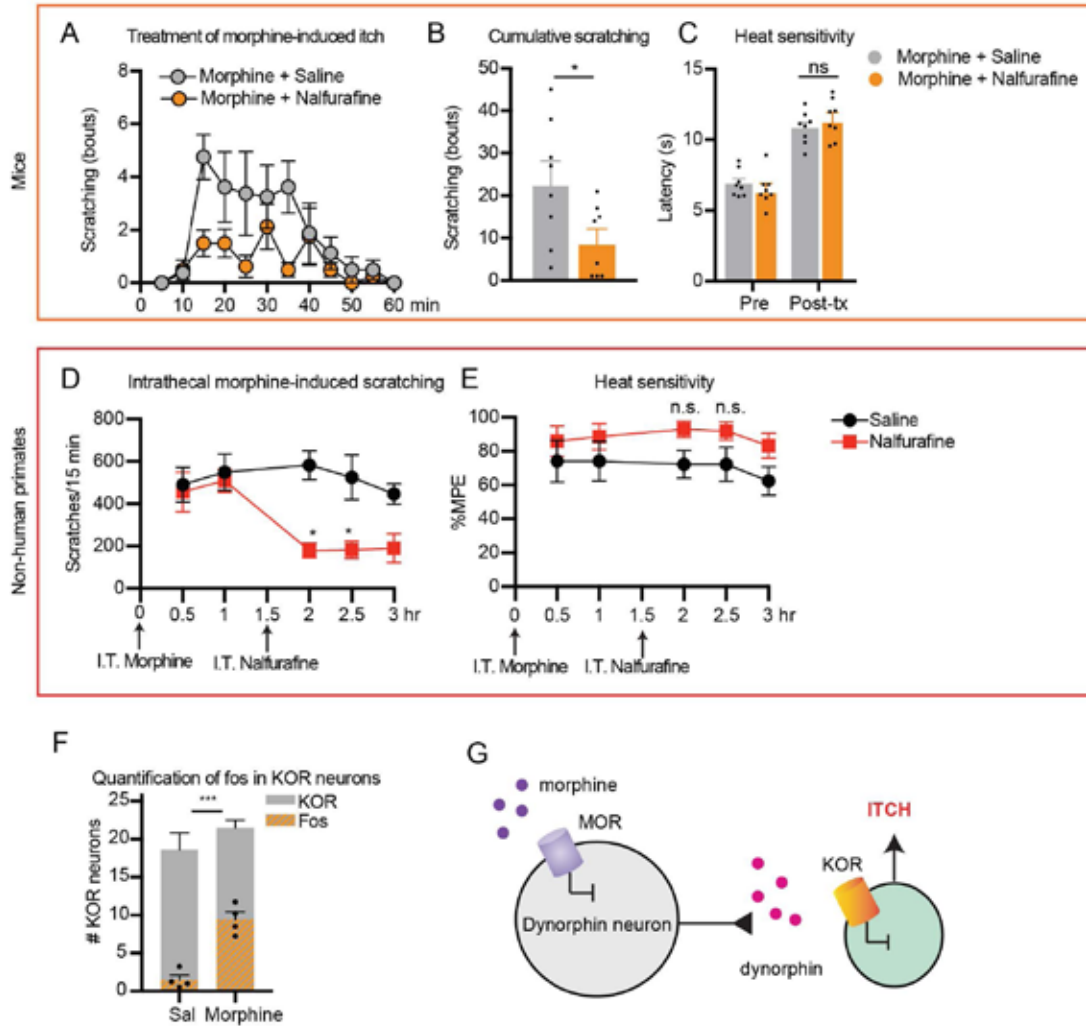
Results: In both mice and non-human primates, nalfurafine treatment led to a reduction in scratching behavior with no effect on the analgesia provided by morphine, assessed using assays for thermal nociception (**Figure 1A-E**). We also found that neurons expressing the kappa opioid receptor were activated by morphine (**Figure 1F**).

Conclusion: In our preclinical models, intrathecal administration of nalfurafine led to a reduction in itch behavior. We propose that morphine causes a disruption in kappa signaling that can be restored with kappa agonist (nalfurafine) treatment. Our findings indicate that morphine leads to a reduction in kappa tone, leading to itch, which can be restored with a kappa agonist (**Figure 1G**). With support from two preclinical model organisms, we propose that selective kappa agonists should be considered for the treatment of neuraxial morphine-induced itch.

References:

1. Ko, M. *J Pharmacol Exp Ther* 2003; **305**: 173–9
2. Jannuzzi R. *Clin J Pain* 2016; **32**: 87–93

Abstract #: BBSP-04



A. Time-course for the reduction in morphine-induced itch with nalfurafine in mice. **B.** Cumulative data shown in A. **C.** Nalfurafine does not reduce the analgesic effects of morphine as assessed using a test of thermal nociception. **D.** In non-human primates, morphine causes scratching that is relieved with nalfurafine. **E.** Nalfurafine does not reduce the analgesic effect of morphine assessed using a tail-flick assay to test thermal nociception. **F.** Neurons expressing the kappa opioid receptor (KOR) exhibit increased expression of *fos*, an immediate early gene used to infer neuronal activity following IT morphine. **G.** A proposed model by which morphine causes itch; morphine inhibits dynorphin neurons, which leads to a reduction in kappa signaling, causing itch. Dots represent individual animals. Asterisks indicate the results of 2-way ANOVA or unpaired t-test. n.s. not significant, * $p < 0.05$, *** $p < 0.001$.

Abstract #: EF1-01

Pharmacokinetics of intravenous calcium chloride in women at the time of intrapartum cesarean delivery

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Presenting Author's Institution: Stanford University - Stanford, California

Co-Authors: Brendan Carvalho - Stanford University School of Medicine

Pamela Flood, MD, MS - Stanford University School of Medicine

Neil Kalariya, MD - Swedish Medical Center

Edward Riley - Stanford University School of Medicine

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Introduction: Intravenous calcium chloride (CaCl_2) is administered to parturients for indications including magnesium toxicity and hypocalcemia from citrate loads in the setting of massive transfusion [1]. Additionally, CaCl_2 may be a potential prevention or treatment measure for uterine atony [2]. Despite approved indications, the pharmacokinetics of CaCl_2 in pregnant women has not been studied, and dosing recommendations are extrapolated from non-pregnant volunteers and patients. The aim of this study was to determine the pharmacokinetic properties of an infusion of 1g CaCl_2 in term parturients undergoing cesarean delivery.

Methods: Venous blood samples from 24 women undergoing intrapartum cesarean were used for this analysis. Beginning at the time of umbilical cord clamp, women were randomized to receive 1 G CaCl_2 in 60 mL saline or normal saline placebo, administered as a 10-minute infusion. Blood samples were drawn at random time points from infusion completion until 2 hours post-infusion. Ionized calcium (iCa) and pH were recorded for analysis. Potential clinical effects during or after drug infusion including nausea, vomiting, IV line or limb discomfort, abnormal taste, changes in heart rate or blood pressure were recorded. The anesthesiologist, who was blinded to treatment group, was instructed to discontinue the infusion if any concern for severe adverse effects.

A pharmacokinetic model was created with NONMEM (Nonlinear Mixed-Effects Modeling) using PLT Tools (PLT Soft). A 1-compartment model provided the best fit. We used an exponential model for interindividual variability on the volume of distribution and clearance with an additive term on the baseline concentration. Ninety-five % confidence intervals for each parameter were calculated from log likelihood profiling and bootstrap analyses.

Results: The baseline iCa concentration was 1.18 mmol/L (95% CI 1.16-1.19). The highest measured iCa value for any patient was 1.6 mmol/L, with most falling in the 1.45-1.55 mmol/L range. The clearance of CaCl_2 was 0.93 L/min (95% CI 0.63- 1.52). The volume of distribution was 76 L (95%CI 49-94). The median prediction error for the model was 0% and the median absolute prediction error was 3%. The model was not improved by incorporating pH. The incidence of potential side effects was 30% in both groups. No infusion required pause or discontinuation for a serious adverse event.

Conclusions: We have characterized the pharmacokinetic properties of an intravenous infusion of 1-gram CaCl_2 given over 10 minutes in women who are immediately post-partum. This kinetic model can be used to inform future studies and dosing strategies. The CaCl_2 infusion appears safe and was well-tolerated, with an estimated peak ionized calcium concentration of 1.5-1.6 mmol/L.

References:

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Abstract #: EF1-01

Figure 1

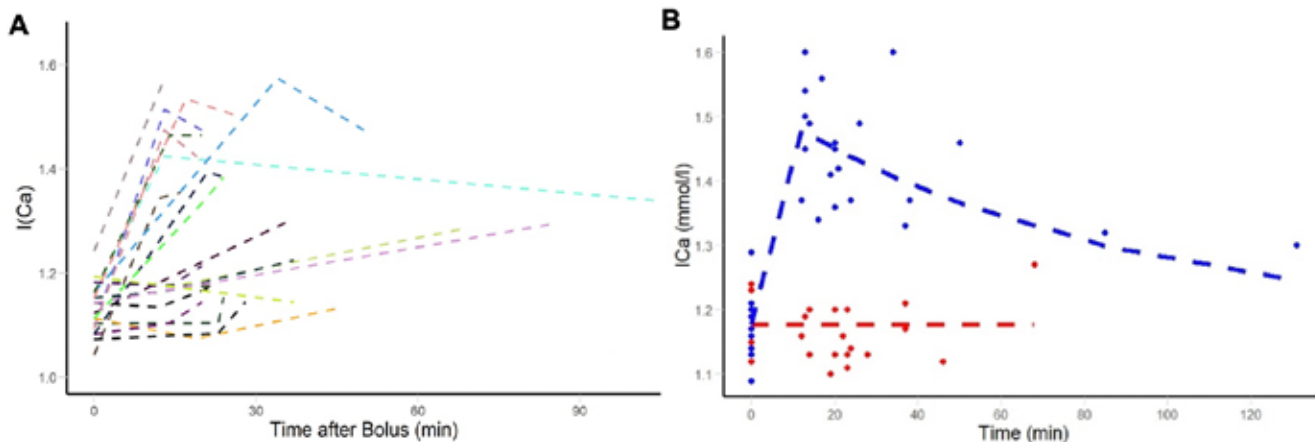


Figure 1A) Individual Patient trajectories over time. B) Calcium concentration over time. Blue dots represent calcium concentrations from over time in patients who received an infusion of 1-gram calcium chloride over 10 minutes starting at time 0. The blue dashed line represents the best one compartment model. The red points and dashed line similarly represent calcium concentrations from patients who received the placebo treatment.

Abstract #: EF1-02

A pharmacokinetic study of tranexamic acid to determine its optimal dose in the postpartum period

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Background: Tranexamic acid (TxA) has been shown to reduce blood loss in childbirth and has become an important drug in the prevention and treatment of postpartum hemorrhage (PPH) (1,2). The fibrinolytic effect of TxA requires plasma concentrations of 5-15 mg/mL sustained for at least 60 minutes after its intravenous administration (3). To date there are no pharmacokinetic studies in pregnant women to guide clinical practice. The objective of this study was to determine the minimum effective dose of TxA required to produce sustained therapeutic plasma levels for at least 60 minutes following childbirth, in term pregnant women.

Methods: This study received institutional research ethics approval and written informed consent was obtained from all participants. We included term pregnant women, ASA II and III, with normal kidney function, undergoing elective cesarean delivery under spinal anesthesia. We conducted a pharmacokinetic study using a dose-escalation design. Each participant received a single dose of intravenous TxA following birth of the baby and prior to clamping the umbilical cord (time-0). Blood samples were collected from a catheter inserted in an antecubital vein at 0, 15, 30, 60 and 120 minutes. The first five participants received a dose of 5mg/kg; the next five, 10mg/kg and the following three, 15mg/kg. Interim analysis was performed at this stage and based on the results, eight more participants were recruited. Upon extraction from plasma by solid phase microextraction, TxA concentrations were measured using tandem liquid chromatography. As plasma protein binding of TxA is about 3% at therapeutic plasma levels, and is fully accounted for by its binding to plasminogen, it could be assumed that its clearance and distribution would remain unchanged following administration of a single dose in participants with normal kidney function.

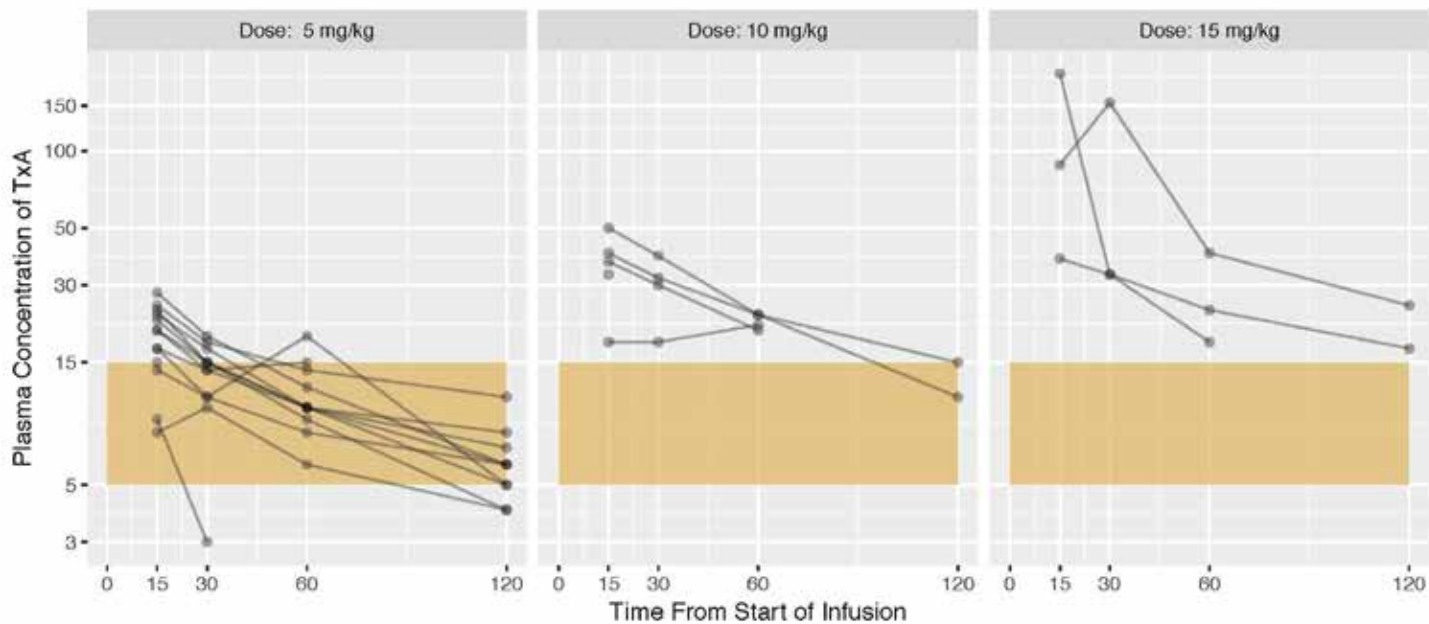
Results: We analysed data from 21 women, weighing between 68 and 117 kg. Interim analysis showed that a dose of 5mg/kg produced sustained therapeutic plasma concentrations, while doses of 10mg/kg and 15mg/kg resulted in supratherapeutic levels for 60-120 minutes following administration (Figure). The study was terminated upon confirming that therapeutic plasma concentrations were attained after administering a 5mg/kg dose to a total of 13 women.

Conclusion: A dose of 5mg/kg of TxA produces therapeutic plasma concentrations in the immediate postpartum period, and should be the dose recommended for PPH prevention in obstetric trials. This translates to under 500mg for women weighing up to 100kg. The dose of 1gm currently used in obstetric trials would amount to 14.3mg/kg in a woman weighing 70kg, resulting in supra-therapeutic plasma concentrations.

References:

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2. ACOG Practice Bulletin No. 183. Postpartum hemorrhage. *Obstet Gynecol* 2017;130:e168-86
3. Tranexamic Acid injection FDA, 2011

Abstract #: EF1-02



The shaded area (5-15mg/ml) represents therapeutic plasma concentrations required for antifibrinolytic effect of tranexamic acid (TxA)

Abstract #: EF1-03

The effects of crystalloid vs colloid hemodilution on coagulation in term parturients: an in vitro study using thromboelastometry

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Background: There have been concerns in the literature regarding the negative effects of colloids on coagulation, beyond that caused by hemodilution alone. No study has examined the impact of increasing hemodilution in vitro on markers of coagulation with crystalloid versus colloid in term pregnant patients.

Objective: To examine the impact of crystalloid versus colloid hemodilution in vitro on components of blood coagulation using rotational thromboelastometry in obstetric patients.

Methods: This is a prospective, observational pilot study including 76 healthy, pregnant patients at term (≥ 37 weeks) gestation without history of bleeding or clotting disorder or on medication affecting coagulation. Venous blood samples were collected and divided into specimen tubes to generate varying degrees of hemodilution with either Plasma-Lyte (crystalloid) or albumin (colloid) at the following dilution levels: 0%, 20%, 25%, 30%, 35%, 40%, 45%, 55%, 60%, 65%, 70%, 75%, 80%. ROTEM® was performed to assess for coagulation changes at each dilution.

Results: At each degree of dilution, there was a statistically significant difference in median FIBTEM A5 between crystalloid and colloid samples. However, this difference remained less than 10% at every dilution. Moreover, the predicted probability of coagulopathy, using the parameter of FIBTEM A5 less than 12 mm, was no different between samples diluted with crystalloid versus colloid at each level of dilution.

Conclusion: The results of this study show that there is no additional risk of coagulopathy when colloid (albumin) is used for hemodilution compared to crystalloid (Plasma-Lyte) in vitro. This is important given that colloids are frequently used to restore intravascular volume during massive hemorrhage, these results support that colloids need not be avoided due to a concern for additional coagulopathy.

References:

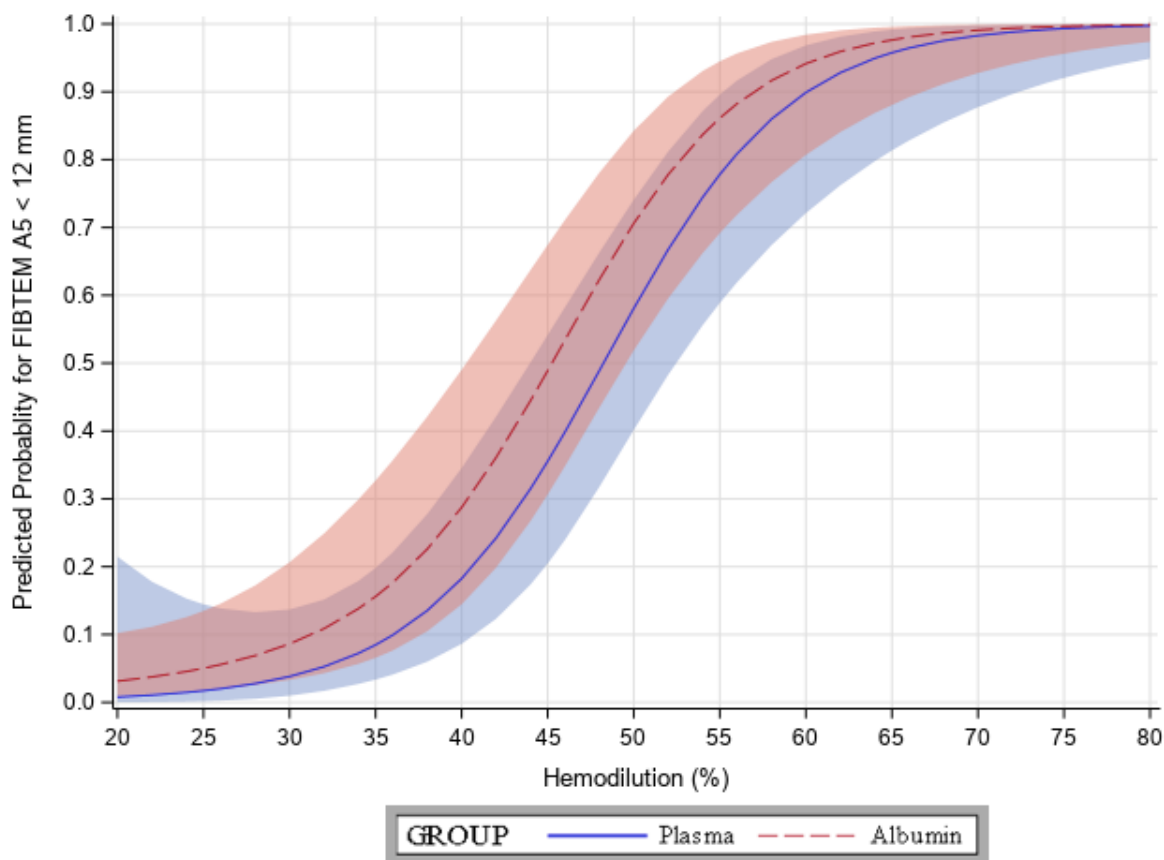
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Abstract #: EF1-03



Abstract #: EF1-04

Intravenous versus oral iron for postpartum anemia: A cost-effectiveness analysis

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Co-Authors: Aaron Caughey, MD, PhD - Oregon Health & Science University

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Background: Postpartum anemia impacts up to 50% of women in developed countries and is linked to maternal depression, fatigue, and impaired cognition (Milman 2011). In a recent systematic review, intravenous (IV) iron resulted in a greater increase in hemoglobin (Hb) levels vs oral iron in women with postpartum anemia (Sultan et al. 2018). However, the cost-effectiveness of IV vs oral iron has not been previously studied.

Objective: To evaluate the cost-effectiveness of IV vs oral iron in women with postpartum anemia, accounting for anemia-related postpartum depression and iron-related gastrointestinal (GI) adverse events (AEs).

Study Design: A cost-effectiveness model using TreeAge Pro software was designed to examine the costs and quality-adjusted life years (QALYs) in women with postpartum anemia (Hb \leq 10 g/dL) treated with IV iron (iron sucrose [two infusions; 200 mg/infusion]) vs oral iron (iron sulfate 325 mg 2x/day for 6 weeks). All model inputs were derived from the literature. This model included a theoretical cohort of 1.9 million women, the estimated annual number of women with moderate-to-severe postpartum anemia in the United States. Outcomes included the incremental cost-effectiveness ratio (ICER), costs, QALYs, anemia prevalence at 6 weeks postpartum, GI AEs (constipation and dyspepsia), postpartum depression, and maternal suicide. A cost-effectiveness threshold was set at \$100,000/QALY. Sensitivity analyses were used to determine the strength of the results.

Results: In a theoretical cohort of 1.9 million anemic women, IV iron resulted in an additional \$600 million in societal costs and an increase of 6,063 QALYs compared to oral iron. IV iron led to 360,388 fewer cases of anemia, 203,561 fewer GI AEs, 27,645 fewer cases of postpartum depression, and two fewer maternal deaths. The ICER for IV iron was \$98,837/QALY and sensitivity analyses demonstrated IV iron was cost-effective up to \$362 for two IV iron infusions, using a baseline cost of \$358 (Figure 1). Additionally, a Monte Carlo simulation of 1,000 trials of the model with simultaneous varying of model inputs found IV iron to be cost-effective in 51.5% of trials, whereas in the remaining 48.5% of trials, oral iron was found to be the cost-effective strategy.

Conclusions: IV iron given for postpartum anemia is marginally cost-effective compared to oral iron, though it only remains cost-effective in a small majority of trials in the sensitivity analyses. Routine use of IV iron would lead to increased societal costs, but would modestly increase QALYs and improve maternal outcomes. Reducing the cost of IV iron may promote its use as a cost-effective treatment modality for postpartum anemia.

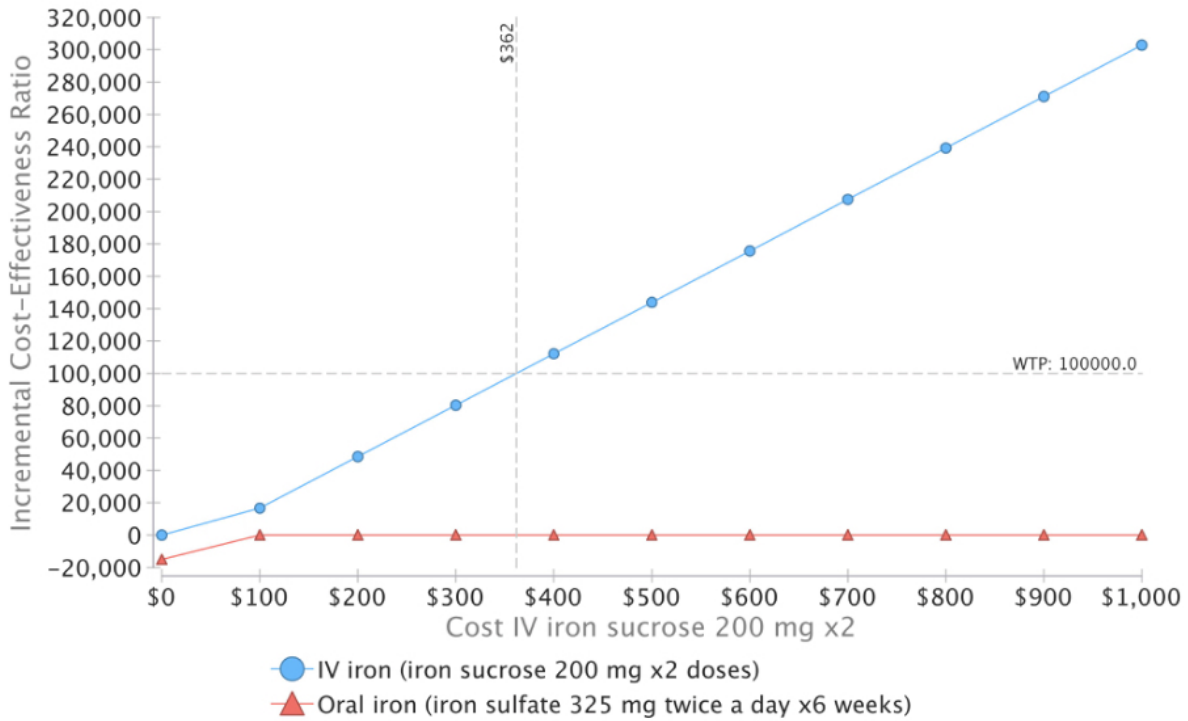
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Figure 1. One-way sensitivity analysis for the cost of IV iron



The vertical axis displays the incremental cost-effectiveness ratio (ICER), and the horizontal axis displays the cost of two doses of IV iron sucrose 200 mg (varying from \$0-\$1,000, with a baseline cost of \$358). This figure demonstrates IV iron is cost effective up to a total cost of \$362 for IV iron, at a willingness-to-pay (WTP) threshold of \$100,000 per QALY.

Abstract #: EF1-05

Differences in Post-Partum Blood Loss Between Racial and Ethnic Groups Using Estimated and Quantitative Blood Loss Assessment

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Introduction: Racial and ethnic disparities in maternal outcomes are well-described. Pregnancy-related mortality and morbidity for African-Americans is several fold higher compared to Caucasian women.¹ However, racial and ethnic difference in peripartum blood loss and incidence of postpartum hemorrhage (PPH) have not been adequately evaluated. We sought to compare postpartum blood loss and PPH in African-American and Hispanic parturients compared to other racial and ethnic groups.

Methods: A secondary analysis of a large observational study comparing blood loss, management and outcomes between an historical (August 2016-January 2017) and interventional (August 2017-January 2018) cohort was performed.² Visual estimation of blood loss (EBL) was used in the historic group and quantitative blood loss (QBL) using novel assessment tools (Triton AI and Triton QBL, Gauss Surgical) were implemented in the intervention group. The primary outcome was the difference in EBL and QBL in African-Americans vs. other racial groups, and in self-identifying Hispanics vs. non-Hispanics. Categorical incidence variables were analyzed with Chi square testing, and Mann-Whitney U used to analyze non-normally distributed variables. Results: Of the 7618 deliveries evaluated, 755 (9.9%) of parturients were African/African American with 1035 (13.6%) of patients identifying as Hispanic. For all deliveries, the distribution of blood loss was similar in racial groups using EBL ($p=0.131$; Table 1A), but significant differences were found using QBL ($p < 0.001$; Table 1A). The percentage of patients with PPH was greater among African/African Americans in both groups (EBL $p=0.023$; QBL $p < 0.001$; Table 1A). Based on ethnicity, blood loss distributions were not different in the EBL cohort ($p=0.951$), whereas a significant difference was seen in the QBL cohort ($p=0.049$; Table 1B). The diagnosis of PPH in the EBL cohort was similar ($p=0.471$) but differed in the QBL cohort ($p=0.018$; Table 1B).

Conclusion: Racial and ethnic blood loss distributions and incidences of PPH depended on whether blood was assessed subjectively using visual EBL or objectively using quantitative measures. More research is needed to determine if these differences are caused by provider cognitive bias, socio-economic and/or language barriers or other factors.

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Abstract #: EF1-05

Table 1A: Blood Loss Information by Race in the EBL and QBL Cohorts

Variables	African American/African EBL Cohort n=330	Non-African American/African EBL Cohort n=3228	p-value	African American/African QBL Cohort n=425	Non-African American/African QBL Cohort n=3345	p-value
Median Blood Loss mL (median [IQR])	350 [300-800]	350 [300-800]	0.131	430 [227-771]	348 [200-612]	<0.001
Patients with PPH (n%)	34 (10.3)	223 (6.9)	0.023	72 (16.9)	389 (11.6)	0.002
Cesarean Delivery (n%)	125 (37.9)	1019 (31.6)	0.019	189 (44.5)	1062 (31.7)	<0.001
High Hemorrhage Risk Score (n%)	16 (4.8)	150 (4.6)	0.734	14 (3.3)	159 (4.8)	0.247

EBL: Estimated Blood Loss; QBL=quantitative blood loss assessment (Triton AL and L&D); High Hemorrhage Risk Score: Placenta Previa, Suspected accreta, Platelet count <70,000, Active Bleeding, Coagulopathy or 2 Medium criteria including prior cesarean delivery, prior uterine surgery, prior laparotomies, multiple gestations, multiparity, prior post partum hemorrhage, large myomas, morbid obesity, estimated fetal weight >4,000g

Table 1B: Blood Loss Information by Ethnicity in the EBL and QBL Cohorts

Variables	Hispanics EBL Cohort n= 474	Non-Hispanic EBL Cohort n= 2543	p-value	Hispanic QBL Cohort n= 561	Non-Hispanic QBL Cohort n= 2752	p-value
Median Blood Loss mL (median [IQR])	350 [300-800]	350 [300-800]	0.951	379 [210-705]	350 [200-624]	0.049
Patients with PPH (n%)	36 (7.6)	170 (6.7)	0.471	83 (14.8)	310 (11.3)	0.018
Cesarean Delivery (n%)	173 (36.5)	789 (31.0)	0.019	194 (34.6)	914 (33.2)	0.531
High Hemorrhage Risk Score (n%)	16 (3.4)	131 (5.2)	0.124	10 (1.8)	143 (5.2)	0.001

EBL: Estimated Blood Loss; QBL=quantitative blood loss assessment (Triton AL and L&D); High Hemorrhage Risk Score: Placenta Previa, Suspected accreta, Platelet count <70,000, Active Bleeding, Coagulopathy or 2 Medium criteria including prior cesarean delivery, prior uterine surgery, prior laparotomies, multiple gestations, multiparity, prior post partum hemorrhage, large myomas, morbid obesity, estimated fetal weight >4,000g

Abstract #: EF1-06

The pharmacokinetics of oxytocin at cesarean delivery

Presenting Author: David Monks, MBChB

Presenting Author's Institution: Washington University in Saint Louis - St Louis, Missouri

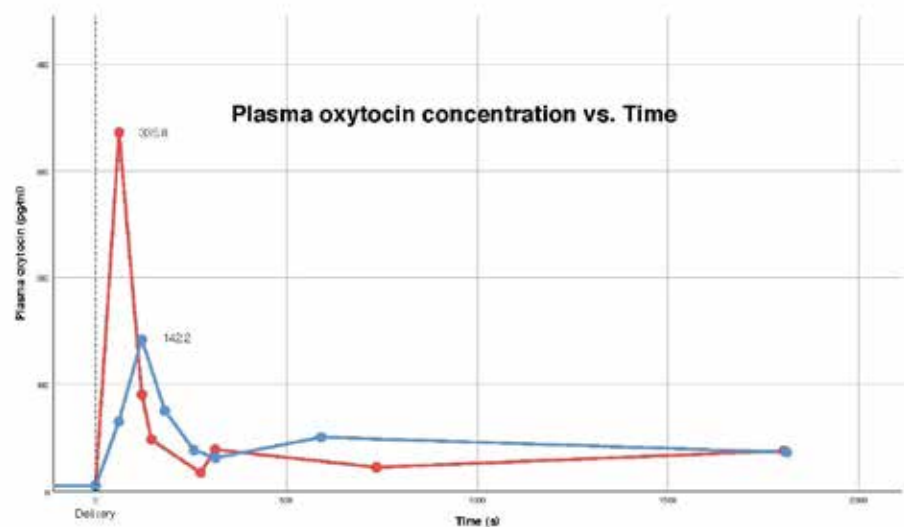
Co-Authors: Arvind Palanisamy, MD, FRCA - Washington University School of Medicine
Preet M. Singh, MD - Washington University in Saint Louis

Introduction: Oxytocin (OXT) is the first line uterotonic agent for preventing postpartum hemorrhage (PPH), a leading cause of global maternal mortality. Treatment failure is common but serious adverse effects, including cardiovascular collapse, occur when OXT dose is increased. Granular data on the pharmacokinetics (PK) of OXT at cesarean delivery are lacking but have the potential to enhance efficacy and safety. The objective of this pilot study is to provide preliminary data essential to the design of a future PK study of OXT at cesarean delivery (CD). Firstly, we will examine whether venous blood samples will provide values that approximate to arterial samples and, secondly, we aim to establish the timeframe in which initial peak plasma levels are observed.

Methods: We sampled arterial and venous blood in term pregnant women scheduled for CD under neuraxial anesthesia. We collected samples before and, at seven timepoints in the thirty minutes, after administration of OXT at delivery. OXT was administered according to institutional protocol. Blood samples were collected into aprotinin-treated tubes, immediately cold-centrifuged, aliquoted into cryotubes, and stored at -80 C for later endocrine assays. The level of OXT was determined by enzyme immunoassay (EIA) with extraction. Uterine tone was assessed at 3 min intervals after delivery using a Shore durometer and an, obstetrician-assessed, numerical rating scale (NRS, 0-10). Systemic vascular resistance and cardiac output were measured using the "LiDCO rapid" monitor.

Results: 23 women have been enrolled to date, 2 were excluded due to the postponement of their surgery and recruitment is ongoing. Plasma OXT levels are available from the first 5 women and results from the second *a priori* planned analysis, of samples from a further 10 women, is expected in February. Of those 5 sets of assay results 3 were from paired arterio-venous samples whilst in the other 2 it had only been possible to obtain arterial or venous samples, respectively. The range of OXT levels was 3.5 - 12.5 pg/ml, at baseline, and 31.1 - 335.8 pg/ml at the initial peak. In the paired samples, the ratio of peak venous to peak arterial OXT were 0.79, 0.72 and 0.42, respectively. The timing of the initial peak was observed as early as 61 seconds and as late as 391 seconds after the initiation of oxytocin administration. No women needed additional uterotonics and tone varied between 25 - 41 Shore units as measured by the durometer and 6-9 on the NRS.

Conclusions: Arterial sampling seems necessary to provide valid measurement of plasma concentrations after the administration of OXT by slow bolus at CD. Peak OXT levels were observed within 3.5min after the initiation of 3 units over 30s. With a complete dataset we will confirm these initial findings and employ NONMEM® software to explore the optimal weight-based dose-scalar with which to adjust OXT dose in individual patients.



Abstract #: EF1-07

A Comparison of Post-delivery Platelet Trends in Preeclampsia to Gestational Thrombocytopenia

Presenting Author: Francis Seiler, MD

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Co-Authors: Mark Rollins, MD PhD - University of Utah

Introduction: Although gestational thrombocytopenia is the most common cause of low platelets during pregnancy, thrombocytopenia is secondary to preeclampsia in about 20% of these cases. There is concern that patients with preeclampsia who also have thrombocytopenia may develop a significant further drop in their low platelet count post delivery. This nadir value can not be accurately predicted prospectively and could result in a value low enough to make catheter removal unsafe.¹ This post delivery decrease occurs in patients with HELLP syndrome, with a nadir typically occurring on post delivery day 1 or 2.^{2,3} To our knowledge, there is no current evidence that preeclamptics display a similar propensity to experiencing a sudden drop in their platelet values post delivery. We wanted to quantify the possible drop in platelet levels of preeclamptic patients with low platelets following delivery and compare the change to patients who deliver with gestational thrombocytopenia.

Methods: A review of our EMR from November 2011 to present identified parturients with platelet values $< 100\text{k}/\text{mm}^3$ within 48 hours of delivery. Only patients with gestational thrombocytopenia, or preeclampsia were included. Patients with HELLP syndrome, ITP, steroid administration for thrombocytopenia, or those who received a platelet transfusion were excluded. 24 preeclamptic patients and 18 patients with gestational thrombocytopenia met inclusion criteria. The highest platelet value within 12 hours prior to delivery was compared to the lowest platelet value within 12 hours after delivery. If there was no value within 12 hours then the first available value before or after delivery was used. The mean differences in platelet values before and after delivery were compared between groups.

Results: Preeclamptic patients had mean pre and post delivery platelet values of $110\text{k}/\text{mm}^3$ and $82\text{k}/\text{mm}^3$ respectively, with a mean difference of $28\text{k}/\text{mm}^3$. Gestational thrombocytopenic patients had mean pre and post delivery values of $95\text{k}/\text{mm}^3$ and $80\text{k}/\text{mm}^3$ respectively, with a mean difference of $15\text{k}/\text{mm}^3$. The pre and post delivery differences in platelet values were not statistically different between the groups ($p=0.16$)

Discussion: Although there was a trend for a greater drop in platelet values following delivery in the preeclamptic group, it did not achieve statistical significance. We believe this may be due to the small sample size and not necessarily a true reflection of the pathophysiology of thrombocytopenia in preeclampsia. We plan to refine our inclusion criteria, partner with MPOG to achieve a larger sample size, and also perform a meta-analysis that examines the influence of other demographic and delivery data.

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Abstract #: EF1-08

The effects of treatment of antenatal anemia with intravenous iron on postnatal depression: a retrospective cohort study

Presenting Author: Hon Sen Tan, MD, MMed

Presenting Author's Institution: Duke University

Co-Authors: Matthew Fuller - Duke University

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Ashraf Habib, MB Bch - Duke University

Background: Postnatal depression (PND) affects 15 to 25% of parturients, with suicide claiming up to 1 million lives annually. Iron deficiency has been reported to be associated with increased risk of PND. Iron is vital to neuronal processes and is associated with decreased dopamine receptor levels, which has been implicated in the pathogenesis of depression. Hence, the high incidence of perinatal iron deficiency anemia may predispose a large parturient population to PND. Although oral iron remains the standard first-line treatment for iron deficiency, it is slowly absorbed and poorly tolerated in parturients due to significant gastrointestinal side effects, and therefore intravenous iron has become preferred over oral therapy as a method to rapidly restore iron deficits. We hypothesized that intravenous iron supplementation may be associated with reduced incidence of PND in parturients with perinatal anemia compared to a historical cohort of anemic patients that were not treated with intravenous iron.

Methods: This is a retrospective cohort study. After IRB approval, we included adult parturients with anemia who delivered at our institution between June 2013 and August 2019. Parturients were stratified into 2 groups: *IV iron* – received intravenous iron, or *Control* – no intravenous iron. Parturients in the *Control* group were matched 1:1 with parturients in the *IV iron* group using variable optimal matching. Our primary outcome was the incidence of PND, defined as Edinburgh Postnatal Depression Scale (EPDS) of ≥ 10 within 12 months after delivery. Logistic regression model for PND was constructed using iron therapy as the main predictor. The logistic regression model was also adjusted for covariates that could not be balanced during the matching process.

Results: Data from 8196 parturients were extracted (*IV iron*: 313; *Control*: 7883). Many covariates including age, race, history of depression or anxiety, mode of delivery, and lowest pre-delivery hemoglobin were imbalanced between the groups, based on calculated standardized mean difference (SMD) greater than 0.1 or less than -0.1 indicating meaningful imbalance between groups. 286 parturients (27 failed matching) in the *IV iron* group were matched to 286 controls, and logistic regression was used to adjust for gravidity/parity, repeat cesarean delivery, tobacco/alcohol use, and pre-delivery haemoglobin (Table 1). After adjustment, intravenous iron therapy was not associated with a significant change in PND incidence (OR 1.19, 95%CI 0.74 to 1.92).

Conclusion: Intravenous iron supplementation for perinatal anemia was not associated with reduction in PND incidence. This study was limited by potential covariates not recorded in the electronic medical record (eg. socioeconomic factors). Further prospective studies may better determine the efficacy of IV iron in this population.

Abstract #: EF1-08

	No IV Iron Therapy (n=286)	IV Iron Therapy (n=286)	Total (n=572)	SMD
Age, yrs	30 [26, 34]	30 [26, 34]	30 [26, 34]	0.004
Race				0 (Matched)
2 or more races	12 (4.2)	12 (4.2)	24 (4.2)	
Asian	11 (3.8)	11 (3.8)	22 (3.8)	
Black or African American	169 (59.1)	169 (59.1)	338 (59.1)	
Caucasian / White	76 (26.6)	76 (26.6)	152 (26.6)	
Not reported	1 (0.3)	1 (0.3)	2 (0.3)	
Other	17 (5.9)	17 (5.9)	34 (5.9)	
Marital status				0.132
Divorced	1 (0.3)	4 (1.4)	5 (0.9)	
Married	127 (44.4)	127 (44.4)	254 (44.4)	
Single	154 (53.8)	153 (53.5)	307 (53.7)	
Unknown	4 (1.4)	2 (0.7)	6 (1.0)	
BMI, kg/m ²	32.5 [29.4, 37.9]	32.5 [28.0, 38.4]	32.5 [28.7, 38.1]	-0.010
Delivery type				0 (Matched)
Cesarean	115 (40.2)	115 (40.2)	230 (40.2)	
Vaginal	171 (59.8)	171 (59.8)	342 (59.8)	
Labor analgesia	170 (59.4)	169 (59.1)	339 (59.3)	-0.007
Postdural puncture headache	1 (0.3)	1 (0.3)	2 (0.3)	0
History of depression	47 (16.4)	47 (16.4)	94 (16.4)	0 (Matched)
History of anxiety	27 (9.4)	27 (9.4)	54 (9.4)	0 (Matched)
History of autoimmune disease	6 (2.1)	10 (3.5)	16 (2.8)	0.084
Preeclampsia	22 (7.7)	16 (5.6)	38 (6.6)	-0.084
Preterm delivery	8 (2.8)	5 (1.7)	13 (2.3)	-0.070
Gestational diabetes	30 (10.5)	25 (8.7)	55 (9.6)	-0.059
Chorioamnionitis	1 (0.3)	2 (0.7)	3 (0.5)	0.048
History of chronic opioid Use	4 (1.4)	0 (0.0)	4 (0.7)	N/A
History of chronic pain	2 (0.7)	1 (0.3)	3 (0.5)	-.048
ICU admission	0 (0.0)	2 (0.7)	2 (0.3)	N/A
Gravidity	3 [2, 4]	3 [2, 5]	3 [2, 4]	0.191
Parity	2 [1, 3]	2 [1, 3]	2 [1, 3]	0.159
Gestational age (weeks)	39.0 [37.2, 39.4]	39.0 [37.4, 39.4]	39.4 [37.3, 39.4]	-0.021
Repeat cesarean delivery	56 (19.6)	71 (24.8)	127 (22.2)	0.126
Tobacco use	42 (14.7)	29 (10.1)	71 (12.4)	-0.138
Alcohol use	121 (42.3)	98 (34.3)	219 (38.3)	-0.166
Illicit drug use	16 (5.6)	16 (5.6)	32 (5.6)	0 (Matched)
Lowest pre-delivery hemoglobin, g/dl	9.5 [8.9, 10.1]	9.4 [8.8, 9.9]	9.4 [8.8, 10.0]	-0.107

Table 1 Matched study cohort. Data presented as median [IQR] or n (%). Abbreviations: SMD – standardized mean difference; BMI – body mass index; ICU – intensive care unit.

Abstract #: EF1-09

The Risk of Postpartum Transfusion in Patients with First Trimester Iron Deficiency

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Background: Pre-delivery anemia is associated with increased risk of transfusion after delivery. While anemia screening is required during the first prenatal visit, iron deficiency screening is not [1]. Failure to perform iron deficiency screening in non-anemic gravidas at their first prenatal visit will miss up to 42% of patients who are iron-deficient but non-anemic [2]. This subgroup of patients is at high risk of developing iron deficiency anemia later in pregnancy, when the demand for iron increases. Maternal iron deficiency anemia is associated with increased risk of transfusion, pre-eclampsia, placental abruption, abnormal maternal thyroid status, impaired wound healing, cardiac failure and even death in severe cases [3]. The aim of this study was to evaluate the need for transfusion after delivery in a cohort of patients with known iron deficiency, defined as serum ferritin < 30 µg/L, during the first trimester.

Methods: Electronic records of patients with first trimester ferritin levels who delivered between January 1, 2014 and June 30, 2018 were reviewed (n=1139). In cases with ferritin levels below 30 µg/L (n=475) we extracted demographic data, laboratory results on admission, obstetrical data, quantified blood loss at delivery, RBC transfusion, and length of stay. Categorical outcome tests (Chi squared test and Fisher's exact test) and logistical regression were used to analyze the data.

Results: Anemia at the time of admission, defined as hemoglobin < 11g/dL, was present in 115 (24.2%) of the patients with known first trimester iron deficiency. Of these, 15.7% required RBC transfusion after delivery compared to only 4.4% of those with first trimester iron deficiency who were not anemic on admission. In the adjusted logistic regression model, the odds of receiving an RBC transfusion among parturients with known first trimester iron deficiency and with anemia on admission was 7.2 (95% CI: 2.5-20.4) times greater than the odds among patients with known first trimester iron deficiency without anemia on admission.

Conclusion: The current study demonstrates that patients with a combination of first trimester iron deficiency and anemia at the time of admission to labor and delivery were at considerable risk of receiving a postpartum PRBC transfusion. One explanation for this is that women with first trimester iron deficiency who were adequately treated did not subsequently develop anemia, and thus, were not subjected to the increased risk of transfusion. This further underscores the need for universal iron deficiency screening early in pregnancy to facilitate timely, aggressive iron replacement therapy and adequate follow-up. This approach would be expected to decrease the risk of pre-delivery anemia, thus decreasing the risk of postpartum transfusion.

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Abstract #: EF2-01

Assessing the clinical impact of fibrinolysis on obstetric hemorrhage

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Introduction: Death due to bleeding in obstetric hemorrhage is reduced following early administration of Tranexamic Acid (TXA), an antifibrinolytic agent. Early activation of fibrinolysis and hyperfibrinolysis are pathophysiological mechanisms in obstetric hemorrhage and contribute to hypofibrinogenemia and rapid development of a coagulopathy. Rotational thromboelastometry (ROTEM) assesses fibrinolysis in vitro. However, the incidence of hyperfibrinolysis in obstetric hemorrhage is still unknown. The objectives of this study were to 1) identify and characterize patients who had laboratory evidence of hyperfibrinolysis 2) examine the association between fibrinolysis and hemorrhage related clinical outcomes.

Methods: This IRB approved retrospective observational study included women with an obstetric hemorrhage managed with an obstetric massive transfusion protocol (OBMTP) from September 2012 to May 2018. Included patients had ROTEM data collected during the OBMTP reporting EXTEM or FIBTEM maximum lysis (ML). Data on patient demographics, hemorrhage etiology, transfusion practices, obstetric outcomes and laboratory data at initiation of OBMTP activation were collected. Patients were subdivided into those with or without evidence of hyperfibrinolysis (EXTEM and/or FIBTEM ML >15%) during OBMTP activation. Data were summarized using summary statistics. Logistic regression was used to estimate the association between EXTEM or FIBTEM ML and severe obstetric hemorrhage defined as: peripartum fall in hemoglobin ≥ 4 g/dl, transfusion of ≥ 4 units of blood products, need for invasive procedure for hemorrhage control, ICU admission and death.

Results: We identified 65 patients from 155 patients reporting the relevant ROTEM data. Of these only 6 patients had any laboratory evidence of hyperfibrinolysis during OB hemorrhage. The characteristics of patients with and without hyperfibrinolysis are shown in the table. TXA was administered to 50% of those in the hyperfibrinolysis group and 78% in those without hyperfibrinolysis. Patients with hyperfibrinolysis had lower initial fibrinogen levels and were transfused more blood products than those without hyperfibrinolysis. Initial and peak EXTEM ML did not correlate with nadir fibrinogen. However, initial [r (95% CI): -0.307 (-0.512, -0.068)] and peak FIBTEM ML [-0.438 (-0.616, -0.217)] weakly correlated with nadir fibrinogen. Initial FIBTEM ML was not associated with the development of severe hemorrhage when adjusting for TXA use [OR (95% CI) = 1.014 (0.916, 1.129)]

Conclusion: Ongoing fibrinolysis and hyperfibrinolysis in obstetric hemorrhage may contribute to low fibrinogen levels and increased transfusion requirements but initial laboratory evidence of fibrinolysis is not associated with the development of severe hemorrhage. Further work is needed to determine the clinical relevance of fibrinolysis in obstetric hemorrhage so that patients who will benefit from antifibrinolytic therapy can be readily identified.

Abstract #: EF2-01
Table: Characteristics Of Patients With And Without Laboratory Evidence Of Hyperfibrinolysis

	Hyperfibrinolysis (n=6)	No hyperfibrinolysis (n=59)
Clinical Characteristics		
Age	30.5 [24.5, 32.7]	30.0 [26.0, 34.0]
Race/Ethnicity		
Hispanic	2 (33.3%)	14 (23.7%)
Non-Hispanic Black	1 (16.7%)	23 (39.0%)
Non-Hispanic White	1 (16.7%)	16 (27.1%)
Other	2 (33.3%)	6 (10.2%)
BMI	30.0 [28.0, 31.2]	32.8 [28.4, 38.0]
Gestational age	38.8 [37.3, 39.1]	39.0 [36.0, 39.9]
Gravidity	1.50 [1.00, 2.75]	2.00 [1.50, 4.00]
Parity	0.50 [0.00, 1.00]	1.00 [0.00, 2.00]
Mode of delivery		
Vaginal	2 (33.3%)	20 (33.9%)
C-Section	4 (66.7%)	39 (66.1%)
Augmented or Induced delivery	3 (50.0%)	25 (42.4%)
Additional oxytocics used	4 (66.7%)	46 (78.0%)
Hemorrhage etiology		
Uterine Atony	2 (33.3%)	34 (57.6%)
Genital tract laceration	1 (16.7%)	10 (16.9%)
Abnormal Placentation	1 (16.7%)	8 (13.6%)
Retained products	2 (33.3%)	11 (18.6%)
Placental abruption	1 (16.7%)	6 (10.2%)
Coagulopathy	2 (33.3%)	5 (8.5%)
Total blood products given	8.5 [5.0, 13.5]	4.0 [2.0, 7.0]
Transfused \geq 4 units blood products	5 (83.3%)	34 (57.6%)
Transfused \geq 8 units blood products	4 (66.7%)	14 (23.7%)
Tranexamic acid administered	3 (50.0%)	46 (78.0%)
Estimated blood loss	2850.0 [2175.0, 3000.0]	2500.0 [1800.0, 3000.0]
Laboratory data		
Hemoglobin (g/dl)	7.6 [6.6, 8.3]	8.7 [7.6, 10.3]
Platelet count x 10⁹/L	184.0 [113.7, 245.2]	170.0 [141.0, 226.0]
Blood lactate mmol/L	2.9 [2.6, 8.5]	2.8 [2.2, 4.1]
Activated partial thromboplastin time (s)	26.5 [25.9, 31.8]	27.1 [24.8, 31.2]
Prothrombin time (s)	12.2 [10.8, 16.7]	12.0 [11.3, 13.1]
Fibrinogen (mg/dl)	148.5 [103.2, 349.7]	271.0 [225.0, 324.0]
Nadir fibrinogen(mg/dl)	101.0 [72.5, 200.0]	238.0 [187.5, 314.0]
Initial EXTEM ML (%)	1.0 [0.0, 2.0]	0.0 [0.0, 1.0]
Peak EXTEM ML (%)	2.5 [1.2, 6.0]	1.0 [0.0, 2.0]
Initial FIBTEM ML (%)	12.0 [5.0, 31.0]	1.0 [0.0, 2.0]
Peak FIBTEM ML (%)	22.0 [17.2, 65.7]	2.0 [1.0, 6.0]

Data are n (%) or median (25th, 75th quartile)

Abstract #: EF2-02

Thromboelastographic Assessment of Fibrinolytic Activity in Postpartum Hemorrhage: A Retrospective Single-Center Observational Study

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Background: Postpartum hemorrhage (PPH) is a leading cause of maternal mortality.¹ Antifibrinolytic therapy has the potential to influence outcomes in PPH, but the incidence of elevated fibrinolytic activity in PPH is unknown. Our goal was to estimate the incidence of elevated fibrinolytic activity in PPH using thromboelastography (TEG).

Methods: We retrospectively reviewed TEG results obtained during PPH from 118 deliveries at our institution. PPH was defined as blood loss ≥ 500 mL after vaginal delivery or $\geq 1,000$ mL after cesarean delivery. Our primary outcome was the incidence of elevated fibrinolytic activity, which we pre-defined as clot lysis at 30 min (Ly30) $\geq 3\%$ on kaolin TEG, prior to or in the absence of tranexamic acid (TxA) administration. Platelet-mediated clot retraction can also lead to an elevated Ly30 on kaolin TEG.² To distinguish between fibrinolysis and clot retraction we further evaluated clot lysis using functional fibrinogen TEG, which contains a platelet inhibitor. We also recorded demographic and obstetric characteristics, quantitative blood loss (QBL), primary etiology of hemorrhage, and standard laboratory measurements of coagulation.

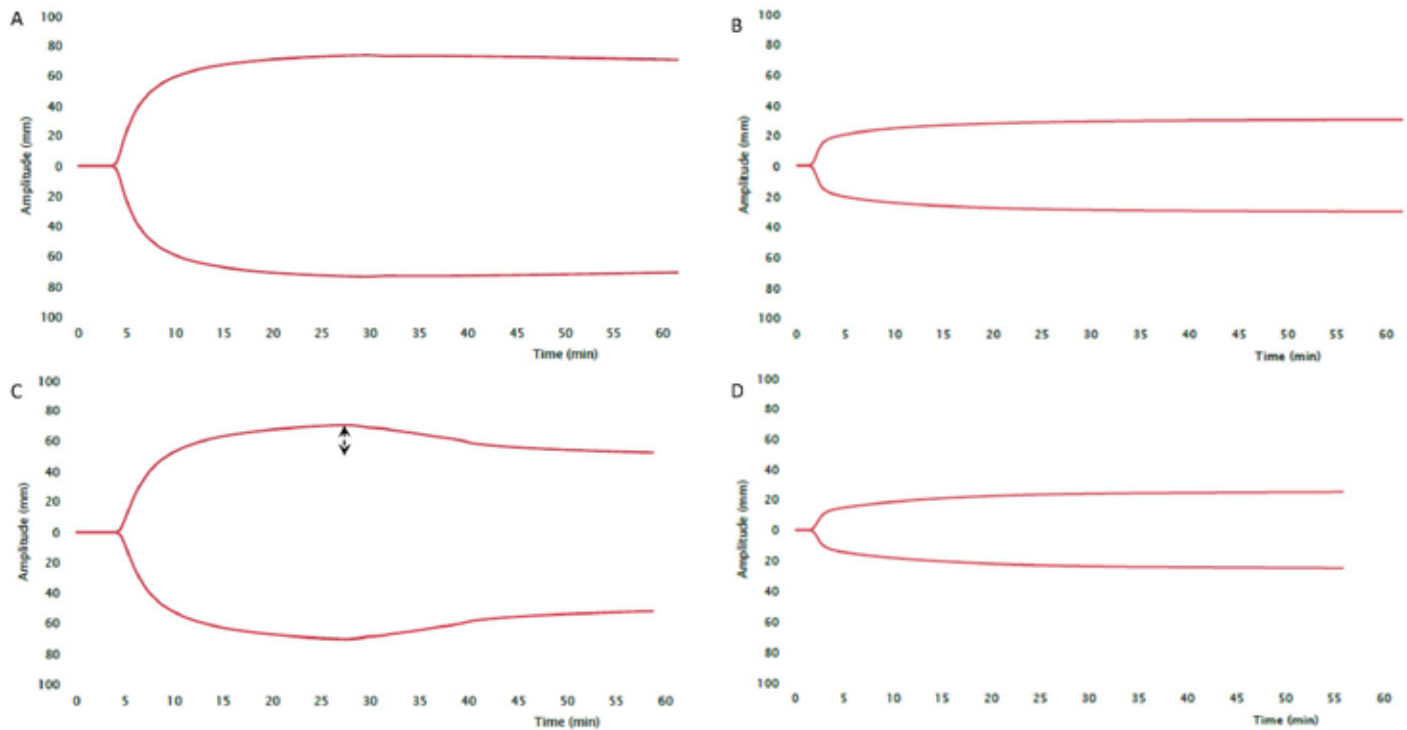
Results: 139 TEGs were performed for PPH prior to (n=5) or in the absence of (n=134) TxA administration in 118 patients. Median QBL was 1,236 mL (IQR 900-1567). The median kaolin TEG Ly30 was 0.2% (IQR 0-0.8%). 15/118 women (12.7%; 95% CI 7.9-19.9%) had kaolin TEG Ly30 values $\geq 3\%$. Of the 15 patients with elevated kaolin TEG Ly30 values, functional fibrinogen TEG Ly30 was available for 13. None of these demonstrated detectable clot lysis. Considering an elevated kaolin TEG Ly30 of $\geq 3\%$ with a non-zero functional fibrinogen TEG Ly30 as suggestive of elevated fibrinolytic activity yielded a 95% CI for elevated fibrinolytic activity in our cohort of 0-3.2%. An example of traces demonstrating normal and elevated Ly30 values on kaolin TEG as well as the corresponding functional fibrinogen TEG traces is shown in the Figure.

Discussion: Our finding that none of the patients in our sample with kaolin TEG Ly30 values $\geq 3\%$ demonstrated a non-zero functional fibrinogen TEG Ly30 value suggests that the observed elevations in kaolin TEG Ly30 may have been secondary to platelet-mediated clot retraction as opposed to fibrinolysis. We therefore were unable to demonstrate elevated fibrinolytic activity in any of the women in our sample using TEG. Importantly, criteria for elevated fibrinolytic activity in PPH have not been established and the sensitivity of TEG for detection of fibrinolysis in this setting is unknown. Our work highlights the need for prospective studies to characterize fibrinolysis and clot retraction in parturients with molecular and mechanistic details, as well as outcomes-based research to determine the impact of fibrinolytic phenotypes on morbidity, thrombotic events, and response to TxA during PPH.

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Abstract #: EF2-02



Thromboelastograms in postpartum hemorrhage. Panel A demonstrates a kaolin activated thromboelastogram from a patient without elevated fibrinolytic activity. The Ly30 in this sample is 0.3%. Panel B demonstrates the functional fibrinogen thromboelastogram from this same sample. There is no clot lysis on this thromboelastogram. Panel C demonstrates a kaolin activated thromboelastogram suggesting elevated fibrinolytic activity. The Ly30 in this sample is 14.8%, and is approximated by the double-headed arrow demonstrating the difference between the maximum amplitude and the amplitude 30 minutes following attainment of the maximal amplitude. Panel D demonstrates the functional fibrinogen thromboelastogram from this same sample. There is no clot lysis, suggesting that the decrease in clot amplitude in Panel C is secondary to platelet-mediated clot retraction.

Abstract #: EF2-03

Risk factors for severe postpartum hemorrhage among women with placental abruption

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Objective: Women with placental abruption are at risk for severe postpartum hemorrhage (PPH). However, it is unclear what risk factors are associated with severe PPH among women with placental abruption.

Study Design: We identified women with placental abruption during delivery hospitalization in California between 2007-2012. Women with placenta previa or gestational age < 20 weeks were excluded. Severe PPH was classified as PPH plus blood transfusion. Candidate variables were selected based on literature review and clinical plausibility. Abruption, severe PPH, and candidate variables were identified by ICD 9 codes. Variables associated with severe PPH ($P < 0.1$) on univariate logistic regression models were included in a multivariable logistic model. Analysis was replicated using supervised machine learning techniques (lasso and random forest ensemble). Model predictive performance examined using the area under the receiver operating characteristics curve (AUC).

Results: Of 2,733,409 births in California between 2007-2012, 26,283 (1.0%) were complicated by placental abruption. The incidence of severe PPH was 1.5%. Prevalence of candidate risk factors and adjusted odd ratios (aOR) for severe PPH are presented in Table. Factors independently associated with severe PPH were: advanced maternal age (aOR 1.5), Asian/Pacific Islander (aOR 1.8), non-Hispanic Black (aOR 1.5), prenatal care started in the 2nd trimester (aOR=1.6) or 3rd trimester/none (aOR=2.5), chorioamnionitis (aOR 2.1), hypertensive disorder (aOR 1.9), multiple pregnancy (aOR 1.6), prolonged labor (aOR 1.4), and cesarean delivery (aOR 2.0). The AUC for models developed using logistic regression and machine-learning were similar (0.68 and 0.64, respectively).

Conclusions: Among a large delivery cohort with placental abruption, the strongest predictors for severe PPH were delayed/no prenatal care, chorioamnionitis, and cesarean delivery. Models developed using regression and machine learning had similar predictive performance. Our findings may assist in allocating resources to those at greatest risk of severe PPH.

Abstract #: EF2-03

Table: Prevalences and multivariable analysis of risk factors for severe postpartum hemorrhage among women with placental abruption.

Variables	No Severe PPH ^a (n=25,895)	Severe PPH ^a (n=388)	aOR (95% CI)
Advanced maternal age (≥ 35 years)	21	33	1.5 (1.2, 1.9)
Race/Ethnicity			Ref
Hispanic/Latina	51	40	1.2 (0.9, 1.5)
NH White	25	25	1.8 (1.3, 2.4)
Asian/Pacific Islander	13	21	1.5 (1.1, 2.2)
NH Black	7	10	1.1 (0.6, 1.8)
Other	4	4	-
BMI at delivery (kg/m ²)			-
< 25	17	17	-
25-34	65	66	-
≥ 35	19	17	-
Initiation of prenatal care			Ref
1 st trimester	82	76	1.4 (1.0, 1.8)
2 nd trimester	14	16	2.5 (1.7, 3.7)
3 rd trimester or none	4	8	-
Insurance			Ref
Private	45	50	0.9 (0.7, 1.1)
Government-based	49	43	1.0 (0.7, 1.6)
Other	6	7	-
Chorioamnionitis	4	7	2.1 (1.5, 3.2)
Hypertensive disorder	14	25	1.9 (1.5, 2.4)
Twin or Multiple pregnancy	4	7	1.6 (1.1, 2.4)
Macrosomia	3	2	-
Uterine fibroids	2	3	-
Prolonged labor	5	8	1.4 (1.0, 2.1)
Induction of labor	17	17	-
Intrauterine fetal demise	0.4	0.5	-
Cesarean delivery	58	76	2.0 (1.6, 2.6)

^a Data presented as %.

aOR, adjusted odds ratio; BMI = body mass index; NH, non-Hispanic; NS, not significant; PPH, postpartum hemorrhage

Abstract #: EF2-04

Novel Point of Care Rapid Coagulation System for Obstetrics – Sonic Estimation of Elasticity of Polymerized Fibrinogen via Resonance (SEER Sonorheometry)

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Kenichi Tanaka, MD - University of Maryland Medical Center

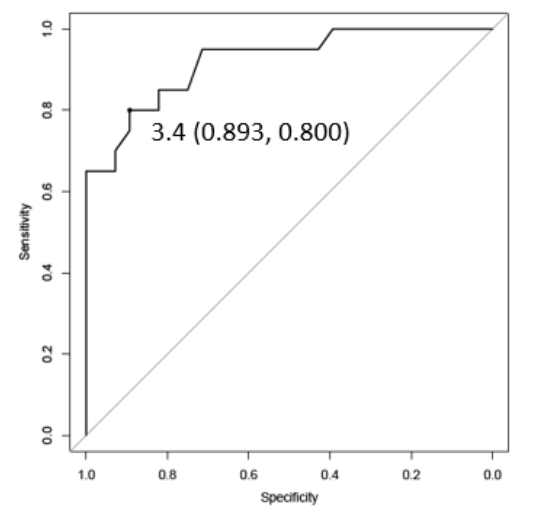
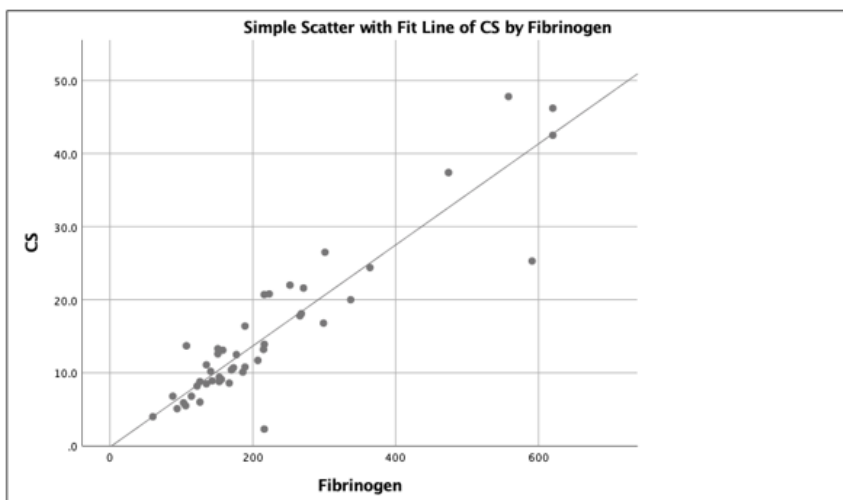
For centuries, hemorrhage continues to be a prominent contributor of obstetric morbidity and mortality around the world. A rapid coagulation test would be a significant improvement for the diagnosis of coagulopathy and the management of obstetric hemorrhage. Conventional tests are time consuming, and TEG® and ROTEM® are alternate techniques to gain rapid results, but they require training and manipulation of samples that prevents its widespread adoption. The Quantra® Hemostasis Analyzer is a novel, rapid coagulation system that utilizes ultrasound to measure clot stiffness over time. We obtained blood samples from pregnant patients and tested the sensitivity of the Quantra® Hemostasis Analyzer with the QPlus Cartridge compared to the results of conventional coagulation tests at various levels of fibrinogen, platelets and clotting factors.

Methods: Blood was obtained from healthy pregnant subjects at term in 8 citrated tubes. The blood was pooled into a container and 3 mL was analyzed for Quantra® variables (Q): Clot time (CT), Clot time with heparinase (CTH), Clot stiffness (CS), Clot stiffness platelet (PCS), Clot stiffness fibrinogen (FCS). Two mL was centrifuged to obtain plasma for conventional coagulation (CL) tests: PT, PTT, INR, Factor VIII and Fibrinogen. Three aliquots containing 2 mL of blood were centrifuged to obtain pregnant plasma. Thirty mL of saline was added to 10 mL of blood to mimic fluid resuscitation (DB). DB was evaluated in Quantra and centrifuged plasma for CL. Fractions of pregnant plasma was added to DB to obtain 15% and 30% clotting factor enriched samples (PP). Nonpregnant plasma from the blood bank was added to DB in lieu of pregnant plasma to obtain 15 and 30% (NP) enriched samples. DB+pregnant blood (1:1) constituted the final resuscitation sample with (RBC and platelets). Each of the samples were analyzed for Q (3 ml) and centrifuged plasma for CL. In all, each case provided 7 samples of variations in clotting factors. Data was analyzed using regression analysis to determine sensitivity of the Quantra parameters against CL.

Results: Seventy-seven samples from 11 parturients at term were analyzed in this study. The mean (SD) of Quantra parameters at term gestation were CT=126(13), CTH=123(12), CS=32 (10), PCS=27(7), FCS=5(2). CL were: Fibrinogen-490(109), platelets-240(61), PT=13(1), INR=0.9(.07), PTT=27(2), Factor VIII=270(77). There is very high linear correlation between Fibrinogen and CS ($R=0.93$, $P < 0.001$), Fibrinogen and FCS ($R=0.76$, $P < 0.001$), and Platelet and PCS ($R=0.87$). The area under the ROC curve for FCS when fibrinogen < 200 is also very high at 0.921 (95% CI 0.845-0.998), and for CS 0.943 (95% CI 0.868-1). The optimal point for FCS for detecting fibrinogen < 200 is 3.4.

Conclusion: Sonorheometry is a reliable future technology to provide coagulation results in 12 minutes. Inserting conventional blue top tube with blood into the cartridge is only step required to initiate the process.

Abstract #: EF2-04



Abstract #: EF2-05

High Dose Subcutaneous Heparin and Safety of Neuraxial Labor Analgesia in Third Trimester Parturients

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Introduction: Venous thromboembolism (VTE) is a leading cause of maternal mortality and morbidity but is amenable to prevention (1). Since the National Partnership for Maternal Safety (2) and ACOG (1) expanded the obstetric VTE prophylaxis guidelines, the number of pregnant women receiving thromboprophylaxis are growing. Although many societies have published thromboprophylaxis guidelines, the SOAP consensus statement is the ONLY one that addresses thromboprophylaxis and neuraxial anesthesia consideration in the obstetric patient (3). We reviewed our data on parturients who were on high doses of heparin and who received neuraxial analgesia/anesthesia in order to provide evidence for decision making.

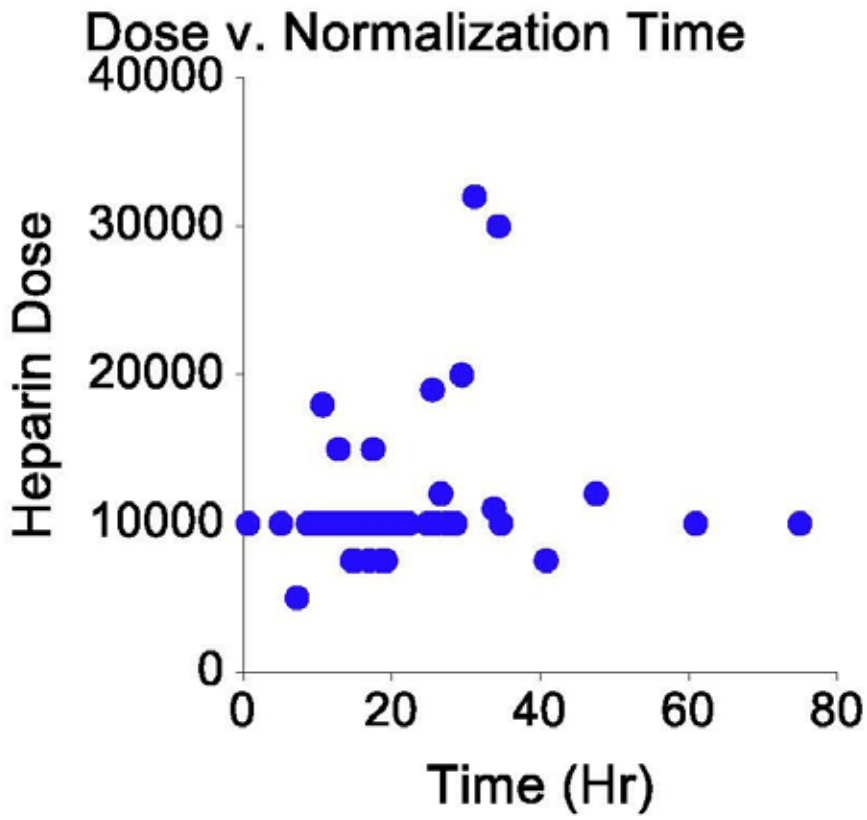
Methods: We queried the electronic anesthesia record and medical record database at Beth Israel Deaconess Medical Center, including approximately 14,685 deliveries in 3-year period (1/1/2017-1/20/2020) and identified 157 parturients on prophylactic heparin. Patients on 5000 U BID of SC heparin and heparin infusion were excluded. The remaining patients who received high dose heparin were analyzed for time of last dose, trend of activated partial thromboplastin time (aPTT), obstetric and anesthesia outcomes. The timing of aPTT tests was at physicians' discretion.

Results: 65 patients were reviewed. Most patients received a heparin dose of 10,000 U BID, with only 7 (10%) receiving less, and 7 (10%) had $\geq 15,000$ U BID (highest 32,000 U BID). The first aPTT was measured 16 hr (IQR: 11.5-22.2) after the last dose and the median was 26.3 sec (IQR: 24.8-30.2; range 21.5 to 134), but 10 (15%; 95%CI 8% to 26%) were elevated at a median of 23 hours. We found a correlation between the first aPTT result with heparin dose ($r = 0.41$; $p < 0.001$) and negative correlation with the time of the test ($r = -0.45$, $p < 0.001$). No correlation between BMI and aPTT was found. The median time to a normal aPTT was 17.5 hr (IQR: 13.4-25.6; Range 1 hr to 75 hr) (Figure), and there was no correlation between dose and time to normalization. The median time between last heparin dose and neuraxial procedures was 22.8 hr (IQR: 16.2-32.3); normal aPTT was demonstrated in ALL patients. One patient had a general anesthetic due to urgency of her cesarean and absence of aPTT. No patients experienced postpartum hemorrhage and no blood transfusion occurred during their hospital stay.

Conclusion: Some patients (8% to 26%) who received 10,000 U BID or more of heparin have an elevated aPTT at 23 hours after last administration. We found no correlation between dose of heparin and the time to normalization of aPTT, which can remain prolonged from 1 to 75 hours after the last administration of high dose heparin. The large variance seen in normalization time demonstrates the importance of the SOAP recommendation to measure an aPTT prior to neuraxial procedures in parturients receiving heparin $\geq 10,000$ U BID.

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Abstract #: EF2-06

Patterns of Fibrinolysis Shutdown, Physiologic Fibrinolysis, and Hyperfibrinolysis in Postpartum Hemorrhage

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Introduction: Physiologic fibrinolysis (PHY), hyperfibrinolysis (HYP), and fibrinolysis shutdown (FSD) are described in traumatic hemorrhage based on thromboelastography (TEG). HYP and FSD are independently linked to trauma mortality. Postpartum hemorrhage (PPH) is a frequent, preventable cause of maternal death, but fibrinolysis phenotypes in PPH are not well-defined. Our primary aim was to describe fibrinolytic phenotypes in PPH. The secondary aim was to quantify outcomes associated with PHY, HYP, and FSD: mortality, thromboembolism, transfusion requirements, and intensive care unit (ICU) and hospital length of stay.

Methods: After IRB approval, TEG results and medical records for cesarean and vaginal deliveries from 1/1/2012 – 12/31/2016 at a high-risk center were reviewed. Cases with TEG done during PPH were included. Controls were cases where TEG was done for non-PPH reasons (i.e. routine cesarean with physician-judged increased risk for bleeding, with or without observed abnormal bleeding). Cases were excluded if percentage of fibrinolysis at 30 minutes (LY30) was missing or if antifibrinolytics/anticoagulants were given prior to TEG. Severe PPH was defined as 1) decrease in hemoglobin >4g/dL; 2) hemostatic procedure; 3) transfusion ≥ 4 red cell units; 4) blood loss (EBL) >2 liters; or 5) death [1]. Non-severe PPH was defined as EBL ≥ 500 mL (vaginal) and ≥ 1000 mL (cesarean). FSD was defined as LY30 < 0.8; PHY was LY30 0.08 to 3.0, and HYP was LY30 >3.0. Descriptive statistics were performed for demographic variables. Odds ratios for severe PPH were calculated by fibrinolysis groups. PHY, FSD, and HYP rates were calculated and compared across hemorrhage groups. A P-value < 0.05 was considered significant.

Results: 446 unique TEGs were performed on 196 cases during the study period. Demographic traits were similar between groups (Table 1). FSD was observed in 77.4% (345) TEGs, while PHY and HYP were observed in 15.7% (70) and 7.0% (31) respectively. Odds of FSD and PHY were not elevated for severe PPH, but odds of HYP was 4.5 times higher in severe PPH (OR 4.5, 95%CI 1.5-19.4, P=0.02, Table 2). TEG values (R and MA) were statistically, but not clinically, different across hemorrhage groups (Table 3). Fibrinogen levels were lower in severe PPH, but higher than the 150mg/dL quoted in published literature[1] (severe PPH average fibrinogen, 260 ± 140 mg/dL v. non-severe PPH 420 ± 123 mg/dL v. no hemorrhage 389 ± 144 mg/dL, P< 0.001). Mortality, thromboembolism, transfusion requirement, and ICU length of stay were not different across PHY, HYP, and FSD groups. Hospital length of stay was longer for PHY (7.1 ± 10.8 days v. FSD 5.0 ± 5.4 days v. HYP 6.6 ± 6.5 days, P=0.046).

Conclusions: FSD is common in PPH; in contrast to trauma hemorrhage, FSD is not associated with severe PPH. Odds of HYP, but not FSD and PHY, are significantly elevated in severe PPH. These findings require corroboration by prospective evaluation.

References:

1. J Thromb Haemost. 2007;5:266

Abstract #: EF2-06

Table 1. Demographic, obstetric, and laboratory characteristics of the study population.

	FSD [N=345]	PHY [N=70]	HYP [N=31]	P-value
Age (years)	30.68 ±5.54	30.77 ±5.85	31.16 ±6.23	0.90
Obstetric Characteristics				
Estimated gestational age (weeks)	35.59 ±5.95	35.20 ±4.86	35.91 ±4.12	0.82
Gravidity	2 (3)	2 (3)	3 (2)	0.60
Parity	1 (2)	1 (2)	1 (2)	0.18
BMI (kg/m²)	33.48 ±7.62	31.11 ±6.41	32.88 ±4.15	0.11
Vaginal delivery (frequency)	11.01% [38]	17.14% [12]	9.68% [3]	0.33
Cesarean delivery (frequency)	85.09% [291]	77.94% [53]	90.32% [28]	0.21
Clinical Outcomes				
ICU LOS (days)	0.91 ±1.66	0.74 ±1.28	1.35 ±3.46	0.28
Death (frequency)	0	0	0	1.00
Hospital LOS (days)	5.03 ±5.44	7.07 ±10.83	6.55 ±6.49	0.046 *
Transfusion (frequency)	43.48% [150]	41.43% [29]	54.84% [17]	0.43
Thromboembolism (frequency)	0.58% [2]	0.0% [0]	0.0% [0]	1.00
Traditional Laboratory Values				
Fibrinogen (mg/dL)	291.64 ±155.90	288.51 ±126.47	297.90 ±135.31	0.80
Platelets (count per µL)	134.81 ±67.39	140.26 ±66.97	173.25±78.61	0.02 *

Data are reported as mean ± standard deviation, percentage [N], or median (IQR). FSD, fibrinolysis shutdown; PHY, physiologic fibrinolysis; HYP, hyperfibrinolysis; ICU, intensive care unit; LOS, length of stay; TXA, tranexamic acid; BMI, body mass index. Platelet counts and fibrinogen levels were drawn within 2 hours of TEG performance. *P<0.05

Table 2. Odds of fibrinolytic phenotypes given hemorrhage severity

	No Hemorrhage [N=134]	Non-severe PPH [N=78]	Severe PPH [N=234]
FSD [N=345]	reference	0.86 (0.44-1.74) P = 0.68	0.73 (0.43-1.2) P = 0.24
PHY [N=70]	reference	0.79 (0.35-1.7) P = 0.56	0.88 (0.5 – 1.6) P = 0.65
HYP [N=31]	reference	3.64 (0.93 – 17.6) P = 0.07	4.53 * (1.5-19.4) P = 0.016 *

FSD, fibrinolysis shutdown; PHY, physiologic fibrinolysis; HYP, hyperfibrinolysis; PPH, postpartum hemorrhage *P<0.05

Table 3. Clinical and TEG characteristics by hemorrhage phenotypes

	Severe PPH [N=234]	Non-severe PPH [N=78]	No Hemorrhage [N=134]	P-value
R time (min)	4.72 ±2.17	6.66 ±5.68	5.95 ±1.85	<0.0001 *
K time (min)	2.07 ±2.28	2.26 ±4.62	1.63 ±0.56	0.16
α Angle (degrees)	65.22 ±13.81	67.88 ±13.52	67.92 ±6.09	0.06
MA (mm)	62.02 ±14.15	65.78 ±26.07	67.43 ±17.51	0.01 *
LY30 (%)	1.36 ±4.94	0.91 ±2.40	0.45 ±0.92	0.08
Fibrinogen (mg/dL)	259.89 ±139.32	419.60 ±121.92	388.83 ±144.23	<0.0001 *
Cell salvage (mL)	330.26 ±400.05	31.84 ±80.81	8.37 ±41.11	<0.0001 *
Platelets (count per µL)	133.13 ±61.63	192.16 ±77.04	118.96 ±61.97	<0.0001 *
Vasopressor utilization (frequency)	48.67% [110]	31.58% [24]	43.55% [54]	0.03 *
TXA				
0g	81.33% [183]	100.00% [76] 0.00%	100.00% [124] 0.00%	
1g	16.89% [38]	[0]	[0]	<0.0001 *
2g	1.78% [4]	0.00% [0]	0.00% [0]	

Data are reported as mean ± standard deviation, or percentage [N]. TEG, thromboelastography; R, time to start forming clot; K, time until clot reaches a fixed strength; alpha angle, speed of fibrin accumulation; MA, maximum amplitude or the highest vertical amplitude of the TEG; LY30, lysis at 30 minutes. *P<0.05

Abstract #: EF2-07

Obstetric Patients with Hemostasis Abnormalities Can Be Monitored Using Viscoelastic Testing: A Comparison of Two Instruments

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Hemorrhage is a major cause of maternal mortality. The management of parturients with coagulopathy adds to the complexity in the management of these patients as the propensity for bleeding must be weighed against the known hypercoagulable state of pregnancy.(1) Neuraxial anesthesia is the safest method of delivering pain relief to obstetric patients. In patients with coagulopathy, it is vital to assess hemostatic integrity before neuraxial instrumentation. Viscoelastic testing has been used to assess global hemostatic function in obstetric patients.(2) The Quantra (Hemosonics, Charlottesville, VA) is a novel point of care device which uses sonorheometry to detect changes in the viscoelastic properties of blood. We undertook a pilot evaluation of the Quantra, using ROTEM delta as a comparator in obstetric patients at risk for bleeding. We sought to compare baseline and postpartum coagulation parameters using both devices.

Methods: The study was approved by our IRB. All subjects gave written informed consent. Inclusion criteria included pregnant women with a coagulopathy, either due to congenital or acquired disease, or a drug-induced condition. We prospectively enrolled patients at risk for bleeding as defined by either hemostatic abnormalities or placental abnormalities. Baseline samples for Quantra and ROTEM were collected before delivery. If appropriate, blood samples were collected after delivery and after a hemostatic intervention.

Results: Thirty-three women were enrolled. Subjects included patients with gestational thrombocytopenia, ITP, eclampsia, lupus anticoagulant, Factor XI deficiency, vWD, anticoagulant medication, and placenta accreta. No patient had a massive transfusion protocol activated and no patient had an adverse thrombotic complication. Significant changes are noted in INTEM CT, Quantra CS, Quantra PCS and Platelet count. Analogous measurement parameters between Quantra and ROTEM were also statistically significantly correlated with each other. See Table. Differences in the activators used in these 2 clotting assays may account for some of the discrepancies presented, however clinical significance is unclear.

Discussion: Hematologic abnormalities are prevalent in the obstetric population and an assessment of bleeding and thrombosis risk should be undertaken. Quantra detected the hyperfibrinogenemic state of pregnancy and correlated strongly to the ROTEM FIBTEM results. Quantra was able to identify low platelet function in a patient with platelet count 90K, who might not have otherwise been considered a bleeding risk. Quantra may be a useful point of care monitor of hemostasis in patients who are at risk for peripartum hemorrhage.

References:

1. Katz D, Beilin Y. Disorders of coagulation in pregnancy. Br J Anaesth. 2015 Dec; 115 Suppl 2:ii75-88
2. Hildyard C, Curry N. Point-of-care testing: a standard of care? Anaesthesia. 2015 Oct; 70(10):1113-8.

n=35	Correlation Spearman's rho	p value
Quantra CT versus INTEM CT	0.5735	*0.0007
(EXTEM A20-FIBTEM A20) vs Quantra PCS	0.5971	*0.0006
EXTEM A20 versus Quantra CS	0.5839	*0.0004
FIBTEM A20 versus Quantra FCS	0.6453	*0.0002
Platelet count versus Quantra PCS	0.9116	*<0.0001

Abstract #: EF2-08

REBOA placement for morbidly adherent placenta; a single center case series involving 14 patients that had a REBOA placed for cesarean delivery

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Presenting Author's Institution: University of Arkansas for Medical Sciences - Cammack Village, Arkansas

Co-Authors: Nadir Sharawi - UAMS

Patients presenting with suspected morbidly adherent placenta (MAP) are at risk of rapid and massive blood loss during cesarean delivery. Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) is a technique most commonly performed in the acute trauma setting¹ but is being increasingly utilized during cesarean delivery in these high risk patients. Placement of a REBOA involves obtaining femoral arterial access, placement of a sheath, followed by insertion of the balloon catheter that can be inflated in the event of massive blood loss.

We report a case series of 14 women presenting with suspected MAP that had a REBOA placed during cesarean delivery. Of the 14 patients that received a REBOA, 6 patients required the balloon to be inflated. One patient had placenta increta and uterine rupture that resulted massive blood loss and intraoperative death. 3 patients had complications from the REBOA placement. The complications included a pseudoaneurysm, an iliac artery dissection requiring endarterectomy, and an iliac vein thrombus requiring thrombectomy. Initially we prophylactically placed REBOAs for all MAP cases. After observing complications from placement we stopped prophylactic placement and instead placed a femoral arterial line. If there was massive blood loss the surgeons could quickly exchange over wire the femoral line for arterial sheath and REBOA. The average estimated blood loss in the 6 cases in which the REBOA was used was 9,250ml. Despite the massive transfusion require intraoperatively in these cases, only 2 of the 6 patients required post-operative blood transfusion.

Retrospective studies have shown that placement of REBOA for patients with MAP is effective in decreasing the volume of blood loss and the amount of blood products transfused compared to patients with MAP without REBOA placement.² REBOA also helps the surgeons by providing a clear and dry surgical field during balloon inflation. While beneficial, this minimally invasive procedure does carry a risk of known complications, some of which require further vascular surgery. Complication rates have been well studied in the trauma literature but it is unclear if these rates correlate to the obstetric population where placement could be more difficult secondary to the changes occurring in pregnancy. Until further research is carried out, careful patient selection and placement of prophylactic femoral line instead of REBOA are ways to decrease potential complications with the use of REBOA.

References:

1. Morrison J.J., Galgon R.E., Jansen J.O., Cannon J.W., Rasmussen T.E., Eliason J.L. A systematic review of the use of resuscitative endovascular balloon occlusion of the aorta in the management of hemorrhagic shock. *J Trauma Acute Care Surg.* 2016;80(2):324–334.
2. Cui S, Zhi Y, Cheng G, Zhang K, Zhang L, Shen L. Retrospective analysis of placenta previa with abnormal placentation with and without prophylactic use of abdominal aorta balloon occlusion. *Int J Gynecol Obstet.* 2017;137:265–270.

Abstract #: EF3-01

Association between Neuraxial Labor Analgesia and Neonatal Morbidity after Operative Vaginal Delivery: A Retrospective Cross-Sectional Study

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Cynthia Wong

Background: Up to 90% of women who undergo operative vaginal delivery receive neuraxial analgesia (1,2). However, little is known about the association between neuraxial analgesia and neonatal morbidity in women who undergo operative vaginal delivery.

Objective: To determine whether neuraxial analgesia is associated with a reduced risk of neonatal morbidity among US women who underwent operative vaginal delivery (forceps or vacuum) in 2017.

Design: Retrospective, population-based, cross-sectional analysis using United States birth certificate data.

Exposure: Neuraxial labor analgesia.

Main Outcomes and Measures: The risk of neonatal morbidity was defined as any of the following: 5-min Apgar score < 7, immediate assisted ventilation, assisted ventilation > 6 hr, neonatal intensive care unit admission, neonatal transport, or seizures.

Results: The cohort included 106,845 women who underwent operative vaginal delivery, of whom 92,518 (86.6%) received neuraxial analgesia. The rate of neonatal morbidity was higher among women receiving neuraxial analgesia versus no neuraxial analgesia [10,409 (11.3%) vs. 1,271 (8.9%), respectively; $P < 0.001$]. The unadjusted relative risk was 1.27 (95% CI, 1.20-1.34) and after accounting for confounders using a multivariable model, the adjusted relative risk was 1.19 (95% CI, 1.12-1.26) [Table]. Stratified analysis to examine the risk of neonatal morbidity among women who had forceps only and vacuum only generated similar findings [Table]. The adjusted risk difference per 100 women receiving neuraxial analgesia compared with no neuraxial analgesia was 1.8 (95% CI, 1.2-2.3).

Conclusions: Among women in the United States who underwent operative vaginal delivery in 2017, those receiving neuraxial labor had a statistically significant but small absolute increase in the risk of neonatal morbidity compared with women not receiving neuraxial analgesia. Further research is necessary to determine whether residual confounding explains this association.

References:

1. *Obstet Gynecol.* 2005;106(5 Pt 1):908-912.
2. *Obstet Gynecol.* 2014;123(4):796-803.

Abstract #: EF3-01
Table. Unadjusted and adjusted associations between neuraxial analgesia and neonatal morbidity

	Number of Patients		Number of Outcomes		Unadjusted RR (95% CI)	P-value	Adjusted RR (95% CI)	P-value
	Neuraxial Analgesia	No Neuraxial Analgesia	Neuraxial Analgesia	No Neuraxial Analgesia				
Operative vaginal deliveries	95,165	11,680	10,409	1,271	1.27 (1.20-1.34)	<0.001	1.19 (1.12-1.26)	<0.001
Restricted to birthweight <4000g	86,262	13,405	9,514	1,170	1.26 (1.19-1.34)	<0.001	1.19 (1.12-1.26)	<0.001
Stratified Analyses								
Forceps	14,002	1,826	1,861	131	1.64 (1.38-1.94)	<0.001	1.50 (1.26-1.78)	<0.001
Vacuum	68,107	12,501	8,548	1,140	1.22 (1.15-1.30)	<0.001	1.16 (1.03-1.19)	0.009

RR, relative risk; CI, confidence interval.

* Adjusted for maternal age; race; highest educational level; insurance; onset of prenatal care; body mass index; prior live births; prior cesarean; pre-existing or gestational diabetes; pregnancy induced hypertension or pre-eclampsia; induction of labor; labor augmentation, gestational age, and US census region.

Abstract #: EF3-02

Diagnosing postpartum haemorrhage through pre- and post-delivery haemoglobin and hematocrit values: a prospective study

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Rohan Ganeshathasan - Mount Sinai Hospital, Toronto

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Adam Rosen - University of Toronto

Background: The accurate diagnosis and management of postpartum hemorrhage (PPH) is crucial to peripartum management. PPH is currently defined as blood loss of 1000cc or greater, regardless of mode of delivery, in the first 24 hours postpartum (1). However, most estimates of blood loss are restricted to the intrapartum period, and do not include the 24 hours following childbirth. In a previously published study, we validated ten systematically identified formulae that used biometric data and pre- and (24-hour) post-delivery haemoglobin (Hb) and/or haematocrit (Hct) to estimate intrapartum blood loss (2). In the present study we aimed to determine the magnitude of underestimated blood loss in the 24-hours following childbirth, and assessed the test characteristics of formulae in diagnosing PPH.

Methods: To achieve an expected sensitivity of 95% and no less than 65%, 58 individuals presenting for planned caesarean delivery were included. The study had approval from the institutional research ethics board, and all participants provided written, informed consent. Intrapartum and postpartum blood loss was measured using the reference-standard, combination of direct (blood collected in the suction apparatus, after excluding amniotic fluid), and gravimetric measurements, the reference standard. Visual estimates of intrapartum blood loss were compared with calculated blood loss in the intrapartum and 24-hour postpartum periods. We calculated blood loss using each formula and determined their sensitivity and specificity at estimating the blood loss as measured by the reference standard.

Results: In keeping with our sample size calculation, data from 58 caesarean deliveries were included in our analysis. When using the reference-standard, the median intrapartum- and 24-hour blood loss was 487.5ml [interquartile range (IQR) 362.5ml, 753.25ml] and 129.5ml (80.3, 198.3) respectively. Intrapartum blood loss therefore represented 74% of the total blood lost over 24-hours [655ml (494.5, 889.5)]. Visual estimates [600ml (500, 787.5)] over-estimated blood loss in 29 (50%) cases by 106ml (17.6%) and under-estimated it by 292ml (32.7%) in the remainder. Based on visual estimates, measured intrapartum blood loss and 24-hour blood loss, the number of PPH cases were 4, 9 and 11 respectively. Formulae most commonly used to estimate PPH (Δ Hb, % Δ Hb, Δ Hct and % Δ Hct) have poor test characteristics for diagnosing PPH. Three formulae show promise in accurately diagnosing PPH, with sensitivities and specificities between 57 and 85%.

Conclusion/Implications: Intrapartum visual estimates and actual measurement of blood loss under-diagnose PPH. Formulae using objective and readily available biometric data and laboratory values could accurately diagnose PPH, and upon further validation, may be able to replace current methods in clinical practice and research.

References:

1. ACOG Practice Bulletin. Obstet Gynecol 2017; 130:e168-86
2. Eckler R, D'Souza R et al. Obstet Gynecol 2017; 129(5):S148

Abstract #: EF3-03

Preoperative Aminoacids in Obstetrics: Blood Loss Multimodal Prevention, during C-Section: A Prospective Observational Study

Presenting Author: Elisabetta Fanzago

Presenting Author's Institution: Turin - Turin, Piemonte

Co-Authors: Manuela Canicatti - Asl Asti

Silvano Cardellino - Asl Asti

Margherita Freiburger - Turin

Daniela Nicolosi - Asl Asti

BACKGROUND and AIM: Post-partum hemorrhage is one of the major impairments in Obstetrics and important cause of maternal death. During C-section, preoperative fluid therapy, mostly with Colloids, helps against the risk of hypotension. The safe association of Aminoacid-fluids (Isopuramin®7%) reduces the incidence of perioperative hypotension, shivering and hypothermia with its clinical consequences as blood loss, improving perioperative variations in Hb.

METHODS: 113 patients were studied undergoing elective or urgent C-section in Combined Spinal Epidural Anesthesia, at Cardinal Massaia Hospital, Asti, Piemonte Italy. The parturients received i.v., either Hetastarch-Volulyte® 1L + Isopuramin® 7% 1L, or Hetastarch -Volulyte® 1L + Ringer Acetate® 1L, before CSEA. The two groups were homogeneous. At the end of the procedure the entity of blood loss was observed into the aspiration bag and with the weight of surgical sheets and gauzes. Before surgery and 48 hours post -op, samples were taken for CBC (cell blood count) and coagulation.

RESULTS: Blood loss was significantly reduced: 37% versus 20% expected using Isopuramin® instead of Ringer® (P value T test < 0,01). Most of the blood losses were below 1000 ml in the Aa group.

Real differences also occur for Hb and Ht (P value T test < 0,01). Hb: percentage variation was -5% for Isopuramin® group vs -11% for Ringer®'s control, χ^2 P value < 0,05.

CONCLUSIONS: Aminoacids infusion seems really effective to prevent perioperative shivering and, now for the first time in Obstetrics, to reduce blood loss and improve Hb and Ht. It was possible to reduce blood transfusions and save erythrocytes. Coagulation results were not significant, confirming the absence of hemostatic impairment by this type of infusions. There were no side effects on parturients, and there was a good postoperative recovery and a quick discharge from the hospital. Nevertheless, further RCTs studies will be useful.

References:

1. Collis R, Guasch E. *Managing major obstetric haemorrhage: Pharmacotherapy and transfusion*. Best Pract Res Clin Anaesthesiol. 2017;31(1):107-124.
2. Zhou B. et al. *The effects of amino acid infusions on core body temperature during the perioperative period: A systematic review*. J Perianesthesia Nurs. 2014;29(6):491-500.
3. Aoki Y et al. *Perioperative Amino Acid Infusion for Preventing Hypothermia and Improving Clinical Outcomes during Surgery under General Anesthesia: A Systematic Review and Meta-analysis*. Anesth Analg. 2017;125(3):793-802.
4. Widman J, Sellden E. *Amino Acid Infusion Induces Thermogenesis and Reduces Blood Loss During Hip Arthroplasty Under Spinal Anesthesia*. Anesth Analg. 2002.

Figure 1
BLOOD LOSS

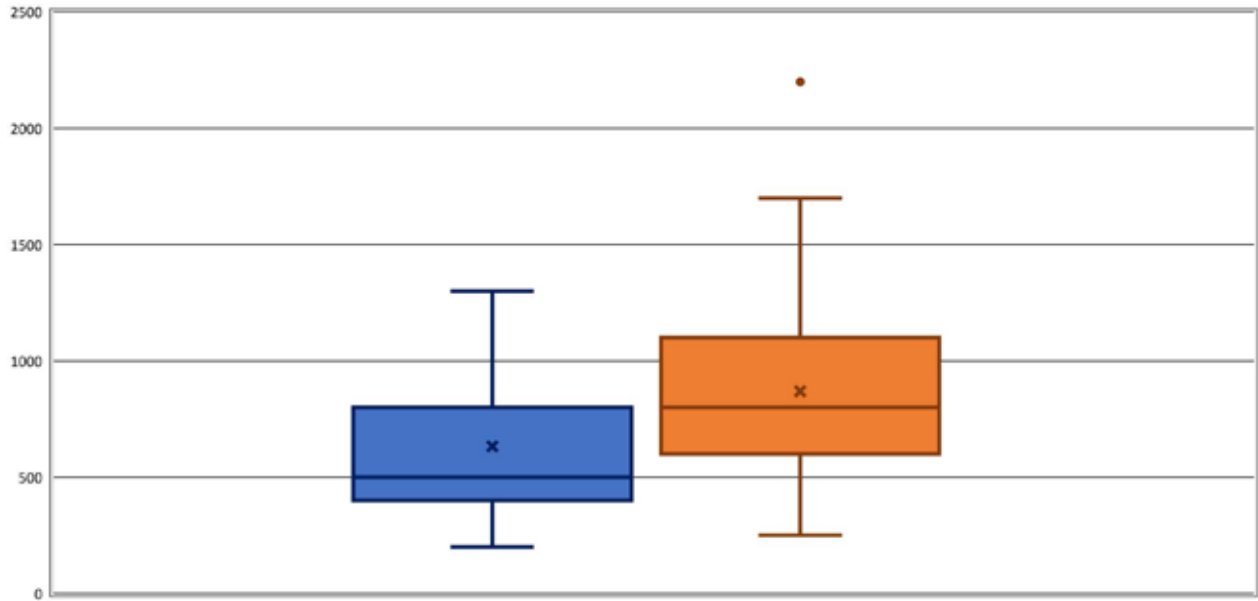


Fig 1 legend
Blood Loss: Blue box plot = Aminoacids, Orange box plot =Crystalloids

Abstract #: EF3-04

Anesthetic Management for Cesarean Hysterectomy: A review of 121 cases from a US private practice (2003-2017)

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Co-Authors: Afshin Bahador, MD - Sharp Mary Birch Hospital for Women and Newborns

Valerian Catanzarite, MD, PhD - Rady Children's Specialists/San Diego Perinatal Center

Phoebe Jen, BA (Hons) - Western University of Health and Sciences

After obtaining IRB approval, we did a retrospective chart review of all cases of cesarean hysterectomy associated with placenta accreta spectrum (1) from October 2003 to August 2017. The primary aim of this project was to describe the anesthetic management, perinatal management and surgical management of these cases. Diagnosis was made preoperatively by ultrasound and MRI but a few women presented unexpectedly at delivery with massive postpartum hemorrhage. In the study period there were 121 women identified as undergoing a peripartum hysterectomy within the same hospital admission. Of these, 10 women were nulliparous but 78% of women had at least 1 prior cesarean delivery (range 1-5). The total number of deliveries in that time frame was approximately 110,000, so our peripartum hysterectomy rate was 110 per 100,000 deliveries, higher than the rate reported by Bateman in 2012 of 82 per 100,000 deliveries (2). However, like Bateman we also saw an increase over time, with a doubling of the number of peripartum hysterectomies between the years 2003-2010 and 2011-2017. The commonest anesthetic was conversion from spinal (SAB) to general anesthesia (GA) 70%; followed by GA alone 10%; SAB alone 7%; CSE alone 8% and epidural converted to GA 5%. Total time in the OR was 145±49 minutes (mean±SD). Average blood loss was 2.1±1.1L for planned surgeries but this almost tripled in unplanned cases. Transfusion occurred in 70% of cases with average pRBC units 3.2±4.4; plasma 1.6±3.6 and platelets 1.1±5.8 units. Surgical technique included hypogastric artery ligation in 30% of cases and we do not use intra-arterial balloon catheters. The average drop in hematocrit during the procedure was 8.5±5.3. Average maternal age was 34.2±5.0 yrs and older women were more likely to need blood transfusion and require ICU admission. Overall, about 25% required admission to ICU, and length of stay after surgery for all patients was 5.3 days. Placenta accreta spectrum continues to challenge our diagnostic, surgical and anesthetic skills (3). Further data will be presented at the meeting.

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3. Kingdom JC et al. Minimizing surgical blood loss at cesarean hysterectomy for placenta previa with evidence of placenta increta or placenta percreta: the state of play in 2020. *Am J Obstet Gynecol* (in press - available online 30 January 2020).

Abstract #: EF3-05

Excess risk of postpartum hemorrhage in US rural hospitals.

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Presenting Author's Institution: Columbia University Vangelos College of Physicians and Surgeons - New York, New York

Co-Authors: Jean Guglielminotti

Ruth Landau

Background: Rural-urban disparities in maternal health are a serious public health concern in the United States. The risk of severe maternal complications during childbirth among rural residents was about 9% higher among urban residents during the 2007-2015 period, probably due to decreased access to obstetric care (1, 2). Disparity in quality of obstetric care between rural and urban hospitals, however, has not been adequately studied (3). Postpartum hemorrhage (PPH) affects 1 in 20 parturients nationwide and is a leading cause of preventable maternal morbidity and mortality. This study examined the excess risk of PPH associated with delivering in rural hospitals compared with delivering in urban hospitals.

Methods: Delivery-related discharges were abstracted from the National Inpatient Sample (NIS), 2008-2011, a 20% national representative sample of hospital discharge records. Before the 2012 NIS redesign, within each sampled hospital, 100 percent of discharges were included allowing calculation of some hospital-level characteristics (e.g., annual volume of delivery). The primary outcome was PPH defined using the ICD-9-CM diagnosis code 666. The secondary outcome was in-hospital mortality. Adjusted odds ratios (aOR) and 95% confidence intervals (CI) of adverse outcomes associated with rural hospitals were estimated using a propensity score matching approach. Sensitivity analysis according to delivery mode was performed.

Results: Of the 3,212,266 delivery-related discharges in 1841 hospitals included, 364,387 were in 698 rural hospitals. Before matching, the incidence of PPH was 28.3 per 1000 in rural hospitals and 27.9 per 1000 in urban hospitals ($P = 0.20$; crude OR, 1.01; 95% CI, 0.99-1.03). In-hospital mortality was 0.05 per 1000 in rural hospitals and 0.07 per 1000 in urban hospitals ($P = 0.19$; crude OR, 0.71; 95% CI, 0.44-1.14). After matching, multilevel logistic regression modeling revealed that delivering in rural hospitals was associated with a 22% increased risk of PPH (aOR 1.22, 95% CI 1.08-1.39) and a 36% increased risk of in-hospital mortality (aOR 1.36, 95% CI 1.34-1.37) (Table 1). The increased risk of PPH associated with rural hospitals existed in vaginal deliveries (aOR 1.30; 95% CI, 1.14-1.49) but not in cesarean deliveries (aOR 0.99; 95% CI, 0.81-1.23).

Conclusions: Labor and delivery in rural hospitals is associated with significantly increased risks of PPH and in-hospital maternal mortality compared with labor and delivery in urban hospitals. The excess risk of PPH in rural hospitals appears to be limited to vaginal deliveries. If confirmed with more recent data, these findings underscore the rural-urban disparity in the quality of obstetric quality and suggests that reducing PPH during vaginal deliveries should be a priority target for quality assurance programs in rural hospitals.

References:

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Abstract #: EF3-05

Table: Risk of maternal complications during childbirth in rural and in urban hospitals after propensity score matching ^(a). Abbreviations: PPH: postpartum hemorrhage.

	Deliveries in urban hospitals N = 96,424		Deliveries in rural hospitals N = 96,424		Odds ratio ^(b) (95% confidence interval)
	Number	Incidence (per 1000)	Number	Incidence (per 1000)	
PPH	2264	23.6	2573	26.8	1.22 (1.08-1.39)
In-hospital mortality	-- ^(c)	≈ 0.05 ^(c)	-- ^(c)	≈ 0.10 ^(c)	1.36 (1.34-1.37)

(a) The propensity score used for matching estimated the risk of delivering in a rural hospital using 33 patient- and hospital level characteristics. Matching used the nearest neighborhood approach with 1 control for 1 case, and a caliper of 0.2.

(b) Odds ratios are from a mixed-effect logistic regression with the outcome as the dependent variable, hospital location (rural or urban) as the independent variable, and the hospital identifier as the random effect. Furthermore, odds ratios are also adjusted for 2 variables with a persistent imbalance after matching (standardized mean difference ≥ 10%): year of delivery and patient residence (urban or rural).

(c) Because of Healthcare Cost and Utilization Project data use agreement restrictions on small cell size, the number of observed cases and exact proportions are not presented

Abstract #: EF3-06

Intrathecal 2-Chloroprocaine 3% versus Hyperbaric Bupivacaine 0.75% for Cervical Cerclage: A Double-blind Randomized Controlled Trial

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Introduction: Cervical cerclage is performed in 0.3 – 0.4% of pregnancies in the U.S.[1]. The procedure significantly reduces preterm delivery and improves perinatal outcomes in women with a high risk of preterm birth.[2] Typically a short ambulatory procedure in the lithotomy position, local anesthetic agents with a rapid onset, minimal motor blockade and early recovery of voiding are indicated. 2-Chloroprocaine (CP) may be the ideal agent but there are no published studies evaluating its use for cervical cerclage. We hypothesized that in combination with fentanyl, intrathecal (IT) CP would be as effective with a shorter time to discharge than hyperbaric bupivacaine (HBP) at the dose typically used in our practice.

Methods: Women with an indication for cervical cerclage with spinal anesthesia were randomized to receive either IT CP 3% 50mg or HBP 0.75% 9mg, with fentanyl 15mcg. The onset and resolution of sensory (to pinprick) and motor blockade (Bromage score) and time to achieve recovery room discharge criteria (ability to ambulate and void) were monitored. On postoperative day 1, patients were contacted by phone and asked to rate their satisfaction with the anesthetic (complete, adequate or inadequate) and report any complaints of transient neurologic symptoms, back pain or headache.

Results: The mean (SD) surgery duration was 35.3 (11.4) min. In the CP group (N=22), discharge criteria were met significantly sooner, with a mean difference of 98.8 min (SE 31.0) (Table). Post-operative motor and sensory block resolution were also faster in the CP group, but was only significant for sensory block resolution (Table). One complete block failure occurred with HBP and one subject in each group received IV hypnotic supplementation for intraoperative discomfort. No patients reported TNS symptoms.

Conclusion: As expected, CP 3% provided effective surgical anesthesia for cerclage placement, with more than 90 min earlier discharge than HBP, and no difference in patient satisfaction or incidence of TNS. Based on our findings, the onset/duration/recovery profile of IT CP makes it extremely well-suited for this ambulatory obstetric procedure. Doses used in this study were empirically selected. Dose-finding studies and studies using the recently approved CP 1% are avenues for future research. The ability to shorten recovery room stays could enhance utilization of nursing personnel, improve patient satisfaction and promote cost savings.

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1. Obstet Gynecol. 2015;126:243-9.
2. Cochrane Database Syst Rev.2017 Jun 6;6:CD008991

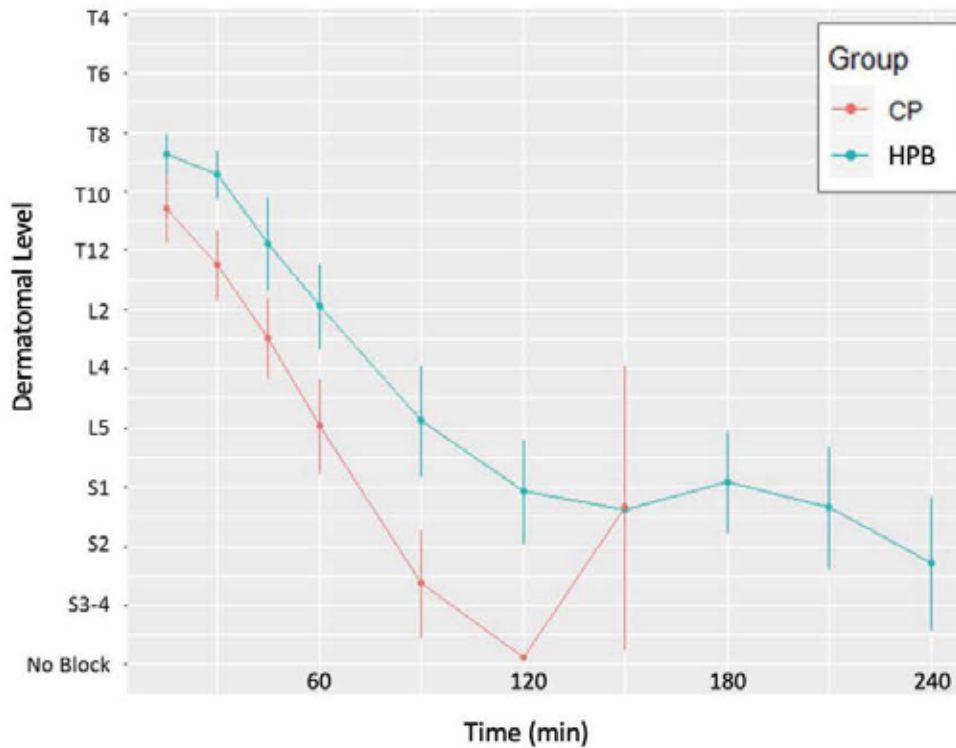
Abstract #: EF3-06

Table: Sensory-motor block resolution and satisfaction

	Chloroprocaine Group (N=22)	Bupivacaine Group (N=20)	Mean Difference (SE)	P value
Time to Sensory Block Resolution (min)	139.1 (30.5)	223.5 (94.2)	84.4 (30.4)	0.009
Time to Motor Block Resolution (min)	114.4 (39.8)	131.7 (70.4)	17.3 (22.7)	0.453
Time from IT dosing to Discharge criteria being met (min)	158.8 (34.6)	257.6 (99.0)	98.8 (31.0)	0.003
Patient satisfaction with anesthetic:				
Complete	16	14		
Adequate	1	3		

Data presented as mean (\pm standard deviation)

Figure: Resolution of sensory blockade to pinprick post-operatively. Point estimates represent the mean; bars represent the 95% CI.



Abstract #: EF3-07

Evaluation of Shock Index and Vasopressor Use During Cesarean Delivery in Patients Requiring Reoperation for Postpartum Hemorrhage

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Background: Postpartum hemorrhage (PPH) after completion of cesarean delivery (CD) can cause substantial maternal morbidity and mortality. Recognizing clinical markers of deterioration that occur during the preceding CD may be helpful. Here we describe intraoperative hemodynamic data (shock index [SI]; phenylephrine [PE] requirement; blood loss [BL]; transfusion requirement) during CD in patients later diagnosed with severe PPH requiring reoperation.

Methods: This is a descriptive analysis of patients who underwent CD from 6/2015 through 6/2017 at a tertiary center and then required exploratory laparotomy (EL) or uterine artery embolization (UAE) for PPH after their CD. Average SI (heart rate/systolic blood pressure [SBP]), maximum SI, delta SI (maximum SI-baseline SI) and duration in minutes that SI was ≥ 1.2 was determined.¹ PE dose over time was calculated by total PE dose in the operating room/total duration of surgery, mcg/min. BL and transfusion during the CD and in the postpartum period was recorded. Patients were divided according to whether their reintervention occurred within 12 hours of CD (early PPH group) or greater than 12 hours after CD (late PPH group).

Results: Eleven patients were identified: 82% required EL and 27% required UAE for PPH after CD. 36% of patients labored prior to CD, and 45% received ≥ 1 secondary uterotonic agent. Uterine artery extensions and adhesions were reported in 45% and 27%, respectively. The median PE requirements were 5.3 mcg/min [Interquartile range (IQR); 3.0, 23.9], median BL during the CD was 1200 ml [800, 2000], BL after CD was 1500 [800, 2000]. Etiologies of PPH requiring intervention after CD were extensions/lacerations (N=4), adhesions (N=3), atony (N=2), and coagulopathy (N=2). Four patients required a hysterectomy and 2 were admitted to the intensive care unit. Three patients were readmitted to the hospital. Two patients required transfusion of blood products during the CD with a median of 9 [8, 13] blood products transfused in the postoperative period.

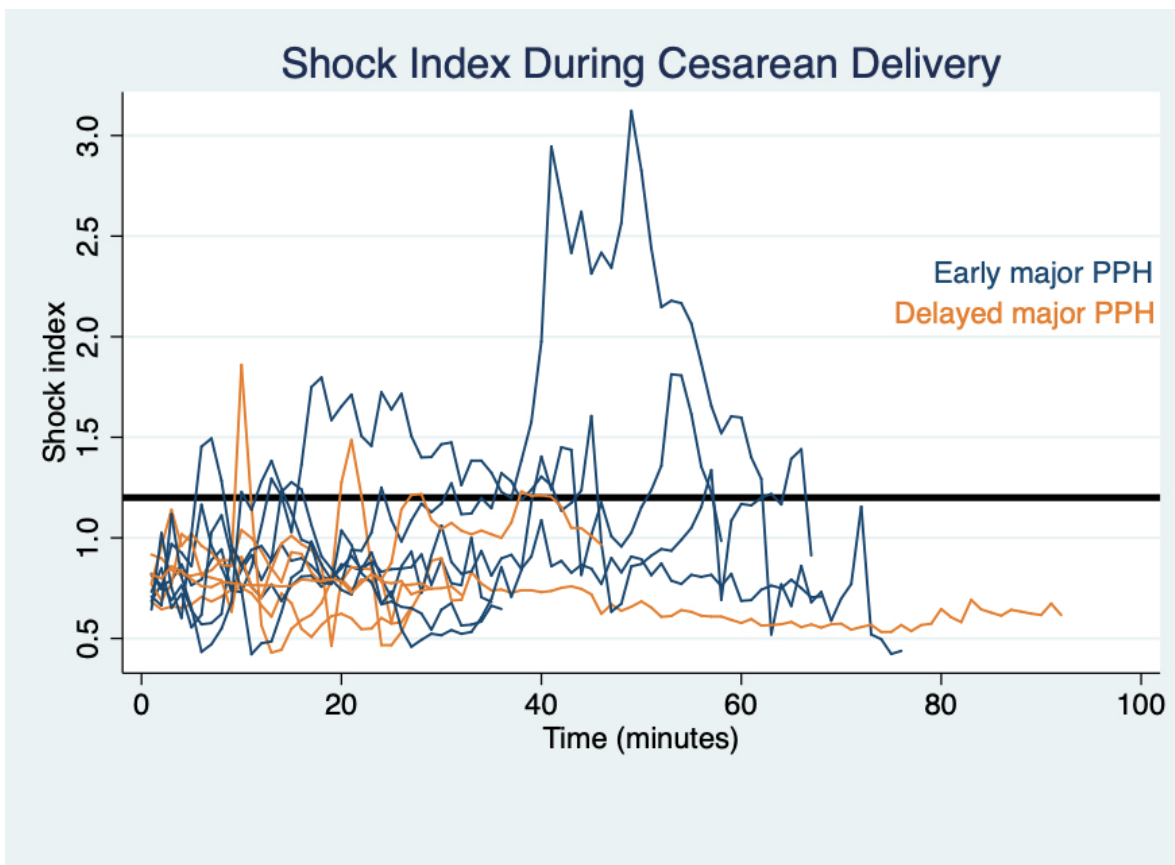
Median SI was 0.8 [0.8, 0.9], maximum SI was 1.2 [1.0, 1.8], median delta SI was 0.4 [0.3, 0.9], for all the SI datapoints 16.4% were ≥ 1.2 . Six patients had an early PPH and 5 had a late PPH. Multiple patients in the early PPH group demonstrated shock indices ≥ 1.2 beyond 40 minutes of operating time, while only one patient in the delayed PPH group had shock indices in this range beyond 40 minutes (Figure).

Discussion: Tachycardia and low SBP captured by the SI are consistent with early warning criteria previously proposed.² We hypothesize that patients developing severe PPH within 12 hours of CD have higher intraoperative SIs than those who do not, particularly beyond a 40-minute time cutoff. We plan to conduct a comparative study with a larger cohort with severe post-delivery PPH, comparing hemodynamic data to those without PPH.

References:

1. Kohn JR et al. J Matern Fetal Neonatal Med, 32 (8), 1238-1244
2. Mhyre JM et al. Obstet Gynecol, 124 (4), 782-6

Abstract #: EF3-07



Abstract #: EF3-08

Development of a prediction model to identify women who may require additional recovery care due to peri-operative bleeding after cesarean delivery

Presenting Author: Marie-Louise Meng

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Introduction: Estimation of blood loss at cesarean delivery is notoriously inaccurate. Tools to improve recognition of women who require additional postoperative care to manage hemorrhage are needed. We therefore performed this study to develop a model to identify women who need increased care postoperatively due to bleeding and to validate it in a prospective cohort.

Methods: All women with cesarean deliveries (scheduled or unscheduled) in 2016 were included in this analysis (n=1595). Potential intraoperative predictors were chosen: blood pressure, heart rate (< 100/ >100 beats/min), vasopressor administration at the end of cesarean delivery (no/yes), uterotonic medication other than oxytocin (no/yes), EBL (< 1000ml/ >1000ml), intraoperative transfusion (no/yes), and ethnicity (African American, white, others). The composite outcome was any of the following: uterotonic given postoperatively, need for a higher level of care (admission to a high-risk step-down unit or ICU), any postoperative blood transfusion or readmission/reoperation within 30 days for wound complication, surgical complication, or bleeding. Using the 2016 cohort, a logistic model was developed to predict the composite outcome. We then tested the developed prediction model in a prospectively-enrolled cohort of 200 women who had consecutive cesarean deliveries in 2019. We generated receiver operating curves (ROC) and calculated areas under the ROC (AUC), sensitivity, specificity, positive predictive value, and negative predictive value. We followed TRIPOD (Transparent Reporting of a multivariable prediction model for Individual Prognosis Or Diagnosis) in developing the prediction model.

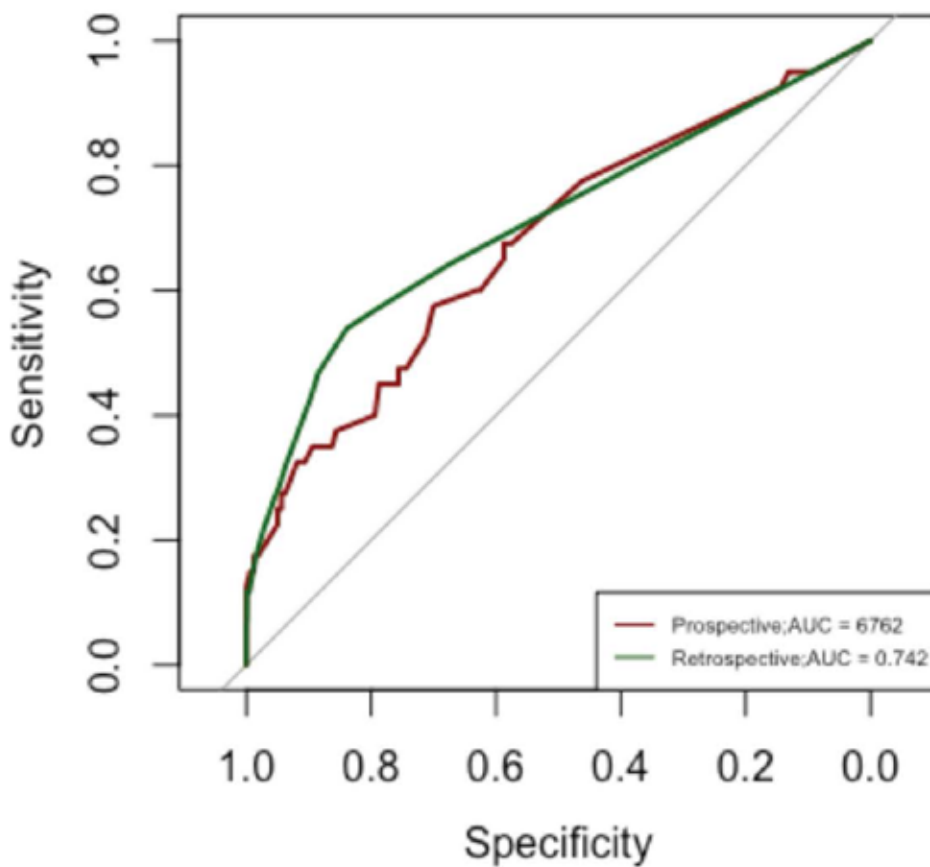
Results: The composite outcome occurred in 10% of subjects in the 2016 development cohort. Three predictors were significantly associated with the composite outcome (uterotonic medication other than oxytocin (OR=3.29, 95% CI (2.12-5.04), $p < 0.001$), blood loss >1000 ml (OR=2.75 (1.76-4.23), $p < 0.001$), and blood transfusion (OR=18.20 (6.11-67.48) < 0.001)). Applying the fitted logistic model to the prospective cohort, we obtained AUC of 0.676, PPV of 0.818, NPV of 0.914, sensitivity of 0.150 and specificity of 0.994 (Table 1 and Figure 1).

Discussion: In this cohort, blood transfusion during cesarean delivery was the strongest predictor of need for additional recovery care. As the three factors that were predictive (blood loss, use of uterotonics and intraoperative transfusion) are fairly obvious clinical risk factors, an implication of this work so far is that more subtle indicators may be difficult or impossible to identify. The low sensitivity and high specificity in the validation cohort are mostly due to the unbalanced nature (low incidence) of the composite outcome in both cohorts (< 10% of subjects), and the small size of the prospectively enrolled 2019 cohort. Validation and potential improvement of this model in other large cohorts are needed.

Table 1. Performance of the model in the retrospective and prospective cohorts

	AUC	Sensitivity	Specificity	Accuracy	PPV	NPV
Retrospective	0.742	0.15	0.99375	0.825	0.8571	0.8238
Prospective	0.6762	0.1169	0.9972	0.9122	0.8182	0.9135

Figure 1. Receiver operating curve



Abstract #: EF3-09

Exploring the Patient Experience of Placenta Accreta Spectrum: Identifying Optimal Interventions for Trauma-Informed Care

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INTRODUCTION: Nearly 50 percent of women describe childbirth as traumatic in some way, making them more vulnerable to perinatal psychiatric illness such as anxiety, depression, and post-traumatic stress disorder (PTSD). Up to 6 percent of women meet criteria for postpartum PTSD [1]. Patients with high-risk pregnancy due to abnormal placentation are even more susceptible to childbirth-related mental health sequelae [2]. We conducted focus groups for women with a history of placenta accreta in order to understand patients' perspective on their care. Specifically, we sought factors that may improve perioperative care and mental health outcomes.

METHODS: Focus groups were conducted with women who experienced a complicated birth experience involving hemorrhage and/or hysterectomy in the context of placenta accreta spectrum. Experienced perinatal psychiatry and social work providers asked general questions about patients' pregnancy, birth, and postpartum experience. Using a grounded theory approach, de-identified focus group transcriptions were coded independently by two investigators, and emerging themes identified. A third investigator reviewed and verified these themes, and determined specific components related to the perioperative care received from the multidisciplinary team.

RESULTS: Four focus groups were conducted with a total of 22 participants. Preliminary themes were identified and linked to the preoperative and intraoperative periods. Patients expressed a desire for detailed discussions of their care coordination, a collaborative and confident environment set by their surgical team, and attentiveness to their and their partners' emotional needs

CONCLUSIONS: Preliminary themes identified in our focus groups suggest that the preoperative and intraoperative periods are meaningful timepoints for intervention to provide added support for patients with abnormal placentation and risk for postpartum hemorrhage and hysterectomy. The sentiments expressed in our focus groups suggest that individualized planning and collaboration with multidisciplinary obstetric and obstetric anesthesia teams is important for patients with high-risk pregnancies. Anesthesiologists can best support these patients through detailed explanations of care, demonstrations of collaboration and confidence, and close attention to patients' and their partners' emotional needs.

References:

1. Sentilhes L et al. *Sci Rep* 2017;7:8724.
2. Tol ID et al. *Placenta* 2019;81:42-5.

Abstract #: EF3-10

Preventing uterine atony in intrapartum cesarean delivery: A retrospective before and after study of oxytocin infusion versus oxytocin bolus plus infusion

Presenting Author: Christine Warrick, M.D.

Presenting Author's Institution: University of Utah

Co-Authors: Mark Rollins, MD PhD - University of Utah

Introduction: Uterotonics are administered after cesarean delivery (CD) to prevent postpartum uterine atony. There is currently limited guidance beyond empiric strategies for dosing. A 2018 publication (1) recommends an oxytocin protocol for intrapartum CD with escalating infusion rates. However, this protocol may not reach therapeutic levels quickly enough, leading to increased uterine atony and higher oxytocin doses. A 2015 protocol (2) demonstrated lower oxytocin dose exposure utilizing small repeated bolus doses compared with a “wide open” infusion following elective CD, but did not use a controlled escalating infusion strategy. A recent consensus statement (3) recommends a combination of bolus plus infusion during intrapartum CD but does not discuss how to escalate oxytocin dosing when uterine tone is deemed inadequate. We sought to ascertain if uterine atony and need for second line agents after intrapartum CD is decreased with the addition of an initial oxytocin bolus at delivery as part of an infusion protocol. Our primary outcome was need for administration of second line uterotonic agents.

Methods: Following IRB approval, we performed a retrospective before and after analysis of women who underwent intrapartum CD with neuraxial anesthesia from March 2017 to November 2019. The “before protocol” was that published by Foley et al. (1) with a starting infusion rate of 18 IU/h. Timed inquiry was performed at 5 and 10 minutes to assess for dose escalation to 36 IU/h and 54 IU/h respectively per published protocol. The “after protocol” was a combination of the infusion protocol (1) and the small bolus protocol (2). A 3 IU bolus was administered at delivery with an oxytocin infusion started at 18 IU/h. Timed inquiry was performed at 5 and 10 minutes to assess for dose escalation to a second 3 IU bolus and infusion rate increase to 54 IU/h. The institution protocol change occurred March 2019.

Results: During the study period, there were 1011 intrapartum CD before and 320 intrapartum CD after the protocol change. The rate of second line agent use for intrapartum CD was 8.7% prior to the protocol change and 7.5% after ($p < 0.0001$), indicating a significant 13.8% decrease in second line agent use with addition of a 3 IU oxytocin bolus at delivery.

Discussion: Our results demonstrate a significant decrease in second line uterotonic agent use for intrapartum CD. This decrease may indicate improved efficacy of oxytocin for intrapartum CD when a 3 IU bolus is administered with an escalating infusion protocol. Patients who undergo intrapartum CD require more oxytocin to prevent uterine atony and providing a small bolus may help reach a therapeutic level faster.

References:

1. Foley A, et. al. A & A. 2018
2. Kovacheva V et al. Anes 2015
3. Heesen M, et al. Anes 2019

Abstract #: EF4-01

Core Temperature Monitoring during Cesarean Delivery under Spinal Anesthesia: A Descriptive Study

Presenting Author: Laura Burey

Presenting Author's Institution: New York Presbyterian Weill Cornell Medical Center

Co-Authors: Klaus Kjaer, MD, MBA - SOAP

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Introduction: Hypothermia is implicated in adverse outcomes in surgical patients, and is common in women receiving spinal anesthesia for cesarean delivery¹. Despite this, routine temperature monitoring by anesthesiologists is infrequent, in part due to the challenge of monitoring core temperature in an awake patient².

Previous studies involving temperature during cesarean deliveries are limited, relying on snapshots in time, or on an invasive continuous monitoring technique³. We therefore conducted an observational study to analyze temperature change over time following spinal anesthesia for cesarean delivery using temperature-enabled Foley catheters.

Methods: Records of women who underwent scheduled cesarean deliveries at our institution were retrospectively identified from January 1, 2018, through September 9, 2018, using our anesthesia information management system. Temperature measurements were automatically recorded every 15 seconds from time of Foley insertion until surgical end. Data for individual patients was modeled using a locally weighted scatterplot smoothing (LOWESS) graph of temperature versus time. Additional descriptive outcomes included time of rise to maximum temperature following Foley insertion, time to temperature nadir, and minimum temperatures recorded. This project was approved by the Institutional Review Board of Weill Cornell.

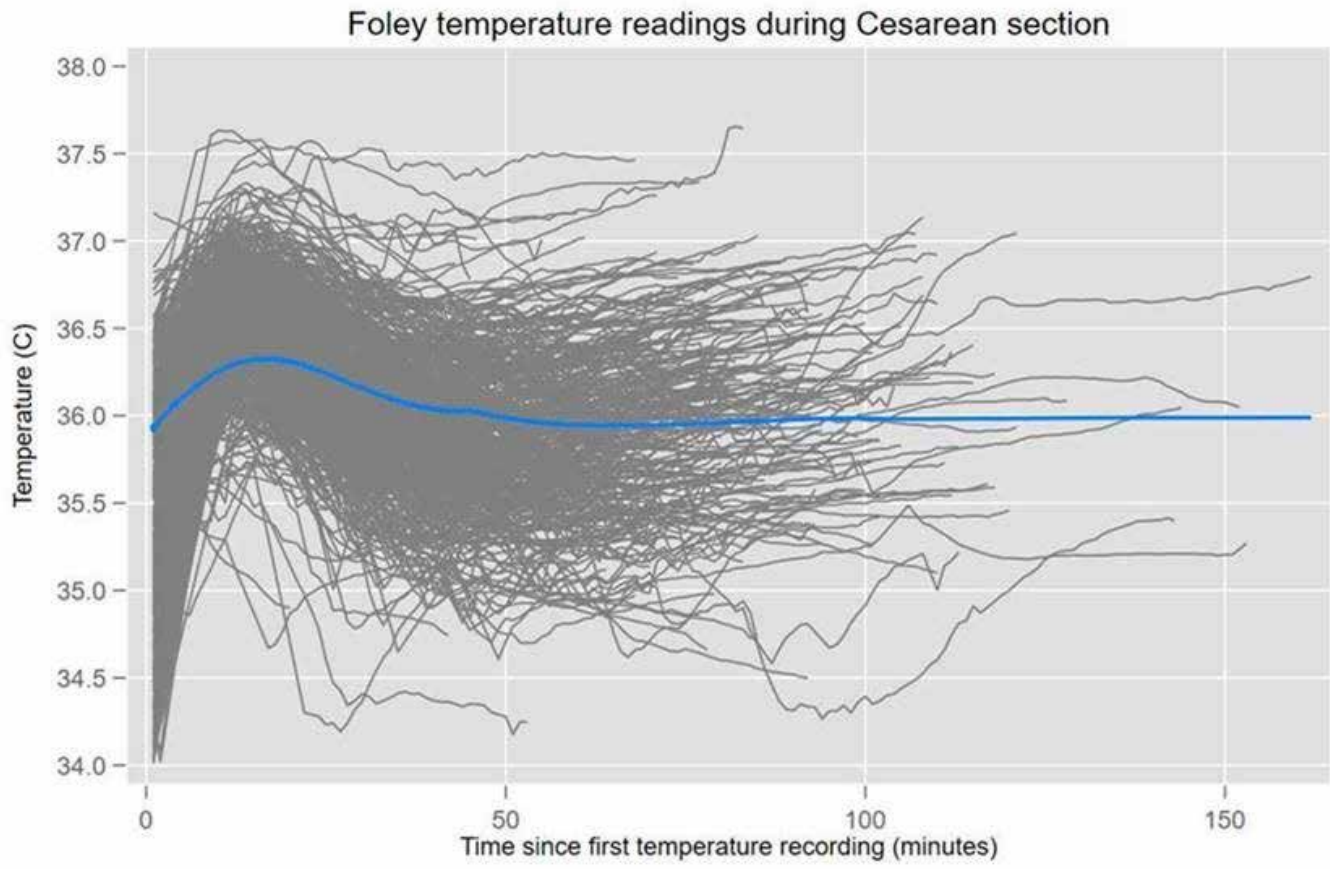
Results: 512 patients were included in the analysis. Median minimum temperature at minute 1 following Foley insertion was 35.24°C (IQR 1.43), with an average of 12 minutes until temperature equilibration at median maximum temperature of 36.54°C (IQR 0.39). Temperature dropped to a nadir of 35.9°C over 45 minutes, reflecting an average 0.64°C decline in temperature. (Figure 1).

Discussion: Maternal hypothermia is common during cesarean delivery and may be associated with adverse maternal and neonatal outcomes¹. However, intraoperative temperature monitoring is infrequently performed, likely limiting efforts to actively warm patients. Bladder temperature is a useful surrogate for core temperature when urine flow is adequate⁴, and offers a practical means of continuous temperature monitoring. Future studies should assess if strategies for maintenance of normothermia could be more effective with this simple monitoring modality.

References:

1. Perlman J, Kjaer K. Neonatal and maternal temperature regulation during and after delivery. *Anesth Analg* 2016; 123: 168-72.
2. Allen TK, Habib AS. Inadvertent perioperative hypothermia induced by spinal anesthesia for cesarean delivery might be more significant than we think: are we doing enough to warm our parturients? *Anesth Analg*. 2018; 126: 7-9.
3. Du Toit L, Van Dyk D, et al. Core temperature monitoring in obstetric spinal anesthesia using an ingestible telemetric sensor. *Anesthesia Analgesia*. 2018; 126: 190-5.
4. Sessler DI. Perioperative thermoregulation and heat balance. *The Lancet*; 2016; 387: 2655-2664

Abstract #: EF4-01



Abstract #: EF4-02

Randomized Double-blinded Comparison of Prophylactic Norepinephrine and Phenylephrine Infusion During Spinal Anesthesia for Cesarean Delivery in Twin Pregnancies

Presenting Author: Weijia du

Presenting Author's Institution: Shanghai First Maternity and Infant Hospital

Introduction Norepinephrine has recently been regarded as an alternative to phenylephrine for treatment of post-spinal hypotension during cesarean delivery(CD)¹, but all of these studies were conducted in singleton pregnant women. Twin pregnancies have become considerably more frequent these years as a result of developing assisted reproductive techniques, however, few data have been published on perioperative maternal hemodynamic changes in twin pregnancies². The objective of this study was to compare prophylactic infusion of phenylephrine and norepinephrine for maintaining maternal blood pressure after spinal anaesthesia in twin pregnancies during elective CD.

Methods This was a double-blinded, randomized, controlled study including 58 healthy twin pregnant women, gestation >36 weeks and scheduled for CD under spinal anesthesia. After spinal induction, either norepinephrine 6µg/ml or phenylephrine 75µg/ml was started infusion at a fixed rate of 1ml/min . Systolic arterial pressure(SAP) was targeted near baseline until delivery.The infusion was stopped if the SAP was more than baseline. Side effects were treated properly.The primary outcome was maternal cardiac output(CO). Other parameters of maternal hemodynamics, cord gases, Apgar score and adverse events were also compared.

Results Data were analyzed from 56 patients (28 patients in each group, from Dec 2017 to Dec 2018).From infusion until delivery, for norepinephrine versus phenylephrine, there was no difference between groups in CO(7.35L/minvs. 7.31 L/min, P =0.91)(Fig).Maternal hemodynamic parameters including SAP , heart rate, systemic vascular resistance and stroke volume were similar (all P >0.05). The umbilical arterial pO₂ of Twin A innorepinephrine group was higher than that in phenylephrine group (P = 0.04). Other neonatal outcomes and incidence of maternal nausea and vomiting, hypotension, bradycardia and reactive hypertension were similarbetween groups.

Conclusion When administered as a prophylactic fixed-rate infusion, phenylephrine and norepinephrine are both appropriate selections for maintaining maternal blood pressure after spinal anaesthesia in twin pregnancies. There is no clear evidence that norepinephrine is superior to phenylephrine in this study.

References:

1. Ngan Kee WD, Lee SW, Ng FF, et al. *Anesthesiology* 2015;122(4):736-45.
2. Lavie A, Ram M, Lev S, et al. *Arch Gynecol Obstet* 2018;297(2):353-63.

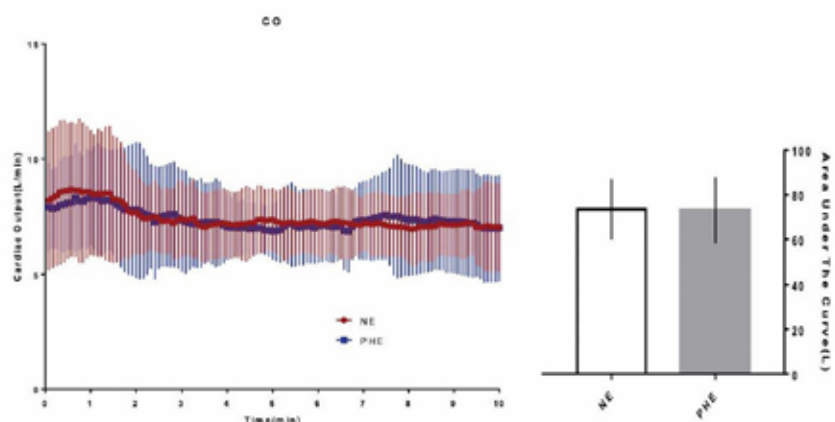


Fig. Continuous changes in cardiac output(CO): On the left side of the panels, data are continuous values for the first 10 minutes from drug infusion shown as mean and SD. On the right side of the panels, bars show the area under the curve for the two groups (N = norepinephrine and P = phenylephrine) and shown as mean and SD. Comparison of the calculated values for standardized area under the curve in Group N and Group P showed that cardiac output was similar between groups(7.35L/min vs. 7.31 L/min, P = 0.91).

Abstract #: EF4-03

The impact of maternal hypotension on umbilical arterial pH after caesarean delivery under spinal anesthesia

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Masahiko Kawaguchi, Anesthesiologist - Department of Anesthesiology

Yusuke Naito, Anesthesiologist - Department of Anesthesiology

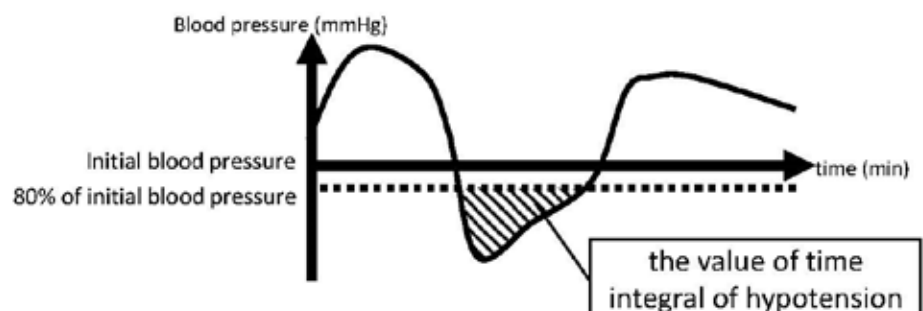
Background: Previous studies reported that both minimum value of arterial pressure and duration of hypotension are independently associated with decrease in umbilical arterial pH (UA pH). However, the effect of hypotension regarding both impact and duration on UA pH has not been well known. Thus, we evaluated the impact of hypotension as time integral in pregnant women undergoing caesarean delivery.

Material and Methods: Pregnant women with term baby aged ≥ 20 years who underwent caesarean delivery with single shot spinal anesthesia in our hospital between January 2017 and March 2019 were eligible. Multiple pregnancies, cases which were converted to general anesthesia, and cases requiring multiple administration of spinal anesthesia were excluded. The outcome of this study was to predict UA pH focused on the value of time integral of hypotension (Figure 1). Patient demographics (age, BMI, gestational days and smoking status during pregnancy, and patient comorbidity such as hypersensitive disorder of pregnancy (HDP) and gestational diabetes, type 1 diabetes, hyperthyroidism, hypothyroidism) were evaluated. In addition, intraoperative data including scheduled or emergent caesarean delivery, the presence of oxygen administration and total dose of ephedrine and phenylephrine before fetal delivery and cumulative duration of maternal hypotension were evaluated. Maternal hypotension was defined as a decrease in systolic arterial pressure (SAP) and mean arterial pressure (MAP) to $< 80\%$ of baseline value defined as initial blood pressure in the operating room. All explanatory factors were included in multiple regression analysis to predict UA pH. The SAP and MAP were included independently in multiple regression analysis.

Results: Of 416 eligible patients, 381 (91.5%) were enrolled. 35 patients were excluded by following reasons: the patient received accidental administration of lidocaine into her subarachnoid space and patients without complete demographic data. Of 381 patients, 62% was elective surgery and the average of UA pH was 7.29. When including the SAP in multiple regression analysis, emergency case ($\beta = -0.015$, $p = 0.006$), total dose of ephedrine ($\beta = -0.002$, $p = 0.001$), HDP ($\beta = -0.016$, $p = 0.04$) and the value of time integral of maternal hypotension defined with SAP ($\beta = -3.1 \times 10^{-5}$, $p = 0.04$) were the significant factors to predict decline in UA pH ($R^2 = 0.15$). Similarly, when including the MAP in the model, emergency case ($\beta = -0.015$, $p = 0.006$), total dose of ephedrine ($\beta = -0.002$, $p = 0.001$), HDP ($\beta = -0.016$, $p = 0.04$) and the value of time integral of maternal hypotension defined with MAP ($\beta = -3.0 \times 10^{-5}$, $p = 0.02$) were the significant predicting factors of UA pH ($R^2 = 0.15$).

Conclusion: Our results suggest that the value of time integral of maternal hypotension might have a negative impact on UA pH. Therefore, in order to minimize the risk of fetal acidosis, excessive hypotension should be avoided and the time between the anesthetic induction and delivery should be shortened.

Figure 1



Abstract #: EF4-04

Crystalloid versus colloid for preventing postspinal hypotension in parturients receiving prophylactic phenylephrine infusion during cesarean delivery: a randomized controlled trial

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Background: The optimal strategy of fluid administration during cesarean delivery remains unclear. A recent consensus statement recommends prophylactic vasopressors for all cesarean sections. However, no data are available comparing maternal hemodynamics between the crystalloid versus colloid administration in the setting of prophylactic vasopressor infusion. This study aims to compare crystalloid and colloid for prevention of postspinal hypotension in parturients receiving prophylactic phenylephrine administration during cesarean section.

Methods: After IRB approval, we conducted a double-blinded, randomized, controlled trial including full-term parturients scheduled for elective cesarean section under spinal anesthesia. Participants were randomized to receive rapid coload of either balanced crystalloid 10 ml/kg (crystalloid group) or 6% hydroxyethyl starch 10 ml/kg (colloid group) during spinal anesthesia. Prophylactic continuous infusion of phenylephrine was started at 25 ug/min immediately after subarachnoid block, and titrated to systolic blood pressure using an identical infusion protocol in all patients. The primary outcome was the incidence of postspinal hypotension (defined as reduced systolic blood pressure less than 80% of the baseline measurement). The secondary outcomes included vasopressor requirements, maternal complications, neonatal Apgar scores, and umbilical artery blood gas analysis.

Results: One hundred mothers were included in the analysis. There was no significant difference in the incidence of postspinal hypotension between the groups (25/50 [50%] in colloid group vs. 31/50 [62%] in crystalloid group; relative risk, 0.8 [95% CI, 0.56 to 1.14]; $P=0.314$). The median number of hypotensive episodes was 0.5 [interquartile range, 0-3] in colloid group and 2 [0-5] in crystalloid group (difference of median, -1.5 [95% CI, -3 to 0.5]; $P=0.077$). Total dose of phenylephrine infused did not differ between groups (612.5 [400-875] ug in colloid group vs. 625 [550-875] ug in crystalloid group; $P=0.160$). The number of patients requiring phenylephrine bolus administration to treat hypotension showed no significant difference between the groups (17/50 [34%] in colloid group vs. 24/50 [48%] in crystalloid group; relative risk, 0.71 [95% CI, 0.44-1.15]; $P=0.222$). There were no significant differences between the groups in the incidence of severe hypotension, symptomatic hypotension, bradycardia, nausea, dizziness, and neonatal outcomes.

Conclusion: Among parturients receiving prophylactic phenylephrine infusion during cesarean delivery, use of colloid for coload during spinal anesthesia compared with crystalloid resulted in no significant difference in the incidence of postspinal hypotension. The findings of this study do not support the use of colloid in such clinical settings.

Abstract #: EF4-04

References:

1. Fitzgerald JP, et al. *Anaesthesia*. 2020; 75: 109-121
2. Tawfik MM, et al. *Anesth Analg*. 2019 Feb;128(2):304-312.
3. Kinsella SM, et al. *Anaesthesia*. 2018; 73: 71-92

Table 1. Demographic, surgical, and baseline characteristics.

	Colloid group (n=50)	Crystalloid group (n=50)	<i>P</i> value
Age (yr)	36.5 [33–39]	37 [33–40]	0.181
Height (cm)	162 [159.4–166.3]	162 [157.4–165.4]	0.410
Weight (kg)	71.3 (9.7)	68.8 (6.7)	0.126
Body mass index (kg/m ²)	26.1 [24.4–29.5]	25.8 [24.5–27.8]	0.546
Gestational age (weeks)	38 [38–38]	38 [38–38]	0.278
ASA physical status, I/II	45 (90%) / 5 (10%)	45 (90%) / 5 (10%)	1.000
Indications for cesarean section			0.213
Breech presentation	6 (12%)	12 (24%)	
Previous section	23 (46%)	25 (50%)	
Maternal request	14 (28%)	7 (14%)	
Others	7 (14%)	6 (12%)	
Baseline vital signs			
Systolic blood pressure (mmHg)	124.5 (12.3)	122.3 (13.6)	0.404
Heart rate (beats per minute)	78.4 (13.6)	78.0 (15.0)	0.878
Spinal-to-delivery time (min)	25.1 [21.7–30.6]	26.5 [23.4–32.5]	0.178
Operation time (min)	65 [50–75]	60 [50–70]	0.219
Anesthesia time (min)	90 [80–105]	90 [80–105]	0.648
Study fluid volume (ml)	713.3 (97.2)	688 (67)	0.133
Upper sensory level	T4 [T3–T4]	T4 [T2–T4]	0.201

Data are presented as mean (standard deviation) or median [interquartile range] or number (proportion).

Abbreviations: ASA, American Society of Anesthesiologists.

Abstract #: EF4-04

Table 2. Maternal outcomes

	Colloid group (n=50)	Crystalloid group (n=50)	P value
Postspinal hypotension	25 (50%)	31 (62%)	0.314
Onset of hypotension (min) ^a	2 [2–4]	2 [1–4.5]	0.473
No. of hypotensive episode	0.5 [0–3]	2 [0–5]	0.077
Severe hypotension	14 (28%)	20 (40%)	0.291
Symptomatic hypotension	8 (16%)	14 (28%)	0.227
Bradycardia	4 (8%)	6 (12%)	0.739
Reactive hypertension	1 (2%)	1 (2%)	1.000
Nausea	6 (12%)	9 (18%)	0.575
Vomiting	0	0	-
Dizziness	1 (2%)	3 (6%)	0.610
Breathlessness	4 (8%)	6 (12%)	0.739
Total phenylephrine infusion (mcg)	612.5 [400–875]	625 [550–875]	0.160
Bolus phenylephrine administration	17 (34%)	24 (48%)	0.222
No. of bolus phenylephrine interventions	0 [0–1]	0 [0–2]	0.064
Ephedrine administration	1 (2%)	3 (6%)	0.610
Atropine administration	0	0	-

Data are presented as median [interquartile range] or number (proportion).

All outcomes are measured from subarachnoid injection until delivery of the fetus.

^aIn patients who experienced hypotension

Abstract #: EF4-04

Table 3. Neonatal outcomes

	Colloid group (n=50)	Crystalloid group (n=50)	<i>P</i> value
Umbilical artery blood gases			
pH	7.3 [7.3–7.3]	7.3 [7.3–7.3]	0.116
PCO ₂ (mmHg)	51.3 [47.3–55.2]	51.2 [49.1–55.5]	0.609
PO ₂ (mmHg)	20.9 [18.1–23.9]	21.6 [16.5–25.1]	0.639
Base excess (mmol/L)	-1.3 [-2.0–-0.1]	-1.6 [-2.9–-0.8]	0.038
Neonatal acidosis (umbilical artery pH < 7.2)	1 (2%)	1 (2%)	1.000
Apgar scores			
1 min	8 [8–8]	8 [8–8]	0.994
5 min	9 [9–9]	9 [9–9]	0.336

Data are presented as median [interquartile range] or number (proportion).

Abstract #: EF4-05

Prevention of maternal hypothermia in women undergoing cesarean sections under spinal or combined spinal epidural anesthesia- quality improvement project

Presenting Author: Jennifer Wilson, CRNA

Presenting Author's Institution: Brigham and Women's Hospital, Boston, MA, Massachusetts

Co-Authors: Mihaela Podovei, MD - Brigham and Women's Hospital, Harvard Medical School

Background: Perioperative hypothermia is estimated to occur in more than 60% of patients undergoing cesarean delivery (CD). Prevention decreases maternal shivering, improves thermal comfort, reduces postoperative wound infection, reduces delay in skin-to-skin contact between mother and baby and decreases intraoperative bleeding. Literature review has found that the use of warmed intravenous (IV) fluids and a forced warm air device decreases the incidence of perioperative hypothermia. The purpose of this quality improvement project was to determine the incidence of maternal hypothermia and assess if warmed IV fluids and a forced warm air device decreases the incidence of hypothermia in patients undergoing CD with neuraxial anesthesia.

Methods: Setting: Labor and Delivery Unit at a large academic acute care hospital.

Design: A baseline group of 81 women received routine anesthesia care for CD. After neuraxial anesthesia (1.6-1.8 ml of 0.75% hyperbaric bupivacaine, 15mcg Fentanyl and 100mcg pf Morphine), a bladder catheter with a temperature sensor was placed. Pre-op oral, continuous intra-op bladder, and first post-op temperature were documented in the electronic record. The data was used to determine the baseline incidence of maternal hypothermia. After the baseline group, educational sessions were provided to staff including L&D nurses, scrub technicians and all anesthesia staff. The second group of 61 women received the same routine anesthesia care for CD, plus an intra-op clinical intervention of actively warmed IV fluids to 41C and forced warm air lower body blanket set on high (43C). Temperatures were recorded. Hypothermia was defined as core body temperature < 36C. This project was reviewed and approved by the IRB.

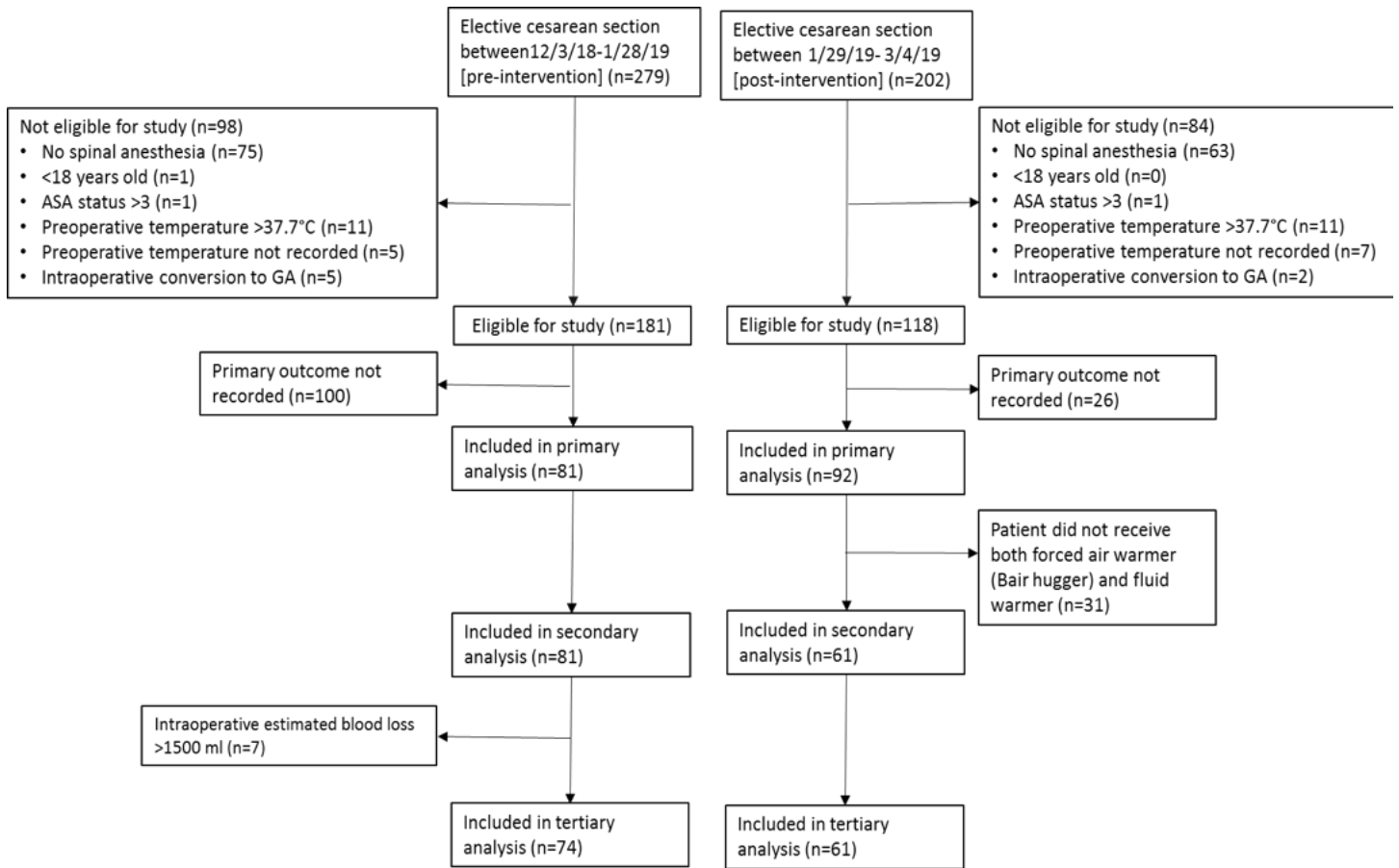
Results: Charts of 481 CDs in the study period (December 3, 2018-March 4, 2019) were reviewed to identify the cases that met the inclusion criteria. Of these cases, 81 patients had a spinal or CSE with intraoperative bladder temperature monitoring in the baseline group and 61 in the intervention group. Based on the power analysis, the goal was at least 60 patients in each group. There was a 40% drop in the incidence of hypothermia (63% in the pre intervention group and 37.7% in the post intervention group, P value 0.014). The women in the intervention group were an average 0.4C warmer before leaving the OR than the women in the pre-intervention group (p=0.003). Results were presented to L&D staff and the protocol adopted. Continued surveillance of hypothermia rate shows a level similar to the intervention group for the rest of 2019.

Conclusion: This was a successful, evidence-based QI project that led to a practice change due to buy in from different clinical groups interested in improving outcomes. Actively engaging multiple groups ensured achievement of a high compliance rate, not affected by the high turnover rate of trainees.

References:

1. Cobb B, *Anesthesia & Analgesia*. May 2016;1490-1497
2. Sultan, Br J *Anesth*. 2015;115(4):500-510

Abstract #: EF4-05



Abstract #: EF4-06

More Stressor, Less Pressor: Pre-operative anxiety is associated with lower vasopressor requirements after spinal anesthesia.

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Introduction: The current guidelines and evidence¹ support the use of prophylactic phenylephrine to avoid hypotension after spinal anesthesia for cesarean delivery. The exact amount, mode and timing of vasopressor administration has been extensively studied, however, there are no clear predictors that can be used to identify patients that are at high risk for developing post spinal hypotension. A small study suggested a relationship between the risk for hypotension and anxiety². Therefore, we sought to determine if pre-operative anxiety levels may predict which patients are at higher risk for developing hypotension as measured by the amount of vasopressors needed to maintain normotension.

Methods: For this prospective observational study, we enrolled 351 patients who underwent elective cesarean delivery under spinal anesthesia at Brigham and Women's Hospital. All patients were at least at 36 weeks of gestational age. Prior to surgery, patients were asked to complete the Patient-Reported Outcomes Measurement Information System (PROMIS)-Anxiety short form. After spinal anesthesia, the amount of phenylephrine (μg) and ephedrine (mg) required to maintain optimal maternal blood pressure were recorded. Data were analyzed using linear multivariate regression using R 3.4.0.

Results: A total of 332 patients completed the study. Bupivacaine doses used for spinal anesthesia varied from 12mg to 13.5mg. Increased pre-operative anxiety was associated with lower post-spinal vasopressor requirements. For each 1-point increase in baseline PROMIS Anxiety Score, the phenylephrine dose administered decreased by an average of 28 μg (95% CI: 4-45 mcg; $p \leq 0.05$) and the ephedrine dose decreased by a median of 24 mg (95% CI -3-51mg; $p = 0.07$). Age, BMI and race were not associated with altered vasopressor requirements after spinal anesthesia.

Discussion: This study demonstrated a relationship between pre-operative anxiety levels and maternal post-spinal hypotension. Interestingly, we found that higher PROMIS anxiety scores were associated with lower phenylephrine requirement, indicating less hypotension. A possible explanation is that higher circulating catecholamine levels in those with greater anxiety may be protective against hypotension after spinal anesthesia. Further analysis of other possible predictors will be performed. Identifying high risk patients will allow for personalized, pre-emptive vasopressor treatment.

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1. Kinsella et al. *Anaesthesia* 2018, 73, 71-92.
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Abstract #: EF4-07

The association of maternal temperature and umbilical artery pH during Cesarean Delivery.

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Presenting Author's Institution: St Luke's International Hospital

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BACKGROUND: Active management for maternal temperature during Cesarean Delivery (CD) decreases hypothermia and shivering. Some studies report that maternal hypothermia induced low UA-pH and neonatal hypothermia. However, accurate monitoring of maternal temperature during CD under spinal anesthesia is a challenge.

OBJECTIVE: The aim of this study is to retrospectively investigate factors associated with maternal hypothermia that impact fetal outcome in women who underwent scheduled term CD under spinal anesthesia.

METHODS: We reviewed medical records of mothers and babies who underwent a scheduled CD from September, 2016 to July, 2019 at an urban teaching hospital. We excluded the cases in which no intrathecal morphine was used, temperature was measured for less than 70% of anesthesia time, and the peak temperature was beyond 37.6 degrees Celsius. Forced-air-warming was utilized to warm the patient (3M™ Bair Hugger™ Warming Blanket System, 3M Japan Limited, Tokyo, Japan). Non-invasive temperature sensor was placed on the patient's forehead to measure the core temperature (3M™ Bair Hugger™ Temperature Monitoring System, 3M Japan Limited, Tokyo, Japan). Cubic regression spline smooth and multivariate analysis were utilized to analyze the data.

RESULTS: 293 cases met our inclusion criteria among 536 women who underwent a scheduled CD during the study period. In most cases, the maternal temperature fell one hour after spinal anesthesia (Figure). There are significant associations between UA-pH and ephedrine ($\beta = -0.315$ $p < 0.001$), minimum maternal temperature ($\beta = -0.301$ $p < 0.001$), maximum maternal temperature ($\beta = -0.207$ $p = 0.004$), anesthesia to delivery time ($\beta = -0.160$ $p = 0.009$), and fluid ($\beta = -0.158$ $p = 0.041$) (Table).

Conclusion: Maternal hypothermia during elective CD is associated with decrease in UA-pH. Maintenance of maternal temperature within normal range during CD may improve baby's outcome.

Figure. Maternal temperature changes

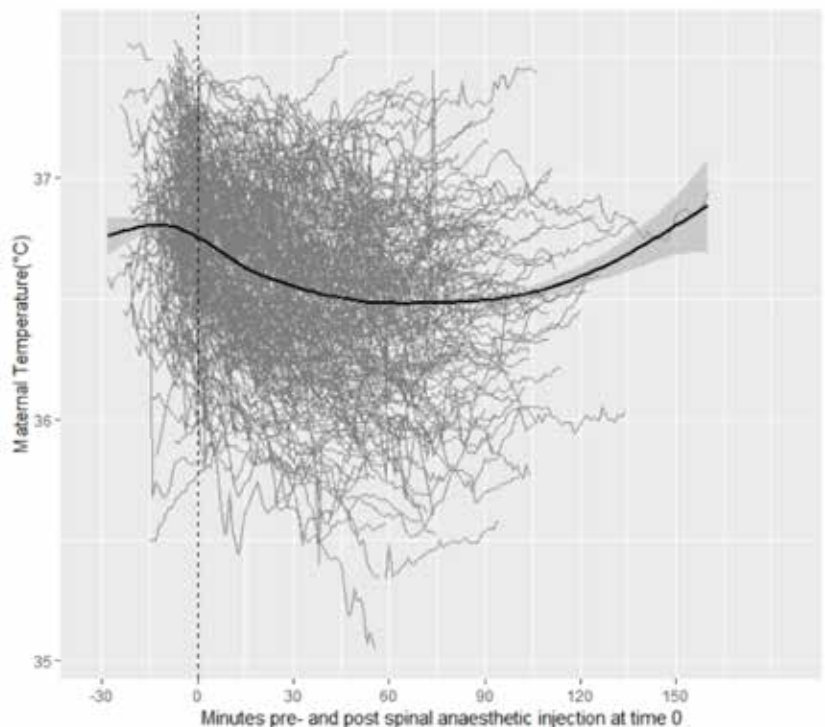


Table. linear regression analysis for variables predicting UA-pH

	Unstandardized Coefficients		Standardized Coefficients	t	Sig
	B	std. error	Beta		
(Constant)	6.923	0.347		19.966	0.000
Age (M)	0.000	0.001	-0.015	-0.264	0.792
BMI (M)	-0.001	0.001	-0.086	-1.457	0.146
Preoperative Hemoglobin (M)	0.00003	0.002	0.001	0.013	0.989
Anesthesia-delivery time	-0.000014	0.000	-0.160	-2.632	0.009
Gestational age	0.006	0.004	0.112	1.689	0.092
Phenylephrine	0.001	0.004	0.022	0.373	0.710
Ephedrine	-0.002	0.000	-0.315	-5.388	0.000
minimum temperature (M)	0.035	0.009	0.301	4.092	0.000
maximum temperature (M)	-0.029	0.010	-0.207	-2.902	0.004
times of mBP under 60 (M)	0.000088	0.001	0.007	0.122	0.903
weight (N)	-0.006	0.008	-0.050	-0.743	0.458
Fluid (M)	0.011	0.005	0.158	2.056	0.041
Urine (M)	0.023	0.018	0.082	1.302	0.194
Blood loss (M)	-0.009	0.005	-0.127	-1.796	0.074

Dependent Variable UA-pH R²=0.197 p<0.001
 (M) maternal (N) neonatal

Abstract #: EF4-08

Association between Intraoperative Hypotension and Severe Fetal Acidemia during Elective Cesarean Delivery – An Observational Study

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Olutoyosi T. Ogunkua - The University of Texas Southwestern Medical Center

Background: Hypotension during cesarean delivery may be associated with poor fetal outcome. Critical levels of hypotension for poor fetal outcome have not been determined.

Methods: To characterize the relationship between the severity of hypotension and fetal acidemia, we analyzed umbilical arterial (UA) blood pH and maternal blood systolic blood pressure (SBP) in 397 women undergoing elective cesarean delivery under spinal or combined spinal epidural anesthesia. Severe fetal acidemia was defined as a UA blood pH less than 7.10 (n=6). Blood pressure was measured every minute after injection until delivery. Time from spinal injection to delivery was recorded. Episodes of systolic blood pressure (SBP) below 100, 95, 90, 85 and 80 mmHg, as well as below 10%, 15%, 20%, 25% and 30% baseline were counted. The summation of SBP decrease before delivery was calculated as the area under the curve (AUC).

Results: The time between spinal injection and delivery was 47 ± 10 min in women with severe fetal acidemia, and 37 ± 9 in the rest ($p < 0.01$). The AUC was -224 ± 167 mmHg·min in women with severe acidemia and -158 ± 206 mmHg·min in the rest ($P=NS$). An SBP below 90 mmHg, or more than 25% decrease from baseline, occurred twice as often in women with severe fetal acidemia; an SBP below 80 mmHg, or more than 30% decrease from baseline, occurred three times as often in women with severe fetal acidemia.

Table. Number of SBP change episodes per individual prior to delivery

UA blood pH	< 100 mmHg	< 95 mmHg	< 90 mmHg	SBP < 85 mmHg	SBP < 80 mmHg	< 10% Baseline	< 15% Baseline	< 20% Baseline	< 25% Baseline	< 30 Baseline
< 7.10 (n=6)	5.8	3.3	1.8	1.2	1.0	8.5	5.0	3.3	1.8	1.2
≥ 7.10 (n=391)	3.8	1.8	0.9	0.5	0.3	7.6	4.3	2.0	0.9	0.4

Conclusions: The severity of fetal acidemia is related to the degree of maternal hypotension. An SBP below 90mmHg, or greater than 25% decrease from baseline, is associated with severe fetal acidemia.

References:

Rimsza, RR et al. Time from neuraxial anesthesia placement to delivery is inversely proportional to umbilical arterial cord pH at scheduled cesarean delivery. Am J Obstet Gynecol. 2019; 220: 389.e1-9

Abstract #: EF4-09

Perspectives from Labor & Delivery: Understanding the Risks and Avoidance of General Anesthesia Use for Cesarean Delivery

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Presenting Author's Institution: Vanderbilt University Medical Center - Nashville, Tennessee

Co-Authors: Jeanette Bauchat, MD - Vanderbilt University Medical Center

Holly Ende, MD - Vanderbilt University Medical Center

Introduction: Neuraxial anesthesia is preferable to general anesthesia (GA) for cesarean delivery (CD) to reduce maternal morbidity.¹ The rate of GA for CD at our institution is higher than the 5% benchmark set by the SOAP Center of Excellence criteria² and the 3% benchmark the United Kingdom's Royal College of Anaesthetists recommend.³ We surveyed LD providers to assess their understanding of risks associated with GA and conducted a manual chart review of GA cases to design a quality initiative to reduce the incidence of GA for CD.

Methods: Phase 1: A multiple choice and free text REDCap survey was emailed to labor and delivery unit providers. Questions were designed to elicit providers' perceptions of our institutional GA rates and the associated risks to the patient. The free text portion of the surveys were categorized into medical and patient-centered themes. Phase 2: A retrospective chart review identified CDs with a documented tracheal intubation from Dec '18 –Nov '19. Each chart was manually reviewed to determine the reason for GA.

Results: 104 (26%) participants (33 anesthesia, 37 obstetric and 34 nursing providers) responded to the survey. Chart review revealed a GA incidence of 5.67% (88/1555). Maternal medical condition (34%) was the most frequent reason for GA use, followed by failed epidural (27%) or no epidural (19%) for urgent CD. Eighty-six providers (83%) felt that GA should occur in 3% of CD and 68 (65%) thought that our institution was already below that benchmark. Anesthesia providers frequently reported medical themes including potential difficult airway, fetal anesthetic exposures, and uterine atony as reasons to avoid GA, although patient's ability to experience the birth was reported as frequently as airway concerns. (Table) Obstetricians were most concerned about fetal exposure and all patient-centered effects, but also raised unique concerns of operative errors related to expediency. Nurses were focused on patient-centered outcomes and postoperative concerns.

Conclusion: Clinicians have different perspectives of the disadvantages of GA for CD and educational initiatives should be designed to address all of these perspectives. Nearly half of our GA cases are those with failed or without epidural analgesia, demonstrating the importance of partnering with our team members to identify those at risk for cesarean delivery and ensure functional epidural catheters. A BABY (Being Awake for the Birth of Your Baby) Bundle is being implemented to target: (1) early identification of non-functioning catheters (2) anesthesia trainee timely epidural medication administration for emergent CD (3) education of all providers regarding risks of GA and (4) multidisciplinary efforts to encourage epidural analgesia in patients at risk for emergency CD.

References:

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2. Carvalho et al. SOAP Center of Excellence Application 2019
3. Wagner et al. *Acta Anaesthesiol Scand* 2019;63.6:769-74

Abstract #: EF4-09

	Anesthesia	Obstetrics	Nursing
Number of responses, n(% response rate)	33 (31%)	37 (35%)	34 (32%)
Patient-centered Themes			
Patient remembering/experiencing birth	23 (70%)	16 (43%)	21 (62%)
Earlier skin-to-skin	7 (21%)	18 (49%)	22 (65%)
Family presence at birth	5 (15%)	17 (46%)	9 (26%)
Patient satisfaction	7 (21%)	7 (19%)	4 (12%)
Patient participation	3 (9%)	7 (19%)	2 (6%)
Patient trauma, anxiety, postpartum depression	7 (21%)	6 (16%)	7 (21%)
Patient recovery	5 (15%)	9 (24%)	11 (32%)
Medical Themes			
Fetal drug exposure	17 (52%)	22 (59%)	12 (35%)
Postop pain control	11 (33%)	6 (16%)	18 (53%)
Difficult airway	25 (76%)	9 (24%)	6 (18%)
Postop respiratory complications	12 (36%)	11 (30%)	8 (24%)
Atony and hemorrhage	15 (45%)	7 (19%)	3 (9%)
Postop nausea and vomiting	4 (12%)	5 (14%)	11 (32%)
Surgical errors related to expediency	0 (0%)	10 (27%)	0 (0%)
Provider satisfaction	1 (3%)	1 (2.7%)	1 (3%)

All values are reported as number of respondents (%) unless otherwise noted

Abstract #: EF5-01

Intrathecal dexmedetomidine at cesarean delivery and hysterectomy for unsuspected placenta accreta: A Case Report

Presenting Author: Kyra Bernstein

Presenting Author's Institution: New York Presbyterian Hospital Columbia Campus - Teaneck, New Jersey

Co-Authors: Ruth Landau

Background: Clonidine and dexmedetomidine have become valuable neuraxial adjuvants in obstetric care and lower abdominal surgeries. A large-scale meta-analysis on neuraxial clonidine in obstetric patients showed prolongation of sensory block by 128min and motor block by 45min, without concomitant increases in hypotension, nausea vomiting, or pruritis.¹ Shivering with labor epidurals is reduced with the addition of clonidine.² Dexmedetomidine similarly increases quality and duration of neuraxial blockade and reduces shivering with the additional benefit of decreased post-operative pain.³ There are no studies of neuraxial dexmedetomidine use in obstetric anesthesia in the U.S.⁵, but up down allocation studies conducted in China show an ED95 of intrathecal dexmedetomidine of 5mcg.^{6,7} Based on clonidine's efficacy and safety in preserving Apgar scores and umbilical cord pH⁸ our institution routinely uses neuraxial clonidine for labor analgesia⁹ or cesarean delivery.

Case Report: In the midst of a clonidine shortage at our institution, a 56 yo G3P2 68kg, 157cm woman with a history of breast cancer in remission and an IVF pregnancy presented for an emergency repeat cesarean delivery in the setting of a bleeding placenta previa. A spinal anesthetic with hyperbaric bupivacaine 0.75% 12mg, morphine 150mcg, and fentanyl 15mcg was administered, with an empiric dose of preservative-free dexmedetomidine (5mcg/ml) 3.8mcg in lieu of clonidine. Two minutes after delivery, the obstetric team noted a placenta accreta and decision was made to perform a hysterectomy. The patient was extremely comfortable and motivated to avoid general anesthesia. An arterial line was placed, and a total of 4UPRBCs and 2U FFPs were transfused, along with 1g tranexamic acid and 250mcg CaCl₂. Mild nausea was treated with 4mg ondansetron and 10mg metoclopramide. Time from spinal to out of OR was 188 min, and no additional IV sedatives or analgesics were required. Final estimated blood loss was 3000ml. The patient remained on the high-risk obstetric unit for observation for 24 hours. She had excellent pain control from her spinal dose and took no systemic opioids until discharge.

Conclusion: In this case, intrathecal dexmedetomidine improved block quality and duration, allowing for hemorrhage resuscitation without general anesthesia, and contributed to outstanding post-hysterectomy analgesia. Dexmedetomidine may be an ideal adjuvant for cases in which a spinal neuraxial anesthetic is required quickly but anticipated procedural duration is unknown (ie, suspected placenta accreta). Care must be given to dosing as current neuraxial dosing of dexmedetomidine is not yet well defined for obstetric use.

References:

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9. Lee, IJOA. 2020

Abstract #: EF5-02

Cesarean Section in a Parturient with Severe Mitral Stenosis, Moderate Pulmonary Hypertension, and Congestive Heart Failure with Live Intra-Operative Transthoracic Echocardiography

Presenting Author: David Gutman, MD, MBA

Presenting Author's Institution: Medical University of South Carolina

Co-Authors: Robert Mester - Medical University of South Carolina

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Bernard Velardo - Medical University of South Carolina

Introduction: Mitral stenosis is a serious comorbid medical considering “pregnancy in women with mitral stenosis is associated with marked increase in maternal morbidity and unfavorable effect on fetal outcome.”¹ Optimal intrapartum management of these women requires extensive multidisciplinary communication, mobilization of additional resources, and collaborative execution of an agreed-upon delivery plan to ensure the health and well-being of both mother and baby.

Case Report: We present the case of a 29 year old G2P0 at 38 weeks with history of chronic hypertension, an unknown cardiac surgery at 5 years of age, moderate to severe mitral stenosis, moderate pulmonary hypertension, and class 3 NYHA congestive heart failure. She presented for primary cesarean section due to breech presentation.

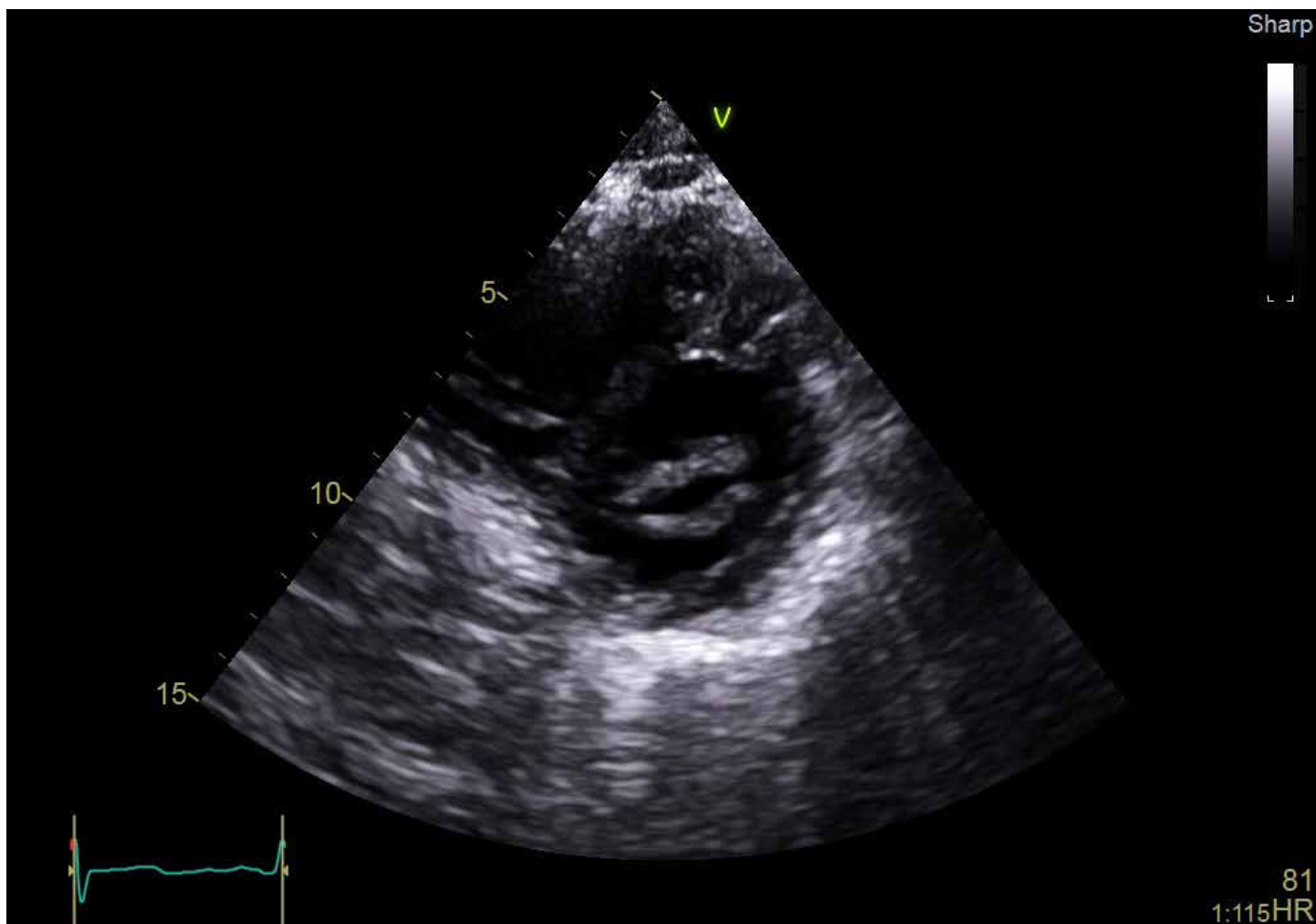
On the day of the surgery, the patient had a left radial arterial line was inserted. This was followed by a dural-puncture epidural which was slowly loaded in incremental fashion over 40 minutes with 2% Lidocaine. A second, perioperative echocardiographic fellowship trained, anesthesiologist performed a pre-procedure transthoracic echocardiogram (TTE) and was present the entire case doing live TTE imaging. A T4 level was ultimately achieved and the cesarean section was successfully performed. Of note, the patient's cardiac physiology, including mitral valve mean gradients and right ventricular systolic pressures did not significantly change during the case and no pharmacologic or physiologic interventions were necessitated. The patient spent the next 24 hours in the ICU as a precaution against postpartum fluid shifts and was discharged 2 days later. There are plans for a mitral valvuloplasty in the near future.

Discussion: Successful anesthetic management of a parturient with mitral stenosis requires meticulous pre-operative planning for multiple contingencies including complete cardiovascular collapse. This is best accomplished via utilization of a multi-disciplinary team approach to patient management and development of an anesthetic plan designed to minimize acute changes in preload, afterload, and intravascular volume.² Transthoracic echocardiography's acceptance and popularity within a capable anesthesiologist's practice is rising and is a terrific tool in the optimization and safety of parturient deliveries.

References:

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Abstract #: EF5-02



Abstract #: EF5-03

Consideration of Neuraxial Anesthesia in Caudal Regression Syndrome

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Case: A 20 year-old G1P0 at 27 weeks 4 days gestation presented in spontaneous preterm labor, dilated to 7 cm. She was known to have caudal regression syndrome (CRS). Previous MRI showed a blunted conus medullaris at T11-12, a stenotic lumbar canal tilted 24 degrees at L4-5, and sacral dysgenesis. She declined neuraxial anesthesia (NA) and underwent urgent cesarean delivery via general anesthesia for recurrent late decelerations. Delivery of her healthy, premature infant occurred 22 minutes after induction of anesthesia. Urology assistance during cesarean delivery (CD) to preserve her bladder turned out to be unsuccessful. Her anesthetic course was uneventful.

Discussion: CRS is a closed spinal dysraphism deformity which includes malformation of the vertebral arches, spinal cord, and meningeal layers (1). Spinal dysraphisms occur in 0.02%-1% of the population with the more severe caudal regression in 0.002%(1,2). CRS usually includes abnormalities of the embryologic caudal region including urogenital, lower limbs, spinal cord, and hindgut (3). Fertility is usually intact and literature describes successful vaginal and CD (1). However, patients with narrow hips and pelvic instability face difficulty in vaginal delivery (3). The possibility for CD requires anesthesiologists to provide accurate and personalized counseling about NA in the setting of the abnormal spinal anatomy.

Isolated spina bifida with normal spinal cord anatomy occurs in up to 50% of CRS patients. In 90% of those cases, the abnormality is confined to the sacrum. Motor impairment may occur, as may varying degrees of sensation loss. NA is not always contraindicated, although failure or complications are more likely. Appropriateness of neuraxial anesthesia depends on several variables including: severity of abnormal development, history, location of surgical repair, and the patient's risks with general anesthesia (GA) must also be balanced. GA is often chosen for CD because of its more predictable effects. The few successful neuraxial anesthetics occurred in non-laboring patients above the affected spinal level after the spinal deformity had been repaired (1).

Planning should begin before labor and should include anesthetic plans for emergent and elective delivery. Assessment of imaging is vital as neither physical exam or ultrasound reliably excludes low-lying spinal cord. If NA is performed, it should usually be done at typical anatomical locations. Catheter titration of neuraxial doses are safer than single doses. Supplementary nerve blocks should be available. Though our patient declined neuraxial anesthesia and urgency likewise precluded its attempt, we think this patient could have safely received NA for CD(1).

References:

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Abstract #: EF5-04

Peripartum Extracorporeal Cardiopulmonary Resuscitation: When Minutes Matter the Most

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Introduction: Peripartum cardiac complications account for more than 40% of maternal deaths in the United States, and mechanical circulatory support devices such as veno-arterial extracorporeal membrane oxygenation (VA-ECMO) have become increasingly utilized to improve maternal morbidity and mortality.¹ Though VA-ECMO is efficacious, its use in peripartum cardiac arrest is underreported. We present two cases of peripartum cardiac arrest where prompt extracorporeal cardiopulmonary resuscitation (ECPR) codes were activated, and VA-ECMO was initiated with favorable maternal outcomes.

Case Presentations: Case 1: A 28-year old G3P1 with a history of polysubstance abuse and gestational hypertension presented at 38w1d gestation with an asthma exacerbation. During repeat cesarean delivery under spinal anesthesia, she had sudden hemodynamic collapse. Cardiopulmonary resuscitation (CPR) was initiated, and an ECPR code activated. Return of spontaneous circulation (ROSC) was obtained after 8 minutes, however, she required supratherapeutic doses of inotropes and vasopressors. She was emergently cannulated for VA-ECMO and quickly weaned off all vasoactive medications. Transesophageal echocardiogram revealed a dilated and dysfunctional right ventricle. She was decannulated the following day with normal biventricular function. Though the etiology of her arrest was unclear, the differential diagnosis included amniotic fluid or pulmonary embolisms. She had a full recovery.

Case 2: An otherwise healthy 25-year old G2P1 at 36w2d gestation with a several week history of worsening shortness of breath presented after syncope. CTA revealed saddle and bilateral pulmonary artery embolisms with evidence of right heart strain. She was started on therapeutic enoxaparin and admitted to the coronary care unit (CCU), however, she went into labor overnight. After an uncomplicated vaginal delivery, she returned to the CCU for further monitoring. On postpartum day one, she sustained a cardiac arrest. An ECPR code was activated, and the patient was cannulated for VA-ECMO. ROSC was achieved after 10 minutes, and she subsequently had a suction embolectomy. She was decannulated four days later with a full recovery.

Discussion: Timely ECPR is a lifesaving modality. Our ECPR code team is multidisciplinary and includes critical care anesthesiologists, cardiac surgeons, and ECMO specialists. ECPR is available 24/7 within our hospital, which is imperative in the setting of cardiac arrest. Though we had two favorable outcomes, limited data suggests a mortality rate of 36% when ECMO is used in the setting of maternal cardiac arrest or critical illness but may be as low as 29% in the setting of circulatory arrest.² More research is needed to draw conclusions about ECPR in this population. However, it is clear that minutes matter, especially in the peripartum period.

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Abstract #: EF5-04

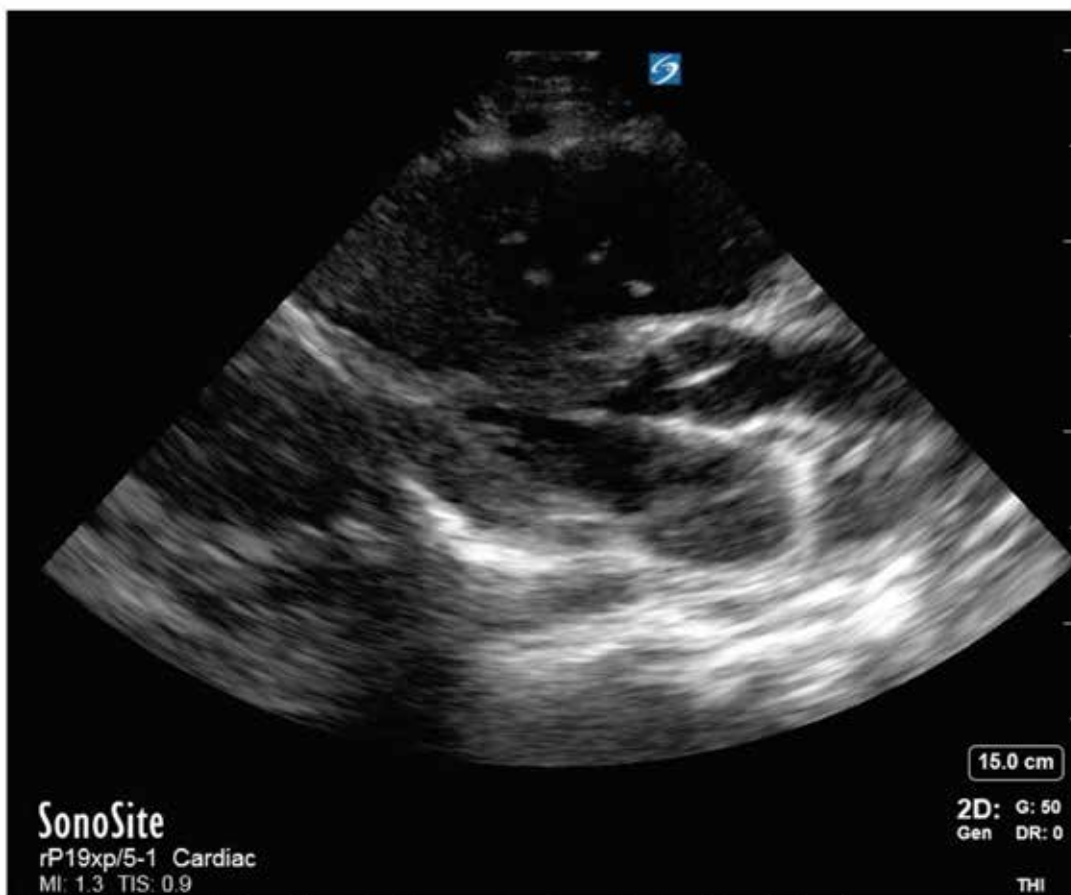


Figure 1. Peri-arrest transthoracic ultrasound captured during Case 1 showing a parasternal long-axis view with an enlarged right ventricle containing echogenic material and decompressed left ventricle.

Abstract #: EF5-05

Bleeding from the Epidural Catheter Site: An Intrapartum Presentation of Disseminated Intravascular Coagulation and Placental Abruption

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Background: The prevalence of placental abruption in North America is 7-12 per 1000 pregnancies.¹ Clinical criteria used to diagnose placental abruption include evidence of retroplacental clot(s), abruption diagnosed on prenatal ultrasound, or vaginal bleeding accompanied with nonreassuring fetal status or uterine hypertonicity.² One severe complication of placental abruption is acute disseminated intravascular coagulation (DIC) and the risk is higher with larger placental detachment and placental detachment resulting in fetal demise.³ We report a case of unanticipated and rapid-onset DIC in a laboring patient secondary to undiagnosed placental abruption.

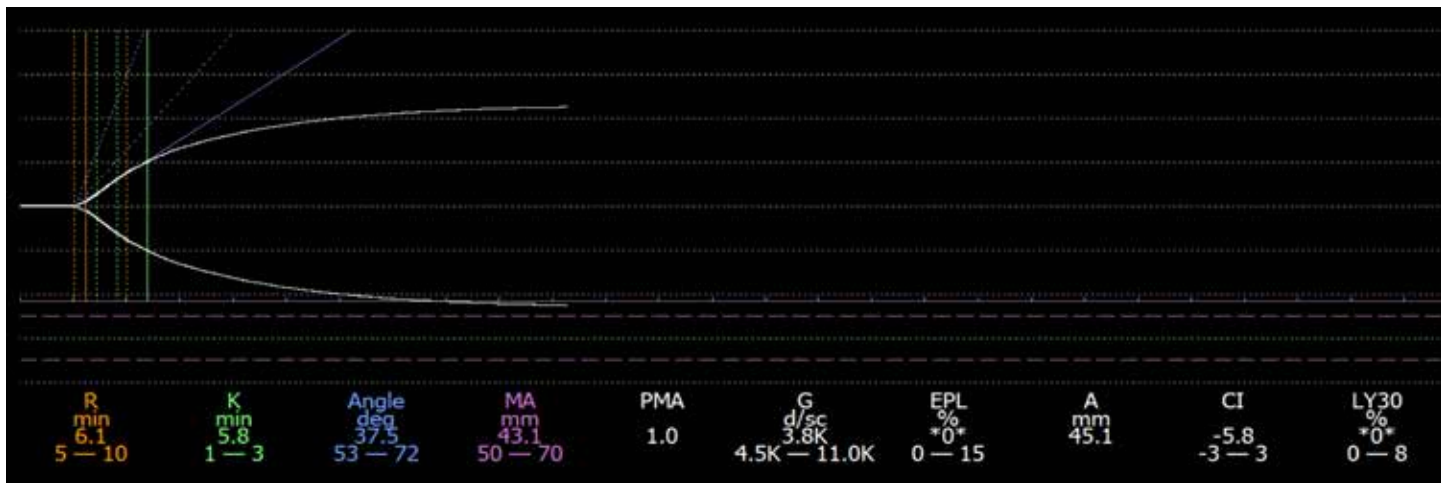
Case Description: A 40 year-old G5P1 patient underwent induction of labor for advanced maternal age and post-term dates (40 weeks 3 days gestational age) following an uncomplicated pregnancy. She underwent uncomplicated placement of a lumbar epidural catheter for labor analgesia. After 17 hours, nursing staff alerted the anesthesia team of bleeding from the epidural catheter insertion site. Following examination, a coagulation panel was sent. Soon after, the patient began the second stage of labor and experienced spontaneous epistaxis and further bleeding (50-100 mL) from the epidural catheter site. After delivery of a healthy male infant, significant postpartum hemorrhage was noted from a vaginal laceration, and uterine atony. Coagulation labs and a thromboelastogram returned indicating severe DIC (INR 4.7, fibrinogen < 30 mg/dL, platelet count 98 x10⁹/L, reduced α angle, low maximum amplitude). (Figure 1) She was transported to the operating room for better visualization and active resuscitation and management, where she received 4 unit packed red blood cells, 6 units fresh-frozen plasma, 2 packs of platelets, 4 grams of fibrinogen concentrate, and crystalloid solution for her 2,500 mL estimated blood loss. She was transferred to the ICU intubated but not requiring vasopressor support.

Discussion: DIC is an uncommon complication in the intrapartum period and more commonly occurs in the postpartum period. It can present with spontaneous bruising or active bleeding from any invasive site (e.g. wound sites, intravenous line sites, epidural catheter insertion sites, drain sites) and/or from any mucosal surface. Any abnormal bleeding encountered in a pregnant patient should be thoroughly evaluated with history and examination and indicated hematologic and coagulation analysis to identify the etiology. Multidisciplinary team involvement is critical to establish immediate treatment (and delivery planning if indicated), and to implement active resuscitation plus escalation of care.⁴

References:

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Abstract #: EF5-05



Abstract #: EF5-06

Acute Coronary Dissection in the Third Trimester: Successful Management with Urgent Cardiopulmonary Bypass.

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Cynthia Wong

Introduction: Surgery during pregnancy requiring cardiopulmonary bypass (CPB) increases the risk of fetal mortality by up to 20%. Several issues, including maternal and fetal factors and ethical considerations, should be addressed.

Case Report: A healthy 27-year-old G3P2 woman presented at 33 weeks' gestation with sudden onset chest pain. An EKG revealed STEMI and cardiac enzymes were elevated. Cardiac catheterization revealed an acute dissection of the left main coronary artery into the left anterior descending ramus, with an ejection fraction of 15%. An intra-aortic balloon pump was placed, and she underwent coronary artery bypass grafting emergently. The patient and fetus did well in the immediate perioperative period. An urgent cesarean delivery (CD) was performed with neuraxial anesthesia on post-operative day 6 for non-reassuring fetal status, with successful outcome.

Discussion: A multidisciplinary team including obstetric anesthesia, cardiothoracic surgery, maternal-fetal medicine, neonatal intensive care team, and perfusion, discussed management. Options included CD followed by CPB, CPB followed by CD, or CPB with delayed CD. Performing CPB during pregnancy may compromise the safety of the fetus^[1]; conversely, performing CPB after delivery may result in greater risk to the mother (e.g., postpartum hemorrhage due to systemic heparinization). Delivery prior to CPB can be considered if the fetus is advanced gestational age and planned surgery is anticipated to be complicated, prolonged, or requiring anticoagulation. Fetal circulation during CPB has not been well-investigated, but may result in lower placental flow and pressure, exacerbated by hypothermia, and resulting in impaired placental perfusion and gas exchange.^[2] Anesthetic considerations include the utilization of high-flow, high-pressure, normothermia, and a short CPB time which results in the best perfusion strategy to ensure adequate placental homeostasis.

Data suggest maternal mortality rates associated with CPB are similar to those of nonpregnant women (1.5%), unless the surgery is urgent. Studies indicate fetal demise is more likely with urgent, high-risk cardiac surgery, and if surgery was carried out at early gestational age.^[3] Fetal/neonatal mortality was 29, 3, and 0%, respectively, for women who had cardiac surgery with CPB during pregnancy, immediately after delivery, or delayed until after delivery.^[4] Ideally, the risks and benefits of immediate and delayed delivery are discussed with the mother and her family with the multidisciplinary team. This is difficult in an emergency setting and our team struggled with this decision, particularly because the mother was sedated for the cardiac catheterization procedure.

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3. Ann Thorac Surg 2011;91:1191
4. Geburtsh Frauenheilk 2014; 4:55

Abstract #: EF5-07

Neuraxial Anesthesia in a Parturient with Blue Rubber Bleb Nevus Syndrome

Presenting Author: Eveline Mordehai, MD

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Introduction: Blue Rubber Bleb Nevus Syndrome (BRBNS) is a rare disorder affecting approximately 200 people in the world (1). It is characterized by diffuse venous malformations that develop over time. Although most commonly associated with cutaneous and gastrointestinal (GI) lesions, there have been lesions found in almost all organ systems, including the spine. GI lesions commonly bleed spontaneously, causing anemia. There are limited reports regarding the safety of neuraxial techniques in patients with BRBNS (2, 3). Here, we report the management of a patient with BRBNS admitted for labor and delivery.

Case: A 31 year old G1P0 with BRBNS presented at 39 weeks gestation in spontaneous labor. She had three prior surgical resections of cutaneous and GI lesions attributed to her BRBNS. The patient had not required surgery for ten years but reported persistent iron deficiency anemia. Her pregnancy course had been uncomplicated. Her physical exam on admission was notable for one cutaneous lesion on her hip. No airway lesions were observed.

The patient denied any known history of spine lesions, and she reported no neurologic symptoms. No prior imaging of the spine was available. The patient was counseled to forego epidural placement given the risk of neuraxial venous malformations. The patient utilized nitrous oxide for labor analgesia. Due to a nonreassuring fetal condition, a cesarean delivery was required, and the patient had a full stomach. The risks of airway versus neuraxial complications were discussed, and after informed consent, the patient opted for spinal anesthesia. A single shot spinal was performed using a 25 gauge needle. The cesarean delivery and postoperative course were uneventful.

Discussion: Multifocal vascular anomalies can present unique challenges for obstetric anesthesiologists. Anesthetic considerations for patients with BRBNS include assessment for airway and neuraxial lesions that may lead to bleeding. Dilatation of the neuraxial venous circulation during pregnancy may increase the size of existing or evolving vascular malformations. Additionally, lesions on the uterus, cervix, and vagina can impact the mode of delivery or compound peripartum bleeding. Given these considerations, it is valuable for patients with BRBNS to receive OB anesthesia consultation prior to delivery so appropriate imaging can be obtained and an informed, multidisciplinary approach can be coordinated. The incidence of BRBNS-related venous malformations in the spine is unknown. In this case, the risks of airway complications in a non-fasted parturient were of equal concern as the theoretical risk of neuraxial hematoma from contact with a spinal vascular malformation. Patients with this condition may benefit from spine imaging prior to pregnancy and during pregnancy if any change in neurologic status occurs.

References:

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2. Galey et al. *AA Case Rep.* 2016
3. Ochiai et al. *Case Rep in Obstet Gynecol.* 2013

Abstract #: EF5-08

Massive Obstetric Hemorrhage from Placenta Percreta: Successful Use of a Management Algorithm

Presenting Author: Chih H. King, MD, PhD

Presenting Author's Institution: Brigham and Women's Hospital - Boston, Massachusetts

Co-Authors: Jean Marie Carabuena, MD - Brigham and Women's Hospital

Michaela Farber

Ken W. Lee, MD - Brigham and Women's Hospital

Background: Postpartum hemorrhage (PPH) is a significant source of maternal mortality in the United States, accounting for 11.2% of pregnancy-related deaths from 2011-2015¹. PPH deaths are often preventable², and morbidity and mortality result from delayed care due to lack of appropriate personnel, equipment, medication, blood products, or communication. To address and minimize such risk, an algorithm to ensure rapid and appropriate treatment of PPH is warranted, especially as a teaching tool for trainees in obstetric anesthesiology. Here we describe the integration of a management algorithm for patients having cesarean delivery (CD) with suspected placenta accreta spectrum (PAS) and major PPH.

Algorithm Development: With expert consensus and revision over time, an algorithm for the management of suspected PAS was created (Figure). The algorithm defines medications and necessary equipment to prepare, anesthesia considerations for each sequential stage of the case, utilization of technology including rotational thromboelastometry (ROTEM) and pleth variability index (PVI), and a formatted blood administration tracking sheet for use in the operating room.

Case: A 33-year-old G4P2 with placenta previa and suspected PAS presented for CD with anticipated hysterectomy. Given her significant PPH risk, a multidisciplinary delivery plan was made. Packed red blood cells (PRBCs) and fresh frozen plasma (FFP) were typed and crossmatched prior to surgery. She received three large-bore intravenous lines, then underwent dural puncture epidural anesthesia and arterial line placement. Ureteral stenting was performed to facilitate surgical resection, and cell salvage was arranged.

Placenta percreta was confirmed upon delivery, hysterectomy was required, and massive PPH occurred. The patient received 15 units of PRBCs, 10 units of FFP, 3 6-packs of platelets, 1 5+5 pack of cryoprecipitate, 2g of tranexamic acid, 3g of fibrinogen concentrate, and 1418 mL of salvaged blood, with a total quantitated blood loss of 4503mL plus an additional 5L of vaginal hemorrhage on the floor, for a total blood loss of approximately 10L. With careful resuscitation to optimize volume status, general anesthesia was avoided. Vasopressor and oxygen requirements were titrated down and eliminated by the end of the case, enabling standard postpartum care on the labor floor with a critical care 1:1 nurse. The patient recovered uneventfully and was discharged home on postpartum day 4.

Discussion: Tools to optimize and consolidate PPH management for complex PAS cases are warranted, particularly for obstetric anesthesiology trainees learning to care for high-risk patients. Our algorithm has proven instrumental for directing appropriate room and device preparation, team communication, volume status monitoring, and goal-directed transfusion using ROTEM.

References:

1. Petersen EE et al. MMWR Morb Mortal Wkly Rep 2019; 68(18): 423-9.
2. Berg C.J. et al. Obstet Gynecol 2005; 106(6): 1228-34.

Checklist for Patients with Suspected Placenta Accreta Spectrum

SETUP for the Operating Room

- **Medications immediately available in the room:**
 - Vasopressors (phenylephrine infusion, ephedrine syringe, epinephrine vial)
 - Uterotonics (oxytocin, methylergonovine, carboprost)
 - Tranexamic acid (1g in 100mL NS), RiaSTAP® (plus 50 mL sterile water)
 - 5% albumin in 250 mL bags
 - Cefotetan if hysterectomy is planned; otherwise cefazolin
 - Local anesthetics (0.75% bupivacaine and 2% lidocaine with epinephrine)
- **Appropriate equipment in the room:**
 - Single transducer for arterial line
 - Additional Baxter PIV pumps (including for propofol infusion in case of GA)
 - Belmont® rapid transducer primed; additional high flow tubing in warmer
 - Intubation Equipment (including VL, ETT 6.5 and 7.0, and LMA)
 - Left uterine displacement ramp
 - All monitors set up (Triton® QBL, BIS®, twitch monitor, ROTEM)

BEFORE Huddle/Transporting Patient Back to the OR

- Appropriate quantity of crossmatched blood available in the room in coolers
- At least 2 **large-bore** PIVs. Central access if inadequate PIV access
- Availability of personnel for planned tasks: perfusionist (cell salvage), urology (ureteral stenting), interventional radiology (arterial embolization), GYN oncology (complex surgery), and Trauma surgery (REBOA).
- Designate **point person** to contact blood bank in the event of PPH
- Designate **event manager** in the event of significant surgical variance
- Prepare ROTEM reagents, perform electronic QC, designate person to run ROTEM
- Verify timing of **last dose of anticoagulation** and baseline **coagulation status**

BEFORE Delivery

- Place arterial access if planned
- Scan blood products into Epic, indicate on each slip that blood had been scanned
- Hook Belmont® to largest available venous access
- Ensure Omnicell is open and available to draw medication from
- Notify perfusionist if not already present in the OR

IN THE EVENT OF HEMORRHAGE

- Announce OB surgical variance, notify and activate appropriate resources
- Monitor coagulation and hematologic status with ROTEM and additional labs
- Volume status assessment with PPV, PVI, base deficit, UOP, ScvO₂, TTE, QBL
- Re-dose antibiotics if QBL >1.5L
- De-escalate resources once major PPH has stopped
- Debrief with all OR personnel at conclusion of the case; discuss post-op disposition

February 2020

Abstract #: EF5-09

ROTEM-guided management of parturients with factor XI deficiency

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Michaela Farber

Background: Factor XI (FXI) deficiency is an inherited coagulation disorder associated with increased risk for postpartum hemorrhage (PPH) [1]. Severity of bleeding does not correlate with FXI level [2], and fresh frozen plasma (FFP) transfusion is not always indicated for patients with low FXI activity [3]. The optimal level of FXI necessary for safe neuraxial techniques or delivery is unknown. Rotational thromboelastometry (ROTEM) can provide rapid assessment of coagulation status [1]. We utilized ROTEM to manage two obstetric patients with FXI deficiency.

Cases: Case 1. A 29 yo G2P1 with a baseline FXI level of 33% presented for trial of labor after cesarean delivery (CD). Her prior CD was under epidural anesthesia with no PPH. For her prior CD she received FFP 10mL/kg prior to epidural placement, which was complicated by fever and rigors consistent with transfusion reaction. While the hematology recommendation for this delivery was again for prophylactic administration of 10mL/kg FFP, the patient requested avoiding FFP exposure. ROTEM Intem and activated partial thromboplastin time (aPTT) at 34 weeks were normal (Table). After multidisciplinary discussion, prophylactic FFP was withheld. Quantitative blood loss (QBL) was 728 mL from a vaginal laceration, with good hemostasis after repair and otherwise uneventful post-vaginal delivery course.

Case 2. A 36 yo G1P0 with a baseline FXI level of 9% presented for induction of labor. She did not have a history of prior surgical challenges or abnormal bleeding otherwise. Initial hematology recommendation was 10mL/kg of FFP on admission. Her admission aPTT was mildly prolonged and ROTEM Intem was normal (Table). After 5mL/kg of FFP was administered, her aPTT normalized (Table) and all her ROTEM values were within normal limit; therefore additional prophylactic FFP was avoided. The patient had a vaginal delivery under epidural analgesia with a QBL of 302 mL, with uneventful recovery.

Discussion: The challenge of FXI deficiency in pregnancy is that PPH risk is higher but FXI levels do not always correlate with PPH occurrence or severity [2, 4]. Therefore, prophylactic administration of FFP or TXA at the onset of labor based on FXI level should not be formulaic. Given the potential transfusion-associated complications from FFP, a theranostic approach with ROTEM testing to individualize bleeding risk and titrate therapy is warranted.

References:

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2. Peyvandi F et al. J Thromb Haemost 2012. **10** (4): 615-21
3. Salomon O et al. Blood Coagul Fibrinolysis 2005. **16** (1): 37-41
4. Santoro C et al. Haemophilia 2015. **21** (4): 496-501

TABLE

	ROTEM Intem Results						Standard coagulation test
	CT (sec)	CFT (sec)	α (degrees)	A10 (mm)	MCF (mm)	Max lysis (%)	aPTT (sec)
Normal range in pregnancy	109-225	40-103	70-82	55-72	63-78	0-15	23.8-36.6
Patient 1	185	58	78	64	69	7	28.4
Patient 2, pre FFP	223	78	74	63	70	6	38.7
Patient 2, post FFP 5mL/kg	220	54	79	66	73	7	34.6

ROTEM: rotational thromboelastometry; CT: clotting time; sec: seconds; CFT: clot formation time; α = alpha angle; A10: amplitude at 10 minutes; mm: millimeters; MCF: maximum clot firmness; max: maximum; aPTT: activated partial thromboplastin time; FFP: fresh frozen plasma. Orange shaded box indicates results out of normal range for pregnancy.

Abstract #: EF5-10

Early Cardioversion of New-Onset Atrial Fibrillation in a Parturient

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Presenting Author's Institution: Beth Israel Deaconess Medical Center

Co-Authors: Merry Colella, MD - Beth Israel Deaconess Medical Center

Background: New-onset atrial fibrillation during pregnancy in a patient without prior cardiac disease is rare, and the acute management is variable.

Case Report: A 41-year-old nulliparous female with gestational hypertension and no other cardiac history presented at 37 weeks for labor induction. At the start of induction, systolic blood pressures (SBPs) were >160, requiring IV and oral labetalol. She had an uneventful epidural placement. Hours later, she had palpitations with heart rates (HR) ranging from 100-160 bpm. SBP was stable at 140-150s. An electrocardiogram (EKG) confirmed atrial fibrillation. Epinephrine was removed from her epidural, and IV esmolol and metoprolol were given, yielding a HR of 100-120s. Electrolyte and thyroid tests were normal. Due to concern about maintaining rate-control during second-stage labor, cardiology was consulted for DC cardioversion (DCCV). Once in the operating room, where emergent surgical delivery equipment and staff were available, 90mg of propofol was given for sedation with maintenance of spontaneous respiration. A single 200J synchronized DCCV achieved normal sinus rhythm (NSR). The patient and fetus tolerated the procedure well. Post-DCCV, a transthoracic echo showed mild left ventricular hypertrophy, ejection fraction >65%, and trivial mitral regurgitation. The patient later had an uneventful vaginal delivery. She remained in NSR while admitted.

Discussion: Despite the arrhythmogenic increase in baseline HR, cardiac output, catecholamine levels, and adrenergic receptor sensitivity during pregnancy, the incidence of new-onset atrial fibrillation is low and often attributed to pre-existing conditions such as mitral stenosis, congenital heart disease, and hyperthyroidism.^{1,2} The acute management of rapid ventricular response in the laboring patient is not well outlined. Nodal blocking agents are first-line in stable patients, with the goal of rate control to promote spontaneous conversion to NSR.³ This approach might not be practical in the setting of increased sympathetic tone in labor. DCCV is effective in all pregnancy trimesters, prevents fetal exposure to rate/rhythm control agents, and maintains uterine blood flow.⁴ DCCV is low risk for causing fetal arrhythmia, as low energy reaches the fetus, and fetal hearts have a high fibrillation energy threshold.⁵ Despite this, there are reports of DCCV causing fetal distress requiring emergent cesarean delivery.⁶ DCCV is effective in the laboring patient, but this population requires strict monitoring, with the immediate ability for cesarean delivery. Coordination between anesthesia, cardiology, and obstetrics is essential for managing atrial fibrillation in the parturient.

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3. *Circulation: Arrhythmia and Electrophysiology* 2014; 961-967.
4. *Eur J Obstet Gynecol Reprod Biol* 2006; 126:268–269.
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6. *BJOG* 2002; 109:1406–1407.

Abstract #: EF5-11

Chronic Regional Pain Syndrome and Pregnancy- A Therapeutic Dilemma

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Complex regional pain syndrome (CRPS) is a chronic disorder of the central and peripheral nervous systems that is characterized by extended periods of excessive pain in specific regions of the body. Because each case varies in symptom severity and duration, no specific treatment regimen has been standardized (1).

Case: A 38 y.o. female with CRPS, presented at 38 weeks for cesarean section(C/S). The patient had been receiving different treatment modalities since age 16 following bilateral ankle fractures requiring multiple surgeries including several for stress fractures caused by bone loss from her CRPS. In addition to tricyclics, opioids, NSAIDs and naltrexone, her management has included peripheral nerve stimulators to the tibial and saphenous nerves, multiple spinal cord stimulator insertions, numerous sympathetic and bretylium bier blocks, pamidronate and ketamine infusions. The CRPS went into remission during pregnancy and she was off all analgesics. Her pain management physician was concerned about the labor and delivery process initiating a flare, and the patient was scheduled for C/S. There was concern that the patient would relapse following her C/S. Together with her obstetrician and pain management team we created a therapeutic approach to prevent this. A CSE was administered with hyperbaric bupivacaine(12mg), morphine 0.15 mg and fentanyl 10 mcg, supplemented by local anesthetic infiltration of the skin. An epidural infusion of Bupi 0.1% with fentanyl 2mcg/ml was maintained for 24 hours. A ketamine infusion (300mg over 4 hr.) was initiated immediately post-operatively. Ketorolac (30 mg iv) and acetaminophen (1000 mg p.o.) were administered around the clock for 24 hr. The patient did well, did not require post-op opioids and her CRPS remained in remission 1 month post-discharge.

Discussion: There is not extensive literature on CRPS and pregnancy. Pregnancy has been associated with onset of CRPS but it is not known if it will worsen preexisting disease(1). Our patient appears to have gone into remission with her pregnancy perhaps due to various hormonal changes. Many of the medications used CRPS in treatment are category C. Several medications our patient had been on including amitriptyline and celecoxib may harm the fetus. Spinal cord stimulation is considered safe with no adverse fetal effects. The pulse generator should be placed gluteally as abdominal placement and subsequent stretching can cause lead breakage. Either cesarean or vaginal delivery may be chosen as per the obstetrician and patient. Neuraxial anesthesia with morphine for post op pain may be supplemented with local infiltration, TAP or quadratus lumborum blocks. Ketamine infusions have been used and may be anti-hyperalgesic via NMDA antagonist activity(2).

Conclusion: A multidisciplinary, team approach involving OB, anesthesia and pain management should be used to optimize pain management in the peripartum period.

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2. Pain Med 2008 vol 9:8,1173

Abstract #: EF5-12

When Low Platelets in Pregnancy isn't HELLP; A Case Report of Complement Mediated Thrombotic Microangiopathy

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Co-Authors: Lacey Straube, MD - UNC Hospitals

Introduction: Complement mediated thrombotic microangiopathy (C-TMA, formerly known as atypical HUS) is a rare condition in pregnancy (rate 1:25000)¹ and difficult to diagnose postpartum due to laboratory similarities to thrombocytopenic purpura (TTP), pre-eclampsia, disseminated intravascular coagulation (DIC), and hemolysis, elevated liver enzymes, low platelet (HELLP) syndrome. Many providers correctly acknowledge HELLP as the most common cause of post-partum thrombocytopenia (3-5% of all pregnancies) but fail to quickly diagnose other causes, potentially delaying treatment. The purpose of this case report is to review clinical presentation and laboratory findings of a patient with C-TMA and to distinguish how these differ from other conditions causing thrombocytopenia.

Case: A 37 y.o. G2P1001 at 34w2d with dichorionic-diamniotic twins who presented to an outside hospital for preterm premature rupture of membranes. Platelets at admission were 34,000 X 10⁹/L so a general anesthetic for cesarean delivery was planned. Blood pressure was 140/87 mm/Hg. Cesarean section was uneventful. One unit of platelets was administered intraoperatively and estimated blood loss was 493 mL. Post-operatively, the patient was noted to have systolic blood pressures of 170 mmHg and was oliguric. Magnesium was initiated, and she was transferred to our tertiary care center due to concern for HELLP vs TTP vs C-TMA. Labs showed platelets of 22,000 X 10⁹/L and rising AST/ALT/creatinine. Hematology was consulted and the patient was admitted to the ICU. Platelets continued to fall, liver enzymes worsened, a hemolytic anemia was identified, and creatinine rose to greater than 10 mg/dL. On postoperative day (POD) 1, the ADAMTS13 level returned at 59%, ruling out TTP. The leading diagnosis on POD 2 was C-TMA after low C3 and C4 levels were identified. Hematology recommended eculizumab given multi-organ failure. Labs slowly improved. She required dialysis on POD 6-12. She was discharged on POD 13.

Discussion: Determining the cause of thrombocytopenia in pregnancy can be challenging. Thrombocytopenia with renal dysfunction and low complement values suggest C-TMA, while thrombocytopenia and low ADAMTS13 levels suggest TTP. This case was especially difficult due to elevated liver enzymes, an unusual finding in patients with C-TMA. This patient is at risk for developing C-TMA with future pregnancies¹. Treatment with eculizumab, a C5 membrane attack complex inhibitor, appears to be safe in breastfeeding and for future pregnancies¹. Duration of treatment has not been well defined.

Conclusion: Complement mediated thrombotic microangiopathy can present similarly to other causes of thrombocytopenia in pregnancy. Thrombocytopenia with renal dysfunction and low complement values warrants early hematology consultation and consideration of eculizumab.

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Abstract #: F-01

Acute lymphoblastic leukemia and refractory thrombocytopenia in pregnancy: a multidisciplinary approach

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Leukemia affects approximately 1 in 10,000 pregnancies.¹ This rare condition poses several challenges to pregnant patients and requires a multidisciplinary care team. The timing of the initial diagnosis in relation to gestational age (GA) can limit chemotherapy options and delay definitive treatment. These patients must be carefully monitored due to the increased metabolic demands of the combination of leukemia and pregnancy. They also have hematologic derangements resulting from the malignancy or the associated treatment options. The delivery often occurs in a setting of anemia and coagulopathy. We report a 19-year-old female at 22 weeks GA who was diagnosed with acute lymphoblastic leukemia (ALL), when she presented with fatigue, daily headache, epistaxis, vomiting, hematuria, low back and abdominal pain. She had a past medical history of insulin-dependent diabetes mellitus type 2. Her initial workup showed pancytopenia with the following results: white blood cell count $3 \times 10^9/L$, hemoglobin 9 g/dL, hematocrit 28%, platelet count $11 \times 10^9/L$. Bone marrow biopsy demonstrated Philadelphia chromosome-like B-cell ALL and she was treated with modified CALGB 10403 (vincristine, daunorubicin, prednisone, and no pegaspargase)³. A modified second course was partially completed at 27 weeks GA (dexamethasone, rituximab, cytarabine, cyclophosphamide). Her hospital stay was notably complicated by refractory thrombocytopenia ranging from < 5 to $48 \times 10^9/L$ that defied attempts at optimization for delivery. Specifically, the patient had a poor response to platelet transfusion alone, IVIG and HLA – matched platelet transfusion, steroids, and romiplostim. She delivered vaginally with a frank breech presentation at 30 weeks. She was pretreated with both HLA-nonmatched then HLA-matched platelets, tranexamic acid, and platelet infusion during delivery. Delivery was performed without complication and minimal bleeding. Her pain was controlled with a hydromorphone infusion and remifentanyl patient-controlled-analgesia (PCA). Her baby was transferred to the neonatal intensive care unit (NICU) due to known prematurity, Dandy-Walker malformation, and meningocele. The patient subsequently received additional chemotherapy followed by an allogeneic bone marrow transplant from her sister. This case highlights the importance of a multidisciplinary team in overcoming the challenges presented by the obstetric patient with complicated co-morbidities.

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Abstract #: F-02

Accuracy of Visual Estimates of Postpartum Blood Loss Using Clinical Reconstructions

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Introduction: Postpartum hemorrhage (PPH) is a leading cause of maternal morbidity and mortality (1), and accurate blood loss assessment is critical. The aim of this study was to determine differences in actual and estimated blood loss (EBL) over a range of blood volumes and blood distributions (primary outcome) as well as the influence of hemodynamics, providers (specialty and experience) and delivery type (vaginal (VD) and cesarean delivery (CD)) on EBL inaccuracies.

Methods: This IRB-exempt study questioned providers at a tertiary-care academic center. We reconstructed 18 blood loss scenarios (n=9 VD and n=9 CD). Large-format photographs were taken of each scenario and presented to obstetric care providers (anesthesiologists, obstetricians, nurses) in random order, and participants were asked to assess (without time pressure) the EBL volume depicted in each photograph. Vital sign data (normal (HR 80 bpm, BP 110/70 mmHg), tachycardia and normotension (HR 110, BP 110/70) and tachycardia and hypotension (HR 110, BP 80/50)) were annotated on a select set of VD and CD photographs (Table 1). The clinical scenario involved a healthy 30-year old, G1P0 at 40 weeks gestation who had undergone a VD or CD, with no risk factors for PPH.

Results: 56 healthcare providers have participated in the study. The EBL overestimated by a mean \pm SD difference of 696 ± 411 mL ($p < 0.001$) to actual blood loss. The mean \pm SD EBL vs. actual blood loss difference for 500 mL, 1000 mL and 2000 mL volumes were $+1225 \pm 262$ mL ($p < 0.001$), $+1699 \pm 354$ mL ($p < 0.001$) and $+2664 \pm 679$ mL ($p < 0.001$), respectively, with no differences in overestimation with increasing blood loss volumes (Table 1; $p = 0.561$). Overestimations by group were: anesthesiologists 100%, obstetricians 100%, and nurses 97% ($p = 1.000$). The EBL vs. actual difference was $+1049 \pm 605$ mL and $+342 \pm 333$ mL in the VD and CD scenarios, respectively ($p < 0.001$). The distribution of blood loss volume (25/50/75% in the collection drape vs. 75/50/25% in swabs) did not influence overestimations (Table 1; $p = 0.096$). Provider role and experience level also did not impact EBL overestimations. Annotated hemodynamics did not influence difference in EBL vs. actual blood loss volume unless both tachycardia and hypotension were present (EBL overestimates: $+159 \pm 465$ mL in VD ($p = 0.013$), and $+126 \pm 425$ mL in CD ($p = 0.03$)).

Discussion: Almost all providers significantly overestimated blood loss volumes (by nearly 700 mL), with overestimates even greater in VD scenarios. Surprisingly, EBL was not influenced by blood loss volume, blood loss volume distribution or providers. Hemodynamics only influenced estimations if hypotension was introduced, although tachycardia is known to be an earlier predictor of vital sign changes. This study confirms how poor EBL estimates are, and fails to identify modifiable influencing factors suggesting that objective measures of actual blood loss volume are needed.

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Abstract #: F-02
Table 1. Total blood volume and distribution ratios for vaginal delivery (VD) and cesarean delivery (CD) scenarios

Actual Total Blood Loss Scenario	Blood Distributions	Visually Estimated Blood Loss	
		Vaginal delivery	Cesarean delivery
500 mL	25% in collection drape, 75% in swabs	1339 ± 422	951 ± 268
	50% in collection drape, 50% in swabs	1494 ± 391	1014 ± 431
	75% in collection drape, 25% in swabs	1495 ± 311	1055 ± 219
1000 mL	25% in collection drape, 75% in swabs	1986 ± 668	1263 ± 397
	50% in collection drape, 50% in swabs*	1966 ± 553	1396 ± 355
	75% in collection drape, 25% in swabs	2130 ± 459	1449 ± 264
2000 mL	25% in collection drape, 75% in swabs	3278 ± 1485	1994 ± 639
	50% in collection drape, 50% in swabs*	3253 ± 1091	2173 ± 571
	75% in collection drape, 25% in swabs	3002 ± 857	2334 ± 378

Expired packed red blood cell units were diluted with fresh frozen plasma to obtain a physiological hematocrit of 30%. 650 mL of FFP was added to each scenario to represent average amniotic fluid volume.

A total of 18 (n=9 VD and n=9 CD) blood loss scenarios photographs were evaluated.

*Subset of scenario photographs with (n=3 VD and n=3 CD) and without (n=3 VD and n=3 CD) annotated hemodynamic vital signs.

No differences with overestimation with increasing (500, 1000 and 2000 ml) blood loss scenarios ($p=0.561$) or with different blood distribution ratios ($p=0.096$).

Abstract #: F-03

Anesthetic Management of Thoracopagus Conjoined Twin Cesarean Delivery: A Case Report

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Conjoined twins are rare with an estimated prevalence of 1:100,000 births (1). Thoracopagus conjoined twins – joined from the thorax to the upper abdomen – represent 19% of cases (1). There are few reports on the anesthetic management for the Cesarean delivery of conjoined twins.

Case: 33 y/o G3P2 with thoracopagus conjoined twins presented at 33w6d for intrauterine fetal demise found on routine ultrasound. She was admitted to L&D pre-op with the plan to deliver via primary Cesarean delivery.

Bilateral 18 gauge peripheral IVs and a radial arterial line were placed in pre-op. After transferring to the OR, a combined spinal-epidural (CSE) was performed with the intrathecal dose consisting of 1.6 mL 0.75% bupivacaine, 150 mcg morphine, and 20 mcg fentanyl. A prophylactic phenylephrine infusion was used to maintain baseline blood pressure post-spinal. The obstetricians made a large vertical midline skin incision followed by a large vertical uterine incision from the upper to lower uterine segments. The conjoined fetuses were delivered weighing 5920 grams (13 lbs). Moderate blood loss was noted from both uterine atony and the uterine incision. The mother became hypotensive but responded well to volume resuscitation. Uterine atony improved with intravenous oxytocin and intramuscular carboprost. 1,000 mg tranexamic acid was also given. 94 minutes after the initial spinal dose, the mother reported 7/10 abdominal pain which resolved with 200 mg epidural lidocaine and 10 mg intravenous ketamine. Estimated blood loss was 3,200 mL. Total operative time was 118 minutes. She received a total of 3L crystalloid, 500 mL albumin, and 1 unit packed red blood cells. Postoperatively, the epidural catheter was kept in place and a continuous bupivacaine infusion was used for pain control. On POD1, the epidural catheter was removed and satisfactory analgesia was achieved with scheduled acetaminophen and ibuprofen with PRN oxycodone. Hemoglobin on POD1 was 8.8 g/dL down from 12.0 prior to surgery. She was discharged to home on POD4 meeting all postpartum goals.

Discussion: Cesarean delivery for conjoined twins presents a number of challenges to the obstetric anesthesiologist. We performed a CSE for both the ability to re-dose neuraxial anesthetics in anticipation of a prolonged operative time as well as for postoperative pain control given the large classical skin incision. Blood loss was expected to be greater than usual due to atony of the large uterus and the large uterine incision. We were prepared for massive transfusion with large bore IVs, blood products in the room, and the ability to convert to general anesthesia and place a large bore central line if necessary. The provider should also be prepared for the psychosocial aspects of conjoined twin delivery, as prognosis is typically poor: 50% are stillborn and only 35% survive the first 24 hours (2).

References:

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Abstract #: F-03



Abstract #: F-04**Placental Abruption In A Parturient With Fontan Physiology: A Case Report**

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A 39-year-old G4P3 at 23 weeks' gestation was admitted for premature rupture of membranes. Her medical history was significant for hypoplastic right ventricle status-post Fontan. She was followed closely by a cardiologist and was asymptomatic. On day nine, she suddenly experienced abdominal pain, vaginal bleeding, and a category 2 fetal heart rate tracing. Her contractions could not be captured. The patient was taken for an emergency cesarean section(CS) for suspected placental abruption.

After placement in the supine position with left uterine displacement, a pre-induction arterial line was inserted. General anesthesia(GA) was induced with ketamine, succinylcholine and rapid sequence intubation. Her operative course was complicated by non-sustained episodes of supraventricular tachycardia(SVT) and a brief norepinephrine infusion requirement. Intra-operative TEE demonstrated normal Fontan function. Post-operatively the patient was transferred to the cardiac ICU, extubated, off of vasopressors and in normal sinus rhythm(NSR).

Fontan physiology is that of a single ventricle with a total cavopulmonary connection, which is dependent on adequate preload and low-to-normal afterload to maintain cardiac output(CO).^[i] Importantly, pulmonary vascular resistance (PVR) influences the amount of blood the functioning ventricle receives. Modern Fontan structures are accompanied by a fenestration, connecting the circuit to the right atrium and creating a right-to-left shunt resulting in a small degree of systemic desaturation. Increasing PVR increases the shunt fraction and degree of desaturation.^[ii]

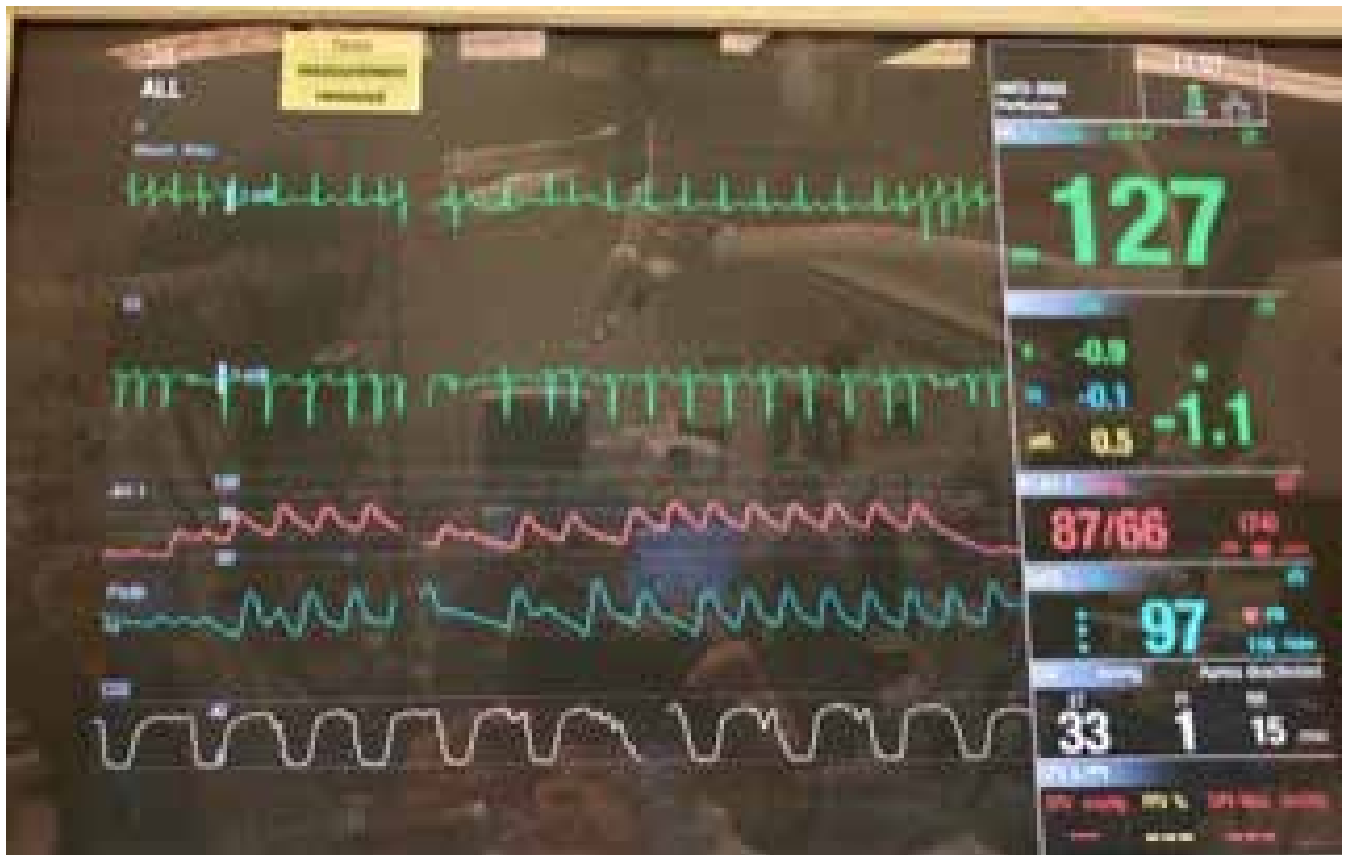
GA was preferred over single shot spinal in this patient as the associated abrupt decrease in preload is a relative contraindication. However, slowly titrated spinal or epidural catheters can be safely administered in these patients in non-emergent settings.ⁱⁱ When undergoing GA, the main concern is balancing pulmonary and systemic blood flow via preservation of ventricular function and avoiding increasing PVR via adequate oxygenation and normocapnia. In our patient, norepinephrine was used during induction and maintenance, relying on its alpha agonism to preserve preload and beta agonism to support cardiac contractility. While dysrhythmias can be seen in up to 26% of parturients with Fontan physiology, maintenance of NSR to promote CO is essential.ⁱ Our patient's episodes of SVT were self-limited or responded to beta-blockade.

Adult patients with repaired congenital lesions are becoming commonplace as medical advances have improved mortality. As such, an anesthesiologist will almost inevitably care for these patients and should be well-versed in their physiology to provide safe care.

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Abstract #: F-04



Abstract #: F-05

Anesthetic Management of Labor and Delivery in Paraplegic Parturient With History of C4-C5 Spinal Cord Injury and Autonomic Dysreflexia

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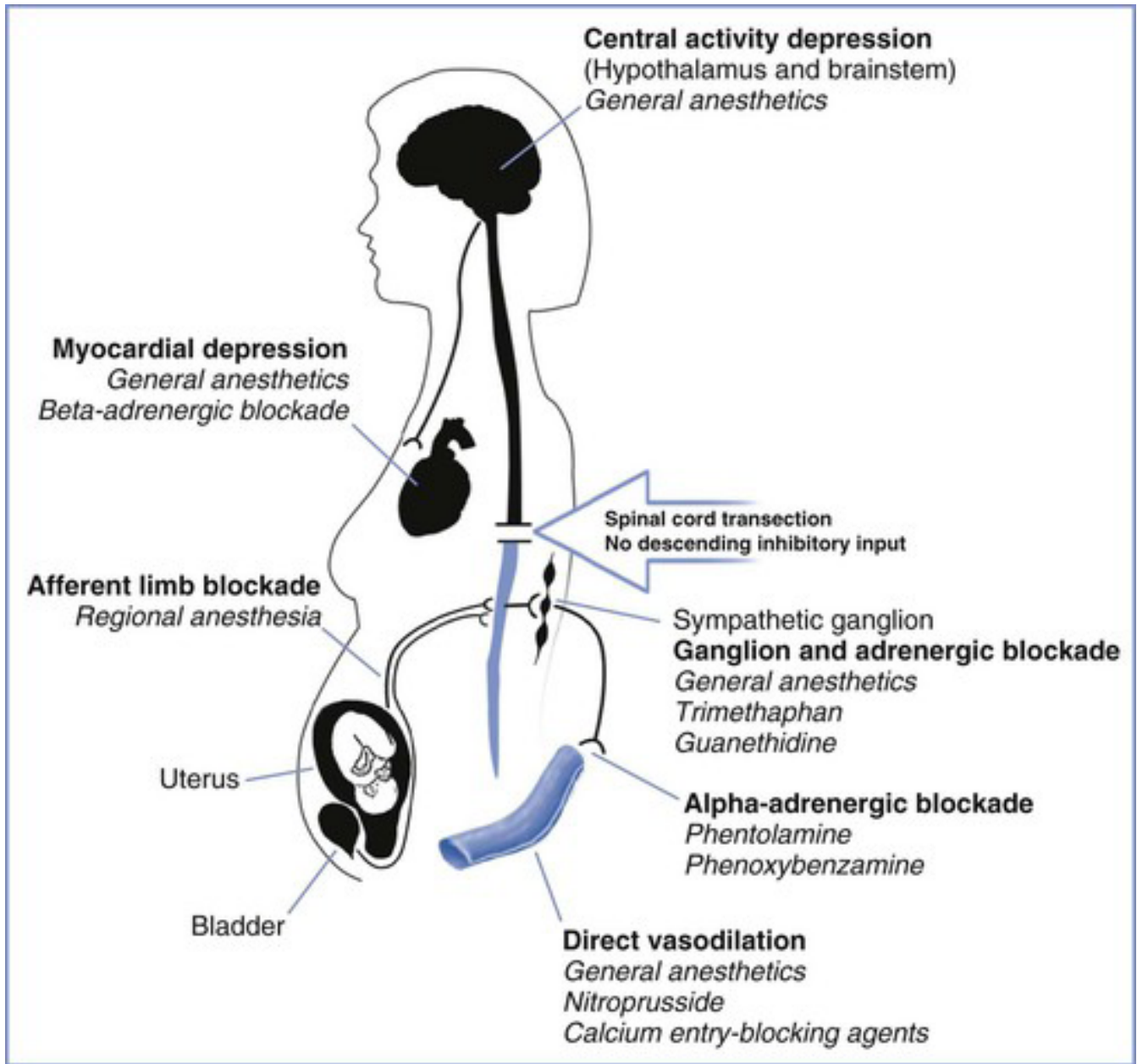
27-year-old G3P0 at 32 weeks gestation with a history of motor vehicle accident resulting in C4-C5 spinal cord injury with subsequent paraplegia, neurogenic bladder, and autonomic dysreflexia presented for management of preterm labor and delivery. Despite initial plan for vacuum delivery versus cesarean section, spontaneous vaginal delivery was achieved five hours after epidural and arterial line placement. The epidural remained in place for 24 hours for prevention of autonomic dysreflexia caused by continued postpartum contractions. Neurology was consulted two days postpartum for syncopal episodes associated with diffuse sweating and piloerection, which were determined to be due to orthostasis and resolved with a fluid bolus.

Autonomic dysreflexia (AD) is defined as propagation of afferent sympathetic stimulation within the spinal cord and lack of central inhibition that occurs in response to noxious stimuli and results in extreme sympathetic hyperactivity and severe systemic hypertension.¹ AD is seen with lesions at or above the level of T6 and manifests as flushing, sweating, and piloerection above the level of injury due to vasodilation and pallor below the level due to vasoconstriction. More serious manifestations include myocardial infarction, seizure, pulmonary edema, and cerebral hemorrhage.²

The most effective approach to management of AD is prevention, therefore adequate anesthesia is vital, despite lack of sensation.³ Neuraxial anesthesia is the preferred method of prevention and treatment of AD during labor and delivery.¹ When AD does occur, identify the trigger and treat promptly to minimize afferent stimulation to the spinal cord. Recommended pharmacologic treatment includes nifedipine, nitrates, and captopril. Other agents mentioned in the literature include hydralazine, magnesium, and beta-blockers, but current evidence is insufficient to warrant recommendation.² Intractable AD unresponsive to anesthetic manipulation is an indication for cesarean section. If general anesthesia is required, succinylcholine should not be given during denervation period, and nondepolarizing neuromuscular blockers should be used instead.¹

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Abstract #: F-06

Ultrasound guided Epidural Anesthesia for a Parturient with Patellar Fracture and Complex Neurologic History

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Introduction: Performing neuraxial anesthesia (NA) in a pregnant patient with preexisting neurologic deficits is controversial. Concerns regarding safety and efficacy of neuraxial techniques in patients with multiple sclerosis (MS) and spinal cord pathology exist, including risks of further neurologic injury, difficult placement and failed blocks¹. The risks of general anesthesia (GA) in a term parturient are also well described², further complicating anesthetic planning. We present management of a parturient with a history of MS, abnormal spinal anatomy, and baseline neurologic deficits presenting for urgent patellar open reduction internal fixation.

Case: A 34 year-old G2P1 at 37 weeks gestational age presented for surgical management of a fractured right patella. She was newly diagnosed with MS during the first trimester of pregnancy due to transient ataxia and vision loss. A conus astrocytoma was resected in childhood via a thoracic to L2 laminectomy, resulting in matted nerve roots in the cauda equina and chronic lower extremity sensorimotor deficits. She reported inadequate lumbar and thoracic analgesia during a previous lumbar labor epidural; review of the labor anesthetic record documented surface anatomy-guided placement of an L4/5 epidural.

We proceeded with epidural anesthesia with ultrasound guidance. Using a low frequency (2-5 MHz) curvilinear probe, the L4/5 interspace was identified. A 17-gauge Tuohy needle accessed the epidural space via loss-of-resistance and a 19-g epidural catheter was threaded uneventfully. Surgical anesthesia was achieved with 20cc of lidocaine 2% with 1:200k epinephrine. The surgery was well tolerated without intraoperative sedation.

The patient was discharged home from the PACU and reported return of baseline neurologic function at 48 hour phone follow up.

Discussion: History of abnormal neuraxial anatomy, previous failed NA, and MS posed unique challenges to this patient's intraoperative management. However, given the risks of GA and the patient's strong desire to remain awake for the procedure, we were motivated to provide regional anesthesia.

We opted to avoid spinal anesthesia due to her baseline neurologic deficits, matted nerve roots, and controversy over spinal anesthesia in MS¹. Given history of epidural failure, likely in the setting of post- surgical epidural scarring or misidentification of the L4/5 interspace, and to reduce the risk of direct needle trauma or intraneural injection, ultrasound guidance enabled identification of L4/5, below the level of known surgical scarring and matted nerve roots. Although under-utilized in NA, ultrasound guidance has been shown to confer better analgesia³, and might explain success of our epidural anesthetic when compared to her previous lumbar epidural.

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Abstract #: F-07

Coronary microvascular disease leading to angina in pregnancy– a rare condition and the need for multidisciplinary planning

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Introduction: Coronary microvascular disease (CMD) is a leading cause of anginal chest pain in women with “clean” coronary arteries, and is associated with adverse cardiovascular outcomes including myocardial ischemia and cardiac death.¹ It occurs more commonly in post-menopausal women, and there is little data on disease manifestations and implications in pregnancy. We present the pregnancy course of a parturient with a presumed diagnosis of CMD, and discuss the benefits of the multidisciplinary approach our institution takes through a monthly conference to discuss management of cardiac patients.

Case: A 31 year-old G1P0 patient was referred to high-risk maternal clinic for a history of ischemic-type chest pain. Prior medical history was noncontributory. Anginal chest pain was first experienced while running a marathon in 2016. Episodes have occurred during and after exertion since then resulting in several ER visits and subspecialty consultations. She underwent extensive workups of cardiac and non- cardiac causes of chest pain. She never had a troponin leak, but Holter monitoring and stress testing revealed ST segment changes at increased heart rates. Cardiac catheterization revealed tortuous but clean coronary arteries. Trials of pharmacologic agents included calcium channel and beta blockers, which did not relieve her symptoms and were discontinued in anticipation of pregnancy. She was placed on aspirin 81mg.

Anginal symptoms improved during pregnancy following recommendations to limit physical exertion and tachycardia. After multidisciplinary discussions with MFM, Anesthesiology and Cardiology, peripartum recommendations included early epidural placement, intrapartum and postpartum telemetry, and heart rate control.

She was induced for gestational hypertension at 40 weeks gestational age. She underwent a combined spinal-epidural technique at 7cm dilation, which was well tolerated. She labored with telemetry to monitor for tachycardia and ischemia. She delivered a healthy neonate via normal spontaneous vaginal delivery without intrapartum chest pain.

She had one episode of self-limiting angina on postpartum day 1, with EKG and telemetry revealing no changes from baseline. The remainder of the postpartum course was unremarkable.

Discussion: Little is known regarding outcomes of pregnancies affected by CMD. Theories regarding the role of low estrogen states in the pathophysiology of disease suggest possible improvement during pregnancy but risk of deterioration following delivery.² Therapeutic aims included limiting pain-induced tachycardia, and monitoring for ischemia with telemetry. Our monthly MFM, Anesthesiology, and Cardiology multidisciplinary conference gave us an opportunity to discuss the intricacies of the diagnosis, latest data, and formulate management plans.

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Abstract #: F-08**To scan or not to scan. Should neuroimaging be part of routine workup for postdural puncture headache evaluation?****Presenting Author:** Alberto Bursian**Presenting Author's Institution:** University of Florida**Co-Authors:** M. Anthony Cometa - University of Florida

CASE: A 32 year old G2P1001 w/ no significant PMH presented for induction of labor. An epidural for labor analgesia was requested but unfortunately an accidental dural puncture (ADP) occurred. The decision was made to thread the epidural catheter intrathecally and labor analgesia proceeded via continuous spinal. Expectant management continued; however, she required cesarean delivery due to fetal intolerance to labor. The patient had an uneventful postoperative course until post-operative day (POD) #2 when she developed worsening postural headaches. Given an ADP, her headache symptoms were thought to be due to post dural puncture headache (PDPH). An epidural blood patch was offered, but the patient elected for conservative measures for PDPH management. On POD #5, the patient returned for intolerable postural headache. A brief neuro exam was performed that was otherwise unremarkable; an uneventful EBP was performed and she was discharged with complete relief of her symptoms. On POD #6, follow up after EBP revealed continued headache relief, but on POD #7, the patient was admitted due to a seizure event and was found to have a superficial venous thrombosis. She was admitted to Neuro ICU for care and started on anticoagulation and antiepileptics.

DISCUSSION: Intracerebral venous thrombosis (ICVT) has an incidence of 10-20 per 100,000 deliveries in developed countries (1). It most commonly occurs in the postpartum period. Headache is the most common presenting symptom of ICVT and can mimic symptoms of subarachnoid hemorrhage, migraines, tension headaches, and PDPH. The literature suggests that a low CSF pressure, which may occur after ADP, may predispose a patient to ICVT (2, 3, 4); however, epidural blood patch is also known to be protective against the development of ICVT (5). Nonetheless, diagnosing ICVT presents a difficult dilemma to the physician and the decision to perform diagnostic brain imaging is a challenge.

Our patient had an ADP that had an initial excellent response to EBP. Additionally, the patient did not have a history of deep venous thrombosis or any coagulopathies but it was later discovered that she had a half-brother die due to thrombosis.

CONCLUSION: ICVT needs to be including in the differential for postpartum headache. Before placement of epidural blood patch, consider neuroimaging in patients who have additional risk factors for ICVT, when headache character changes, or neurological exam suggests more severe intracranial pathology (5).

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Abstract #: F-09**Transverse Myelitis During Labor and Delivery: Balancing Risks**

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Case: A 40 year-old G1P0 woman with PMH of idiopathic transverse myelitis (TM) and hepatic angiomas was admitted for induction at 33w6d due to pre-eclampsia and elevated LFTs suspicious for acute fatty liver. She presented with residual left lower extremity weakness after an acute TM episode 5 years ago with C7-T2 lesions. She had no prior history of autonomic dysreflexia (AD), usually seen in spinal lesions above T6. Epidural labor analgesia was offered as the theoretical risk of neurotoxicity was low. The patient concerns for a potential TM exacerbation led her to opt for a remifentanil PCA. Her pain was adequately controlled with remifentanil boluses of 10mcg q1min PRN. No dose increases were needed, and there were no signs of AD. She delivered after 2.5 hours of labor with no maternal or neonatal complications.

Discussion: TM is a rare, episodic, inflammatory, demyelinating disorder with an estimated 1400 new cases in the United States each year (1). Its etiology is poorly understood but has commonalities with multiple sclerosis (MS) due to their neuroinflammatory nature and similar presentation. Acute TM can be considered the first episode or sign of future MS in some patients (2). Evidence is minimal regarding optimal labor analgesia in patients with preexisting TM, but given its similarity to MS, spinal anesthesia is avoided to prevent potential exacerbation (3). Theoretical risk of exacerbation from epidural anesthesia was weighed against risk of AD as well as potential TM exacerbation from poor analgesia (4). AD was of lower concern in this patient due to no prior history of AD and an incomplete spinal lesion. Ultimately, choice of remifentanil PCA over epidural analgesia reflected clinical judgement and patient preference regarding the potential risks. Institutional protocol for remifentanil PCA includes dose titration and frequent assessments by an anesthesia provider, continuous presence by an RN and continuous pulse oximetry with supplemental oxygen for SpO₂ < 93%.

Remifentanil PCA is a viable alternative to neuraxial anesthesia when there is a contraindication, including the relative contraindication with TM. It may not reliably prevent or treat AD, however. The risk of AD in TM can be difficult to assess. Labor analgesia requires balancing patient concerns against risks, including more or less likely risks. Remifentanil PCA use should be protocolized and requires continuous monitoring and dose titration by anesthesiology providers.

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Abstract #: F-10

Subdural Hematoma after Accidental Dural Puncture During Epidural Labor Analgesia

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Presenting Author's Institution: University of Florida- Jacksonville

Co-Authors: John Cabral - Univeristy of Florida- Jacksonville

Igor Ianov - University of Florida- Jacksonville

Kristen Vanderhoef, M.D. - University of Florida - Jacksonville

Background: Subdural hematoma (SDH) as a result of dural puncture is rare and symptoms may be attributed to other causes of headaches in the postpartum period such as post-dural puncture headache (PDPH).

Clinical Case: An otherwise healthy 26-year old requested an epidural for labor analgesia. Placement was first attempted at the L4-L5 interspace in the sitting position. CSF was noted in the Tuohy needle after the LOR to saline technique. Second attempt at L3-L4 was successful and a catheter was threaded with negative CSF aspiration. Test dose was negative. Patient delivered uneventfully but had PDPH unresponsive to conservative management. An epidural blood patch (EBP) was done on post-partum day 2. Patient was relieved and went home but came back on postpartum day 7 due to recurrence of headache which was not as positional and accompanied by neck pain and low-grade fever. Neurologic examination was normal. Imaging studies of the head and spine were done. Cranial MRI revealed a 1.6mm right SDH within the right occipital and temporal region. Lumbar MRI revealed blood products in the L4-L5 to L5-S1 potentially subdural in location. Short-term follow up head CT was recommended and scheduled after two weeks.

Discussion: SDH has been reported after dural puncture with either epidural or spinal. This complication is rare but serious and potentially life-threatening vs a PDPH. Postulated mechanism for both SDH and PDPH are similar. Reduction in CSF volume resulting in intracranial hypotension causes sagging of pain sensitive structures responsible for PDPH. Traction of the bridging veins can cause them to tear and result in SDH. Diagnosis of SDH can be missed due to similarity of timing and presentation with PDPH. Although a patient may have both SDH and PDPH, it should be suspected if headache persists or recurs with an EBP, loses its postural characteristics and develops neurologic signs. Treatment of SDH can be medical or surgical depending on size and severity of symptoms.

Conclusion: SDH is a rare but severe complication of dural puncture. The importance of a high index of suspicion should be emphasized among providers to prevent catastrophic sequelae.

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Abstract #: F-11

Cesaerean section in a Patient with Wegener's Granulomatosis

Presenting Author: Bernardine Cabral

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Background: Wegener's Granulomatosis (WG) is a rare systemic, necrotizing, small vasculitis rarely diagnosed during the childbearing age. Untreated, mortality is high. Reports in pregnancy are few.

Clinical Case: A 27-year old G2P0101 with WG presents for a repeat C-section at 37wks AOG. Her WG was diagnosed at age 18 and she was treated with Cyclophosphamide and methotrexate in the past. G1 pregnancy when she was 24yo was a stat C-section at 32wks AOG due to a flare. Chest x-ray at this time revealed ground-glass opacities consistent with WG. She is maintained on Prednisone and Azathioprine with poor compliance. Other comorbidities include poorly controlled chronic hypertension, gestational diabetes, chronic proteinuria, history of seizures, history of DVT treated with an IVC filter, history of AVN of hip treated with hip arthroplasty, obesity, depression and anxiety. She was treated at 31wks AOG for dyspnea on exertion, joint pains, new painful cutaneous lesions and at 33wks AOG for shortness of breath but with no hemoptysis. Anesthetic plan for a combined spinal and epidural (CSE) with a back-up of general anesthesia (GA) was discussed with the patient including possibility of delayed extubation. A CSE technique was performed in the sitting position. After three attempts, LOR to saline was at 11cm from skin. An epidural catheter was secured in place. Phenylephrine infusion was started once the spinal dose was given to prevent hypotension. After adequate spinal anesthetic level was confirmed, cesarean delivery proceeded with delivery of healthy baby. Vital signs remained stable though the procedure.

Discussion: Wegener's granulomatosis involves multiple organs and can be exacerbated by pregnancy. Previous reports have categorized therapeutic options for WG on whether diagnosis was during or before pregnancy and whether the disease was active or inactive pre-conception. Preoperative evaluation requires a thorough review of systems. The vasculitis tends to involve the upper respiratory tract, lungs and kidneys. Disease activity and organ system involvement should all be investigated to ensure optimal anesthetic management. In the case presented, diagnosis was at a younger age and has been on treatment pre-conception.

Conclusions: Information on management of WG in pregnancy is limited. We presented a WG patient who has had two favorable pregnancy outcomes. As effective therapy to induce remissions emerge, more patients with WG will fall pregnant and its management in pregnancy need to be reported.

References:

Auzary et al. Pregnancy in Patients with Wegener's Granulomatosis: report of five cases in three women. *Ann Rheum Diss* 2000; 59:800-4

Bessias et al. Wegener's Granulomatosis presenting in Pregnancy. *Journal of Vascular Surgery* 2005 Volume 42 number 4

Soh et al. Wiliinson L. Prenancy Complicating Wegener's Granulomatosis. *Obstetric Medicine* 2009;2:77-80

Abstract #: F-12

Left Ventricular Non-Compaction Cardiomyopathy in Teen Pregnancy

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Co-Authors: John Cabral - University of Florida- Jacksonville

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Background: Left Ventricular Non-Compaction Cardiomyopathy (LVNC) a primary genetic heart muscle disorder. It is a rare and occasionally difficult to diagnose disease. There is limited data between LVNC and pregnancy outcomes.

Clinical Case: We present a 16yo G1P0 presenting with contractions at 36wks AOG. She was diagnosed with LVNC at age 9y and has been following up with pediatric cardiology throughout her pregnancy. They gave clearance in the event of a C-section and requested for postpartum echocardiography. Other co-morbidities include asthma, gestational hypertension and oppositional defiant disorder. Upon presentation at the labor and delivery floor she complained of dyspnea with saturations at 85% responsive O2. Breath sounds were clear. Doppler evaluation of bilateral LE ruled out venous thrombosis. ECG was NSR with sinus arrhythmia. BNP was slightly elevated. Echo showed EF 65-70%. The patient was placed on cardiac monitors while her labor was in progress. Per her request, patient was positioned in left lateral decubitus for an epidural. The catheter was successfully placed after one attempt at L3-L4 with LOR at 6cm and secured at 11cm. Test dose was negative and an infusion of 0.125% bupivacaine with fentanyl was started. She delivered a healthy baby vaginally. Her cardiovascular status was continually monitored postpartum.

Discussion: Pregnancy related problems in co-existing cardiovascular disease are usually due to the physiologic changes. Multidisciplinary management involves prevention and treatment of anticipated complications. These are heart failure, arrhythmias, including sudden cardiac death and systemic embolic events.

LVNC is characterized by non-compaction of the ventricular myocardium. It is a result of failure in embryogenesis. Diagnosis is by echocardiography. Prognosis depends on severity of heart failure and occurrence of thromboembolic events. Treatment depends on the severity of the disease.

Conclusion: LVNC is rare and reports of management in pregnancy is limited. We presented a case of pregnancy with LVNC that delivered vaginally without maternal deterioration with a favorable fetal outcome.

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Engberding R, Stolberger C, Ong P, Yelbuz T, Gerecke B, Breithardt G. Isolated Non-Compaction Cardiomyopathy. *Dtsch Arztebl Int* 2010;107(12):206-13

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Plastiras, S Pamboucas C, Toumanidis S. Noncompaction Cardiomyopathy and Pregnancy: An alarming coexistence ending in a favorable outcome. *Exp Clin Cardiol* 2012;12(3):136-38

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Abstract #: F-13

Noninvasive Hemodynamic Monitoring in a Non-Compliant High-Risk Parturient with a History of Recurrent Postpartum Cardiomyopathy

Presenting Author: Sunny R. Cai

Presenting Author's Institution: Yale University School of Medicine

Co-Authors: Aymen Alian - Yale School of Medicine

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Antonio Gonzalez-Fiol - Yale School of Medicine

Peripartum cardiomyopathy (PPCM) is a form of idiopathic heart failure affecting women in late pregnancy or postpartum. The incidence is reportedly between 1 in 849 to 1 in 4350 live births with a mortality of approximately 10% in two years. Morbidity and mortality in subsequent pregnancies is increased if left ventricular dysfunction persists.¹

A 35-year-old G13P5075 at 36 weeks gestation with a past medical history of PPCM complicated by persistently reduced left ventricular ejection fraction (LVEF) of 30-35%, hypertension, paroxysmal atrial fibrillation, NSVT and recent heart failure exacerbation in early labor. Comorbidities included morbid obesity, gestational diabetes, PTSD, and anxiety. The patient was asymptomatic and compliant with her maintenance beta-blocker and hydralazine therapy. Of importance was the patient's low health literacy, history of noncompliance, and decline of recommended AICD placement and anticoagulation. Her LVEF in correlation to pregnancies including postpartum is summarized in Figure 1A.

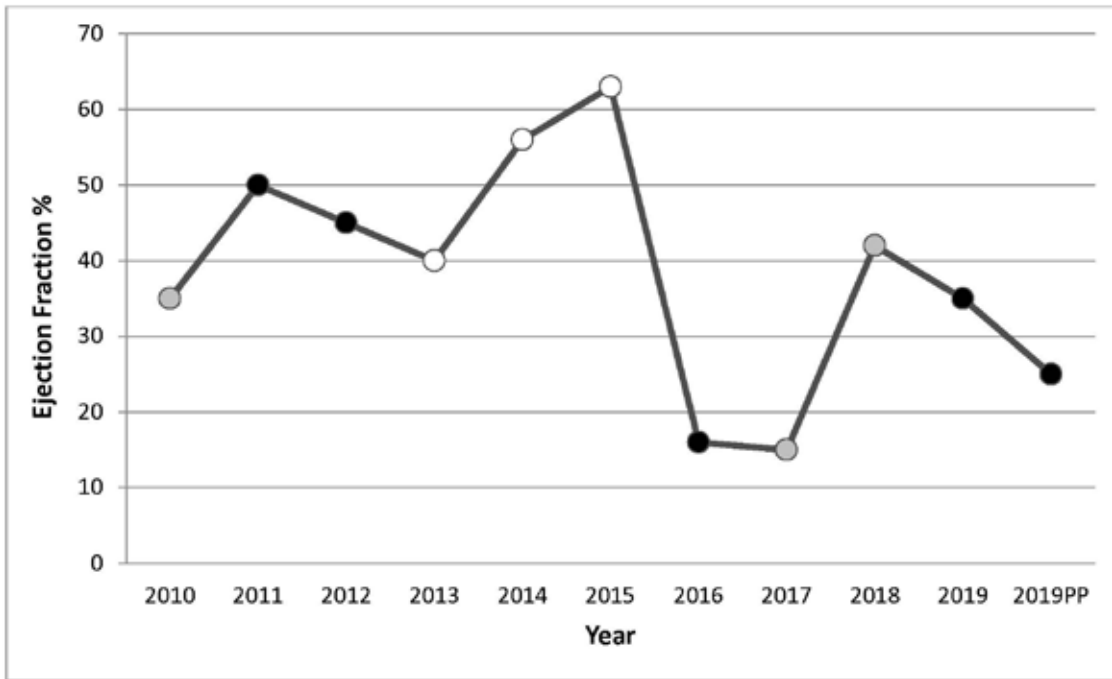
Cardiology, obstetrics, and anesthesiology planned for assisted second stage vaginal delivery with early epidural placement, continuous telemetry, and arterial line monitoring. Upon arrival, a labor epidural was placed to decrease catecholamine surge with the pain of contractions, but the patient refused arterial line placement. We utilized the ClearSight system (Edwards Lifesciences) as a noninvasive monitor with advanced hemodynamic parameters. A 2960g male infant with Apgar scores of 9/9 at 1/5 minutes, respectively, was delivered via vacuum assistance. Postpartum, she had an uneventful recovery in the cardiac ICU despite persistent LV dysfunction.

Major adverse events of PPCM include cardiogenic shock, cardiac arrest, and mortality. Hence, it is imperative to monitor maternal hemodynamic changes during labor and immediately postpartum as cardiac output (CO) peaks. Postpartum fluid overload from relief of vena cava obstruction and increasing systemic vascular resistance (SVR) can be detrimental in this patient population.¹ The ClearSight system utilizes a photometric volume clamp that generates an arterial pulse wave (APW) as well as providing stroke volume (SV), CO and SVR. Although validated in the cardiac surgical population, the CO and SV values were not within acceptable limits during the third trimester of pregnancy when compared to transthoracic echocardiography in a recent study by Duclos et al.² Despite these limitations, the device provided significant hemodynamic trends (Figure 1B) during labor and immediately postpartum. The ClearSight system allowed hemodynamic monitoring in a noncompliant, at-risk parturient who refused the use of invasive blood pressure monitoring.

References:

1. Kolte, D. et al. *Am. Heart Assoc.* 2014
2. Duclos, G. et al. *Int J Obstet Anesth.* 2018

Abstract #: F-13



ClearSight System

Case Report

Gender	Female	BMI/BSA	40.7 kg/m ² / 2.00 m ²
Age	35	Start	08/12/2019 19:48:19
Weight	223 lbs / 101.0 kg	End	08/13/2019 03:49:39
Height	5'2" / 157 cm		

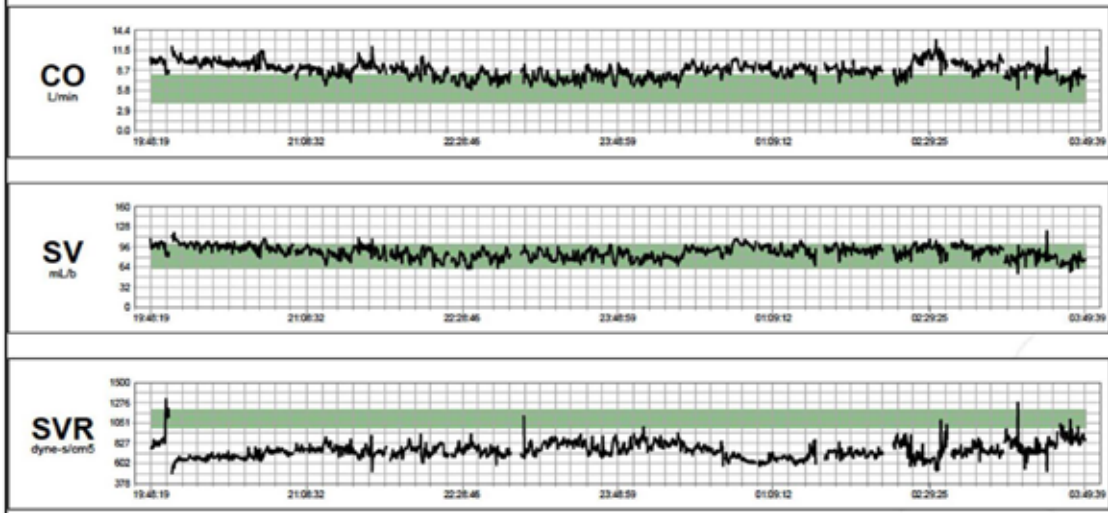


Figure 1A: LVEF over peripartum time period and in association with PPCM. Black indicator: full pregnancy and delivery. White indicator: no pregnancy. Gray indicator: pregnancy and abortion. 2019PP is postpartum. Figure 1B: trends of CO, SV, and SVR peripartum via ClearSight System, delivery at 2:38am.

Abstract #: F-14

PERIPARTUM MANGEMENT OF A PARTURIENT WITH HYPERTROPHIC OBSTRUCTIVE CADIOMYOPATHY

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Hypertrophic cardiomyopathy (HCM) is a genetically associated cardiomyopathy with prevalence of 1 in 500 adults. Characterized by asymmetric left ventricular hypertrophy, HCM is phenotypically variable with a spectrum of manifestations. We report a case of a parturient diagnosed with HCM during pregnancy requiring urgent cesarean section (CS).

37 years old (G7 P3) presented at 37+ weeks of gestation, for evaluation of elevated blood pressures. History was significant for HCM (diagnosed at 25 weeks), asthma, obesity (BMI 33), smoking, alcohol abuse (relapsed 2 days prior). Initial cardiology evaluation at diagnosis noted dynamic left ventricular outflow tract (LVOTO) obstruction with a severe gradient of 60mmHg; she was on metoprolol until she had a relapse, but failed to follow-up. In triage, she complained of 0.5 block exertional dyspnea; fetal tracing was category II with minimal variability, later developed late decelerations. Blood pressure of 166/88 (pulse 81) was controlled with labetalol, hydralazine and magnesium.

Emergency multidisciplinary meeting formulated a plan for CS with neuraxial anesthesia with extracorporeal membrane oxygenation (ECMO) standby. Initial 1L crystalloid bolus was administered. Anesthesia was achieved with lumbar epidural lidocaine/epinephrine after placement of radial arterial line. Cardiothoracic Surgery secured femoral access in the event of emergent ECMO initiation. Hemodynamics were maintained with esmolol, phenylephrine, and vasopressin as needed. A female baby (APGAR 8 and 9) was delivered. Patient was transferred to ICU, on oxytocin and epidural in situ. Transverse abdominis plane block and epidural morphine were administered prior to epidural removal on postpartum day (PPD) 1 and discharged PPD 7.

LVOTO, a hallmark of HCM, can acutely worsen during delivery, resulting in cardiovascular collapse and death. LVOTO is exacerbated by decreased preload, decreased afterload, increased contractility, or tachycardia. Anesthetic goals include: euvoemia to ensure adequate preload; maintain afterload; sinus rhythm with slower heart rate allowing diastolic filling and atrial contraction; and avoid increasing contractility. Achieving such goals involves: augmentation of intravascular volume and prompt volume resuscitation; vasoconstrictors, like alpha agonists; beta-blockers and aggressive management of arrhythmias; avoiding inotropic agents and sympathetic stimulation.

Traditionally, general anesthesia has been employed during CS, as it avoids a precipitous fall in preload afterload and the negative inotropic and sympathetic blunting of inhalational agents may help alleviate LVOT obstruction. Multiple reports have described the successful use of neuraxial anesthesia in HCM parturients, although no controlled trials comparing techniques exist.

References:

Pieper PG, Walker F. Pregnancy in women with hypertrophic cardiomyopathy. *Neth Heart J.* 2013;21(1):14–18.

Abstract #: F-15**Cannabinoid Hyperemesis Syndrome Resulting in Thermal Skin Damage in the Parturient****Presenting Author:** Laurie Chalifoux**Presenting Author's Institution:****Co-Authors:** Jeremy Vandenberg, MD - Michigan State College of Human Medicine, Anesthesia Practice Consultants

Marijuana (MJ) is now legal for medicinal use in 33 states and for recreational use in 11 states and Canada. As laws regulating MJ change, increased use in pregnancy should be anticipated. Chronic use of MJ has been linked to several negative health sequelae. Cannabinoid hyperemesis syndrome (CHS) is particularly challenging. Hot water bathing is a self-treatment among CHS patients, and may result in thermal skin damage.

Our patient with chronic pain, nausea and vomiting presented for induction of labor due to fetal growth restriction at 37.3. She used MJ several times per day throughout pregnancy to treat nausea. Labor epidural was requested for analgesia. The anesthesiologist noted the patient's back was red and blotchy. The patient reported the cause as frequent very hot showers to help with her back pain and nausea. An epidural was placed and secured with paper tape and tegaderm.

After NSVD, the labor RN attempted to remove the catheter. She noted a large 5x46 cm abrasion where skin had been removed with the tape. The anesthesia team was called to the bedside to evaluate. Remaining tape was soaked and then removed easily with the catheter. Due to the patient's upper back abrasion, the burn team was consulted. 7 days of mepilex dressing, follow up in burn clinic, and no bathing were recommended. The patient disregarded these recommendations. She refused the dressing and continued with her scalding hot showers while she recovered on the postpartum floor.

Marijuana is the most commonly abused drug during pregnancy. It is important to recognize potential MJ-related problems in our pregnant patients, especially those that may impact the anesthetic plan. Despite cannabis's usual anti-emetic effect, some cannabinoids including tetrahydrocannabinol, cannabidiol, and cannabigerol, can have paradoxical pro-emetic effects on the GI tract.¹ CHS is a difficult diagnosis to make, often confused with hyperemesis gravidarum. Social history endorsing frequent MJ use and compulsive hot bathing can assist in identifying CHS.² Hot showers or baths are thought to ease nausea and vomiting in CHS via hypothalamic modulation and cutaneous vasodilation which shunts blood away from cannabinoid vasodilated splanchnic vessels.³ Abstinence from MJ is the best treatment, but symptoms of CHS may take 48h to 1 week to resolve.⁴

Maternal hot water submersion is known to have detrimental fetal effects and may induce preterm labor. Scalded skin is also a hazard of CHS due to the learned self-treatment behavior of compulsive hot bathing. Pain management in this population may be challenging due to chronic pain or altered responses to pain. Neuraxial analgesia should be offered after thorough social history and physical exam are documented. In the setting of skin abnormalities, alternate dressing and exquisite care with removal can be utilized to avoid further skin damage.

References:

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2. Sorensen, J Med Tox 2017
3. Kim, Case Rep OB GYN 2018
4. Alaniz, OB & GYN 2015

Abstract #: F-16**Peripartum Management of a Parturient with Atypical Type 1 von Willebrand Factor Deficiency**

Presenting Author: Charles H. Prior, BSc MBChB FRCA

Presenting Author's Institution: BC Women's Hospital, University of British Columbia - Vancouver, British Columbia

Co-Authors: Anthony Chau, BSc(Pharm), MD, FRCPC, MSc - BC Women's Hospital, University of British Columbia
Katherine M. Seligman, MD - BC Women's Hospital, University of British Columbia

Background: Peripartum anesthetic management of type 1 von Willebrand's disease (vWD) is usually uncomplicated, as the partial quantitative deficiency in von Willebrand factor (vWF) and Factor VIII (FVIII) typically normalizes by the third trimester in response to placental estrogen, before returning to baseline postpartum. However, there is wide heterogeneity of phenotypes and genotypes associated with vWD [1]. Here, we describe the anesthetic management of a parturient with atypical 1 vWD.

Case: A 36 yo G1P0 with type 1 vWD was referred to the antenatal anesthesia clinic at 32 weeks. She had very low baseline FVIII/vWF levels, inadequate response to desmopressin challenge, minimal rise in factor levels during pregnancy and raised vWF propeptide to vWF antigen ratio. (Table 1) She was otherwise healthy with a reassuring airway. A multidisciplinary care plan was devised. Early epidural placement was recommended to ensure adequate time for peripartum FVIII/vWF concentrate reconstitution and infusion. Alternatives to neuraxial analgesia and general anesthesia were discussed.

At 39 weeks, the patient presented in labor and requested epidural analgesia at 4 cm dilation. A loading dose of 75U/kg of FVIII/vWF concentrate IV was administered immediately prior to placement. A second dose at 75U/kg was administered at the onset of second stage of labor. Following an uneventful vaginal delivery, the epidural catheter was immediately removed. Three doses of factor concentrate at 35U/Kg were given q12h, followed by 3 doses of 45U/kg q24h. Tranexamic acid 1g IV was given at delivery, then 1.5g orally for 10 days. All NSAIDs were held, and the patient was encouraged to breastfeed to maintain high hormone levels postpartum.

Discussion: This case highlights three learning points. First, some parturients diagnosed with vWD type 1 do not achieve adequate factor levels by term. Therefore, careful antenatal assessment and follow-ups are important in identifying these patients. Second, the very low baseline vWD factor levels (< 0.2 U), non-sustained rise in FVIII/vWF levels after desmopressin and the increased vWF propeptide to vWF antigen ratio suggest a rare diagnosis of type 1C vWD. [1] Finally, FVIII/vWF concentrate requires time for reconstitution and infusion so frequent multidisciplinary communication is key in coordinating the optimal timing of factor administration with obstetric and anesthetic interventions.

References:

1. Atiq F et al. von Willebrand factor and factor VIII levels after desmopressin are associated with bleeding phenotype in type 1 VWD. *Blood Adv* 2019.23;3(24):4147-54

Abstract #: F-16
Table 1. Factor levels and coagulation parameters throughout pregnancy

Lab Parameter	Normal Range	Baseline (Pre-pregnancy)	19 weeks	32 weeks	35 weeks	39 weeks (Labor)
vWF antigen ^a (U)	> 0.5	L 0.1	L 0.15	L 0.21	L 0.31	
FVIII activity (U)	0.5-1.5	L 0.26	L 0.27	L 0.34	L 0.35	
vWF:RCo ^b (U)	> 0.5	L 0.14			L 0.23	
vWFpp:vWF antigen ^c	0.9-1.62	H 13.0				
PT (s)	9.5-11.4		L 9.4			L 9.4
INR	0.9-1.1	1	0.9		0.9	0.9
aPTT (s)	25-38	35	31		37	31
Fibrinogen (g/L)	3.5-8.1	2.2				5.4
Platelets (10 ⁹ /L)	150-400	248	219		198	196

vWF = von Willebrand Factor; FVIII = Factor VIII; Rco = ristocetin cofactor; vWFpp = von Willebrand factor propeptide;
a. Quantitative assay of vWF levels. b. Qualitative assay of vWF. c. Increased ratio suggests accelerated clearance of vWF

Abstract #: F-17**Anesthesia management of a patient with Velo-Cardio-Facial Syndrome undergoing Cesarean Section****Presenting Author:** Iryna Chugaieva**Presenting Author's Institution:** University of Minnesota - Minneapolis, Minnesota**Co-Authors:** Lisa M. Corbett, MD - University of Minnesota

Iryna Chugaieva, MD., Lisa Corbett, MD

Learning objectives:

Upon completion of this learning activity, participants should be able:

1. To learn that 100% of patients with Velo-Cardio-Facial Syndrome (DiGeorge syndrome) present with some degree of facial abnormalities with the classical feature being very small mouth with everted upper lip
2. To recognize that patients with Velo-cardio-facial syndrome may present with significant spinal deformity
3. To highlight the importance of communicating a delivery plan with the obstetric team for gravid patients with Velo-cardio-facial syndrome
4. To understand that neuraxial anesthesia for a cesarean section can be challenging in patients with Velo-cardio-facial syndrome and the backup plan with GA with fiberoptic intubation might be needed

Case Report: We present a case of a 24-year-old G1P0 with a past medical history of DiGeorge syndrome, developmental delay, significant scoliosis, fused cervical spine, ventricular septal defect, congenital insufficiency of aortic valve, and mild aortic root dilation who presented to a preoperative assessment clinic for anesthesia consult prior to delivery. The patient was scheduled for a primary cesarean section, indicated by suspected cephalo-pelvic disproportion. Physical exam was significant for Mallampati 4 score, minimal neck range of motion and mouth opening of 1cm. Radiograph of the lumbar spine showed moderate convex left curvature of the thoracolumbar spine. After discussion with the obstetric team, the decision was made to proceed with spinal anesthesia and a backup plan of general anesthesia with awake fiberoptic intubation. Emphasis was put on avoiding emergency cesarean section, if at all possible, as an emergency situation would place this patient at great risk from an airway standpoint. Patient presented at 38 1/7 weeks for a scheduled primary cesarean section. Spinal anesthesia was performed without complications via the midline approach at L4-5 level in the sitting position with a 25 G Whitacre needle. Surgery was uneventful and the patient was discharged home on postpartum day 3.

References:

Digilio, Mc, et al. "Clinical Manifestations of Deletion 22q11.2 Syndrome (DiGeorge/Velo-Cardio-Facial Syndrome)." *Images in Paediatric Cardiology*, Medknow Publications & Media Pvt Ltd, Apr. 2005, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3232571/>.

Abstract #: F-18

Severe idiopathic thrombocytopenic purpura during pregnancy: A conundrum for the obstetric anesthesiologist

Presenting Author: Arthur Chyan, DO

Presenting Author's Institution: Westchester Medical Center - New York Medical College - Valhalla, New York

Co-Authors: Sangeeta Kumaraswami, MD - Westchester Medical Center - New York Medical College

Learning Objectives

- Review epidemiology, pathophysiology, diagnosis, and management of idiopathic thrombocytopenia purpura (ITP) during pregnancy
- Evaluate neuraxial versus general anesthesia for cesarean delivery in a parturient with ITP
- Understand the value of rotational thromboelastometry (ROTEM) in guiding blood product transfusion

Case Description

A 35-year-old G2P1001 female with a history of idiopathic thrombocytopenic purpura (ITP) was admitted at 28 weeks gestation for severe epistaxis that needed otorhinolaryngologic intervention. Her platelet count was found to be nine thousand per microliter of blood. Despite a treatment regimen consisting of steroids, intravenous immunoglobulin, and blood product transfusions, her platelet count remained critically low with a nadir of two thousand per microliter of blood. She continued to report intermittent headaches and epistaxis and was initiated on eltrombopag, an immunomodulating drug with limited literature regarding efficacy in pregnancy. Despite increasing dosages of eltrombopag, her disease remained refractory to medical treatment. Additionally, the fetus developed supraventricular tachycardia presumably secondary to eltrombopag, resulting in the patient being initiated on oral digoxin. At this point, she declined further medical and surgical (splenectomy) treatment for her ITP. A decision for elective cesarean delivery was made after multidisciplinary planning at 30 weeks gestation due to refractory thrombocytopenia and fetal malpresentation (transverse lie with low-lying placenta).

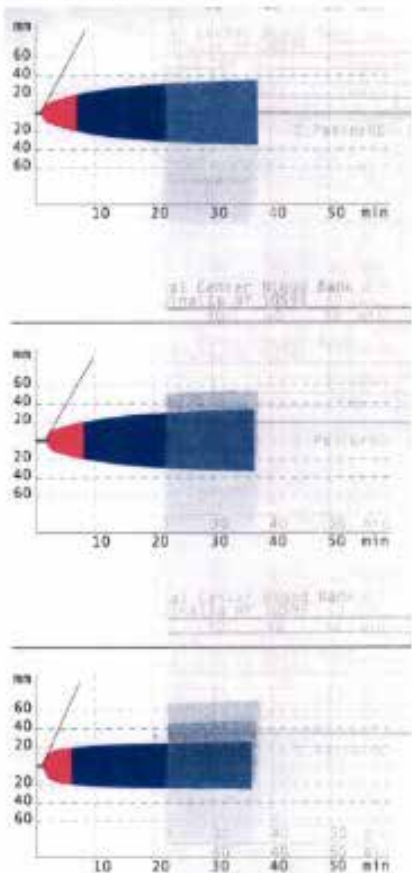
In preparation for surgery, a peripherally-inserted central catheter (PICC) and radial artery cannulation were placed preoperatively. She received general anesthesia with delivery of a baby with Apgar scores 4, 7. Rotational thromboelastometry (ROTEM) was used successfully perioperatively to guide transfusion therapy. Intraoperative cell salvage was used with an estimated blood loss of 1500cc. Her immediate postpartum course was further complicated by preeclampsia with severe features. Postoperatively treatment for her ITP was reinitiated with eltrombopag and rituximab. Her platelet count remained critically low despite these interventions at hospital discharge.

References:

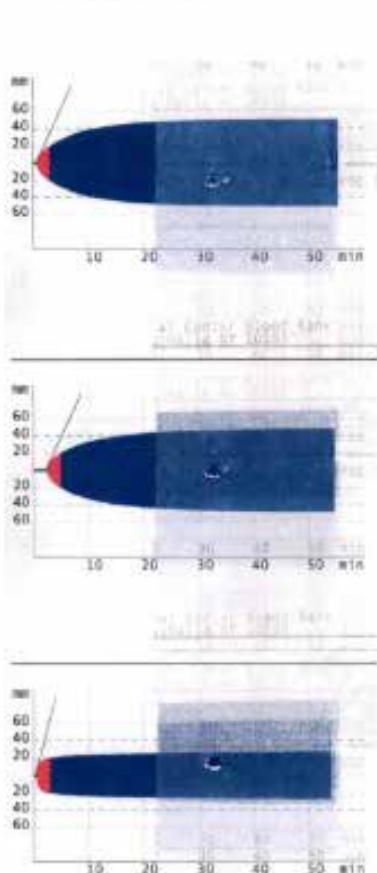
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- De Lange NM, van Rheenen-Flach LE, Lance MD et al. Peri-partum reference ranges for ROTEM thromboelastometry. *Br J Anaesth*. 2014; 112(5):852-9.
- Beilin Y, Arnold I, Hossain S. Evaluation of the platelet function analyzer (PFA-100) vs. the thromboelastogram (TEG) in the parturient. *Int J Ob Anesth*. 2006; 15:7-12.
- Kam PCA, Thompson SA, Liew ACS. Thrombocytopenia in the parturient. *Anaesth*. 2004; 59:255-64

Abstract #: F-18

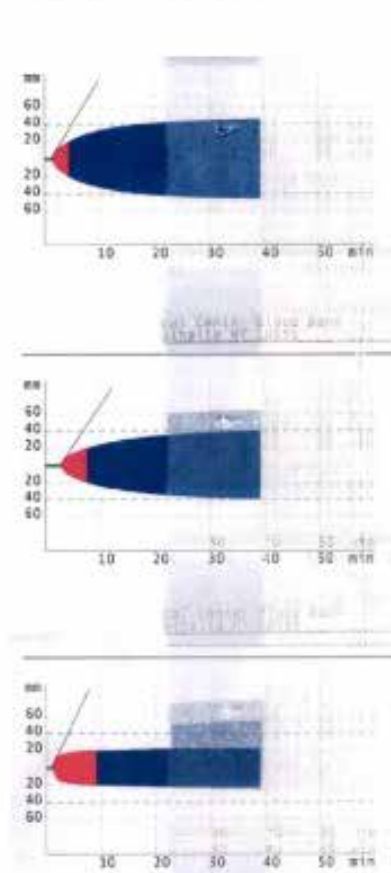
Preop ROTEM



Intraop ROTEM



Postop ROTEM



Abstract #: F-19

Peripartum Management of Hereditary Angioedema

Presenting Author: Kathryn Clark, MB BCh BAO

Presenting Author's Institution: Mayo Clinic

Co-Authors: Katherine Arendt, MD - Mayo Clinic

Adam Jacob, MD - Mayo Clinic

Emily Sharpe, MD - Mayo Clinic

Hans Sviggum, MD - Mayo Clinic

Introduction: Hereditary angioedema (HAE) is a disease characterized by recurrent edematous attacks potentially triggered by emotional stress, mechanical trauma, and intake of estrogens. It is classically caused by a quantitative (type I) or functional (type II) deficiency in C1 esterase inhibitor (C1-INH), although another subtype of HAE, type 3, has been described with normal C1-INH activity. Pregnancy can mitigate, aggravate, or have no effect on HAE edematous attacks.¹ We report two parturients with HAE, and discuss the anesthetic implications of the recommendations for the peripartum management of HAE.¹

Case One: A 26 year old G1P0 woman with HAE Type II was seen in consultation at 33 weeks gestation by Obstetric Anesthesiology and Allergy. Throughout her pregnancy the patient presented multiple times with angioedema which was treated with diphenhydramine and dexamethasone. The plan was to administer prophylactic human C1-INH concentrate 1000 IU 1 hour prior to delivery, regardless of route of delivery with further dosing of the medication in the event of a flare. The patient was admitted at 39 weeks gestation for induction of labor; however, she declined prophylactic treatment with a C1-INH, given the significant cost of the medication. She had a dural puncture epidural placed with subsequent NSVD with no evidence of HAE symptoms throughout the intrapartum and postpartum period.

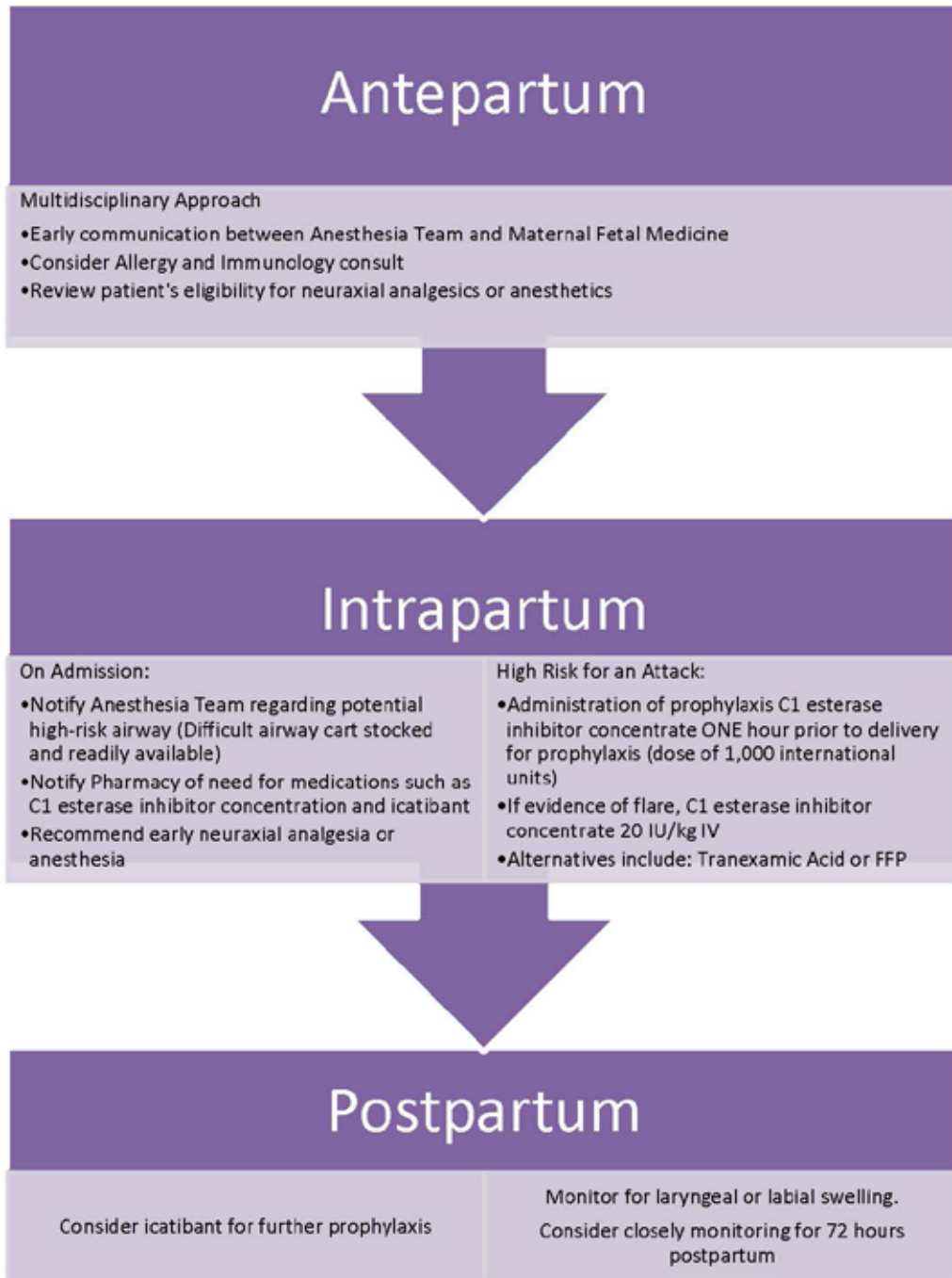
Case Two: A 30 year old G4P0211 woman with a history of HAE Type III was seen in consultation at 28 weeks gestation by Obstetric Anesthesiology. The patient had been maintained on long-term prophylaxis therapy of intravenous recombinant C1-INH at home 2-3 times per week and during pregnancy, had increased her prophylaxis to daily infusions. She did not report any angioedema episodes since the onset of pregnancy. The patient was induced at 34w4d for IUGR, gestational hypertension, and psychosocial factors. She had a dural puncture epidural placed with subsequent NSVD with no evidence of HAE symptoms throughout the intrapartum and postpartum period.

Discussion: There are multiple treatments available to manage the edematous attacks associated with HAE, such as plasma-derived or recombinant C1-INH. Patients with HAE should deliver in hospitals that have resources to provide expert multidisciplinary care in addition to plasma-derived C1-INH concentrate.¹ We propose an anesthetic management protocol for these patients (Figure 1) which are consistent with the goals of obstetric management practice guidelines previously published. Patients with HAE may benefit from early neuraxial labor analgesia and regional anesthesia for cesarean delivery.

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1. Caballero, et al. International consensus and practical guidelines on the gynecologic and obstetric management of female patients with hereditary angioedema caused by C1 inhibitor deficiency. *J Allergy Clin Immunol* 2012;129(2):308-20.

Figure 1. Peripartum management of hereditary angioedema



Abstract #: F-20

Factor XIII deficiency: Is it or isn't it?

Presenting Author: Jakayla Harrell, MD

Presenting Author's Institution: Ochsner Clinic Foundation

Co-Authors: Allison Clark, MD - Ochsner Clinic Foundation

Introduction: Factor XIII (FXIII) deficiency is a rare bleeding disorder that requires evaluation and monitoring during pregnancy to prevent pregnancy loss and postpartum hemorrhage (PPH). Appropriate diagnosis and management by obstetrics, hematology, and anesthesiology are important to ensure good patient outcomes. Here we present a patient with history of bleeding diathesis and family history of FXIII deficiency presenting for delivery.

Case presentation: Our patient is a 27 yo G1P0 who presented in the 1st trimester for pregnancy management. She reported bleeding diathesis during menses and after wisdom tooth extraction, but never required blood transfusion. Family history included a fraternal twin sister with diagnosed FXIII deficiency and mother with bleeding diathesis requiring blood transfusion after routine surgery. Pregnancy was complicated by 4 weeks of vaginal bleeding during the 1st trimester due to subchorionic hemorrhage. She presented to hematology for a full work up at 13 weeks EGA with normal results including a FXIII activity of 91%. She was seen by obstetric anesthesia in consultation at 25 weeks EGA and was deemed a candidate for neuraxial analgesia. She presented in active labor at term and labor epidural analgesia was placed without difficulty. Routine coagulation studies were within normal limits on admission, however given her history, 2 units of pRBC were crossmatched and held in the blood bank in the event of PPH. She delivered a viable male infant with estimated blood loss of 600 mL and was discharged to home on PPD#2.

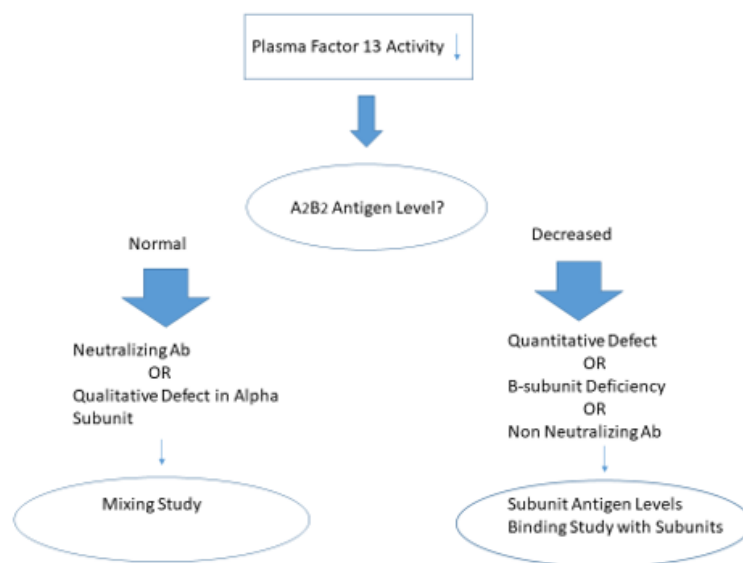
Discussion: FXIII deficiency is an autosomal recessive condition affecting 1 in 3 million people. The alpha subunit is the catalytic portion and accounts for most mutations.(1,2) FXIII has a role in producing the cytotrophoblastic shell in the placenta, thus severe deficiency may present as recurrent miscarriage; other presentations include vaginal bleeding in the first trimester, delayed wound healing, and intracranial hemorrhage.(3) For clinical suspicion, an activity assay followed by antigen testing should be performed, with further subunit testing if indicated.(3) Heterozygotes will have 50-70% activity and are usually asymptomatic. Routine coagulation profile is normal. If FXIII deficiency exists, treatment includes FFP, cryoprecipitate, and FXIII concentrate.(3) We describe a case where the patient has a strong family history of FXIII deficiency, a history of abnormal bleeding, and vaginal bleeding in first trimester. An efficient work-up was essential to avoid unnecessary testing and safely provide neuraxial analgesia.

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Algorithm from [Fadoo et al.](#) New Developments in the Management of Congenital Factor XIII Deficiency

Abstract #: F-21**Migraine with aura presenting as a transient ischemic attack in a parturient****Presenting Author:** Gustavo Diaz-Mercado, MD**Presenting Author's Institution:** Ochsner Clinic Foundation**Co-Authors:** Allison Clark, MD - Ochsner Clinic Foundation

Introduction: Migraine with aura may present with stroke-like symptoms in a small percentage of patients. This can be a challenging diagnosis to differentiate between stroke and symptoms of pre-eclampsia in the parturient. We present a case of atypical migraine with aura presenting as a transient ischemic attack in an otherwise healthy parturient, prompting induction of labor.

Case Presentation: Our patient is 27-year-old G2P0 with history of anxiety and depression, who presented to the obstetric emergency department (ED) at 37 5/7 weeks EGA with a complaint of blurred vision progressing to bilateral loss of vision, bilateral upper extremity numbness, and dysarthria. Code Stroke was called, and the patient underwent workup including CT head and laboratory studies which were both within normal limits. She was evaluated by Neurology and at that time her symptoms had completely resolved. MRI/A/V was performed which also was found to be negative. She was admitted for observation based on symptoms.

On hospital day 1, her headache and blurred vision occurred again and magnesium sulfate was started for suspected atypical pre-eclampsia and induction of labor was initiated (blood pressure and P:C Ratio had been within normal ranges). She subsequently underwent primary cesarean delivery under epidural anesthesia for failure to progress and delivered a viable male neonate. She was discharged to home on POD#3 and is awaiting further outpatient neurology evaluation.

Discussion: Migraine with aura accounts for more than 1% of ED evaluations for stroke-like symptoms. In addition to headaches, associated symptoms may include motor and sensory deficits, dysphasia, dysarthria and seizures. Symptoms may be elicited by stress, odors, food, light or physical exertion. The diagnosis of migraine with aura is clinically challenging due to its stroke-mimicking symptom profile. Patients typically present acutely after symptom onset, are female, have comorbid psychiatric disorders with few cardiovascular risk factors, and are most commonly misdiagnosed in a post-ictal state. Both migraines with aura and pregnancy predispose patients to a higher risk of stroke. Additionally, symptoms may mimic pre-eclampsia which may prompt earlier delivery of the fetus.

Neuroimaging with CT or MRI remains the diagnostic modality of choice in addition to a focused history and physical exam. A proper clinical diagnosis is necessary to ensure adequate treatment and avoid unnecessary and possibly detrimental interventions such as thrombolytics and premature induction of labor.

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Abstract #: F-22**Anesthetic Management for a Parturient with Brugada Syndrome.****Presenting Author:** Praeophayom Clarke, MD**Presenting Author's Institution:** Boston Medical Center - Boston, Massachusetts**Co-Authors:** Rachel Achu, MD - Boston Medical Center

Nicole Spence, MD - Boston Medical Center

Introduction. Brugada syndrome is a genetic defect that causes mutations in sodium channel subunits resulting in arrhythmias and cardiac arrest. The conduction disturbances can be triggered by stress, pregnancy and some medications including bupivacaine, procaine and propofol. Brugada syndrome is rare, affecting 5 in 10,000 people. Since its initial description in 1992 and its acknowledgement as a disease in 1998, a consistent anesthetic management plan for parturients with Brugada syndrome has not been identified. Our case highlights the importance of pre-emptive evaluation of pregnant patients with Brugada syndrome prior to presentation for delivery.

Case Presentation. 28-year-old G2P1001 at 38w2d with a history of hypothyroidism and post-partum idiopathic myopericarditis complicated by tamponade requiring pericardiocentesis in 2015 presented to Labor and Delivery with active labor. Current medications included levothyroxine 75mcg and prednisone 20mg daily. Patient previously had been on azathioprine, which was stopped during this pregnancy with the plan to resume post-partum. This pregnancy had been complicated by multiple admissions for exacerbation of myopericarditis including a week prior to delivery, when she presented with recurrent chest pain, fever and abnormal labs. EKG showed a "saddle type" ST elevation in leads V1 and V2, consistent with Brugada Type 2. A transthoracic echocardiogram revealed a trace pericardial effusion but was otherwise unremarkable. During the current admission, a multidisciplinary team of obstetrics, anesthesiology, rheumatology and cardiology agreed to continue the patient on 20mg of prednisone throughout labor and postpartum. When in labor, she was given a stress dose of 50mg IV hydrocortisone followed by 24mg IV q8h for 48 hours postpartum. She had tolerated neuraxial epidural anesthesia for her prior pregnancy; thus, our plan during labor was to place an epidural and use our standard mixture of 0.125% bupivacaine + 2mcg/mL fentanyl. She had an uneventful vaginal delivery 2 hours after epidural placement.

Conclusion. Brugada syndrome is a rare genetic disorder that can pose challenges to anesthetic management, especially for parturients in labor. Our complex case required a multidisciplinary team effort. Although we were able to manage our patient with epidural bupivacaine and fentanyl, there was a possibility that prolonged use of bupivacaine could promote arrhythmias that would necessitate an intracardiac device in the peripartum setting. This case highlights the importance of a multidisciplinary approach in the evaluation of complex patients such as those with suspected Brugada syndrome prior to their presentation to the Labor and Delivery floor to ensure optimization and development of an appropriate obstetric, anesthetic and cardiac care plan.

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Phillips, Nicole et al. "Brugada-Type Electrocardiographic Pattern Induced by Epidural Bupivacaine." *Anesthesia & Analgesia*. July 2003: 264-267

Abstract #: F-23**Thoracic epidural analgesia for chronic intercostal neuralgia in pregnancy**

Presenting Author: David J. Combs, MD PhD

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Introduction: Management of chronic non-obstetric pain in pregnancy is complex. Pain from intercostal neuralgia, which may worsen as the fetus grows, can be particularly disabling.

Case: A 30 year-old G2P1001 with a history of spontaneous pneumothoraces, treated with a video-assisted thorascopic bleb resection and partial pleurectomy three years prior to her current pregnancy, developed unremitting right-sided intercostal neuralgia characterized by severe pleuritic chest pain and dyspnea, at approximately 12 weeks gestation. Between 12 and 35 weeks gestation, she presented repeatedly with disabling pain. During this time, outpatient management, coordinated by our pain in pregnancy clinic, initiated a multimodal strategy for pain control, including oral and topical analgesics, paravertebral nerve blocks, physical therapy, and other non-pharmacologic treatments. However, despite these specialized interventions her pain continued to intensify, prompting an inpatient admission at 35 weeks, with a plan to utilize thoracic epidural analgesia until delivery. A single thoracic epidural catheter ultimately provided adequate analgesia through 37 weeks, at which time the patient's labor was induced. For labor, her thoracic epidural catheter was maintained for ongoing chest pain, and a second, lumbar, epidural catheter was placed for labor analgesia. After a failure to progress beyond 6 cm, the patient underwent a cesarean delivery with epidural anesthesia provided via her lumbar catheter. Following delivery, her right-sided chest pain resolved, and the thoracic epidural catheter was removed on postoperative day one.

Discussion: Descriptions of intercostal neuralgia during pregnancy are sparse^{1,2}. The progressive worsening of the patient's pain and dyspnea as the fetus enlarged and the need to consider both maternal and fetal risks complicated her management. Two reports detail thoracic epidural analgesia for chronic chest pain in the pregnant patient^{2,3}. While here epidural placement achieved adequate pain control, coordination of her care on an antepartum service unfamiliar with thoracic epidurals and chronic pain management created challenges. These included frustration with the frequent adjustments to her epidural infusion, management of catheter disconnections, an episode of acute hypotension, and inconsistent patient communication in a multidisciplinary setting. Placement of a second lumbar epidural catheter for labor and delivery created additional concerns for maladministration, local anesthetic toxicity, and catheter entrapment.

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Abstract #: F-24**Oh my! How Complicated our Pregnant women are These Days.**

Presenting Author: Patricia L. Dalby

Presenting Author's Institution: University of Pittsburgh School of Medicine (UPSOM) and University of Pittsburgh Medical Center - Pittsburgh, Pennsylvania

Co-Authors: Courtney Mechling - University of Pittsburgh Medical Center (UPMC)

This case of a parturient complicated diagnostic dilemma in the later pregnancy. Obstetric anesthesiologists should expect similar cases.

Case: 35-year-old pregnant female (G2P101) transferred at 35 weeks for RUQ and flank pain, fever, week-long history malaise, and new diagnosis Hepatitis C. On transfer she was febrile (39.5) with hypotension on low dose norepinephrine. Lactate 1.5, CBC with elevated neutrophils and left shift, and MAP in 50's. PMH significant for non-Hodgkin's lymphoma, asthma, epistaxis, chronic thrombocytopenia. Also, hearing loss (childhood meningitis, speaks sign language, with cochlear implants), Lyme disease, polysubstance abuse. New complaint; chest pain and headache.

Course: Admitted to Obstetric ICU for management. Working diagnosis: Acute hepatitis, vs HELLP, vs Sepsis vs GI or Urol pathology. Hydrated and vasopressors weaned.

Fetal findings; good activity, NST reactive/reassuring, and later term steroids administered.

Infections disease consult: Ordered multiple empiric antibiotics after testing for multiple ID etiologies. Hepatitis C markers chronic. Later, bone marrow biopsy (BMB) showed evidence of Epstein Barr virus reactivation, all other tests were normal. Antibiotics stopped day 6.

Head CT; negative

Cardiology consult: Day 1, EKG: Sinus tachycardia, Septal infarct pattern, PAC's. Cardiac Echo: mildly dilated LV with EF 55-60%, flattened IV septum consistent with RV pressure overload, PAS 41 mmHg, BNP mild elevation
Chest CT / Angiography remarkable for multiple partially visualized hyper-vascular liver lesions, possible hepatic AVMs, enlarged PA, no pulmonary emboli. Day 7 right heart catheterization to rule out pulmonary hypertension; found normal pressures.

SVT developed late day 7, responded to: adenosine, IV amiodarone bolus and oral metoprolol 12.5 mg

GI consult ordered abdominal ultrasound: No free fluid or loculated fluid collections are visualized. Mild splenomegaly, .2.5 cm lesion in a segment of the liver with a echogenic rim suggestive of an atypical appearance of a hemangioma. Findings suggestive of large portal venous to hepatic venous shunt. Suggested, If clinical concern regarding acute appendicitis, further evaluation with non-contrast MRI should be considered. Further evaluation of both the liver lesion and the shunt with multiphasic MRI of the liver after delivery recommended

Hematology consult: BMB – no malignancy

Anesthesia Consult: ASA PS 4, patient's airway class IV due to poor effort, small mouth. Anesthesia options explained

Preterm contractions started late day 8 with precipitous delivery early day 9, healthy girl baby born. Natural child birth.

Final dx: Left to right shunting due to hyper-vascular liver lesions and pregnant physiology contributing to an elevated cardiac output state. Probable Osler-Weber-Rendu syndrome.

Abstract #: F-24

D/c to home day 11 with baby. F/U Hematology, Center Liver disease, Pulmonology, OB-Gyne

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Abstract #: F-25**Management of a Pregnant Woman with a Spinal Cord Stimulator for Cesarean Delivery**

Presenting Author: Bahaa E. Daoud, M.D.

Presenting Author's Institution: Columbia University - New York, New York

Co-Authors: Stephanie Goodman, M.D. - Columbia University

Nicole Matar, M.D. - Columbia University

Introduction: Complex Regional Pain Syndrome (CRPS) is a neuropathic pain condition that has a high prevalence in women of child-bearing age.¹ First appearing in the late 1960s, spinal cord stimulators (SCS) modulate and inhibit pain pathways by applying a small electrical current to the dorsal columns and supraspinal centers.² They have been shown to reduce pain medication usage, reduce pain scores, significantly improve quality of life and reduce healthcare costs.³ Although there is a paucity of data regarding maternal-fetal safety, the use of SCS in parturients has been reported at least 25 times with the vast majority leading to healthy births.⁴

Case: A 36-year-old G3P1 presented for anesthesiology consult in advance of a planned repeat cesarean delivery. She developed CRPS in 2009 after a foot injury and after many years of pain and disability had a low-thoracic (T9-T10) SCS implanted which restored her quality of life (Figure 1). Her previous cesarean delivery at an outside hospital was due to a non-reassuring fetal heart tracing. She received general anesthesia because the anesthesiologist was uncertain about the safety of neuraxial anesthesia in the presence of a SCS. Due to her chronic, severe pain, she wanted to keep the SCS active throughout this pregnancy.

We confirmed with imaging the exact location of the SCS and leads, which was away from the lumbar area. After informed consent, a combined spinal-epidural was performed with intrathecal 12mg hyperbaric bupivacaine, 150mcg preservative-free morphine and 15mcg fentanyl. The epidural catheter allowed for enhanced post-operative pain control. The patient deactivated the SCS immediately prior to surgery to avoid possible electrocautery interference. She was very grateful to be awake for the birth of this child. The SCS was reactivated in the recovery room and the patient was given a dose of epidural 3mg preservative-free morphine on post-operative day 1. Her pain was well controlled for the duration of her hospital admission and she was discharged on post-operative day 3.

Discussion: Neuraxial anesthetic management of a parturient with a SCS centers around appropriate needle placement. It is imperative that the exact location of the wires is known to avoid severing the SCS leads with the needle or causing entanglement of the SCS leads with the epidural catheter. With adequate planning and consultation with neuromodulation specialists when needed, neuraxial labor analgesia and anesthesia should not be denied to these patients. There are not only medical advantages but, as demonstrated in this case, also emotional advantages for parturients that just want to feel "normal."

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Abstract #: F-25



Abstract #: F-26**A Case of Burn Trauma Management in a Pregnant Patient****Presenting Author:** Gyan Das, MD**Presenting Author's Institution:** San Antonio Uniformed Services Health Education Consortium - Ft Sam Houston, Texas**Co-Authors:** Crystal M. Manohar, MD - San Antonio Uniformed Services Health Education Consortium

We present a 26 year old G3P1102 at 20+6 weeks gestational age presenting with 16% Total Body Surface Area burns. The patient was referred from a community facility after gasoline explosion with deep partial and full thickness burns to the left upper extremity, chest, neck, and face. On arrival in our Burn Intensive Care Unit, the patient was already intubated and bronchoscopy demonstrated grade II inhalational injury. Oscillatory ventilation was initiated with fentanyl and ketamine infusions for sedation, fluid resuscitation consisted of 150 mL/hr of Lactated Ringer's, and burn wounds were dressed in mafenide acetate solution. The obstetrical service was consulted and performed an ultrasound which indicated positive fetal heart rate and otherwise normal findings; recommendations included prioritizing maternal life-saving interventions, avoiding NSAIDs, fetal monitoring pre- and post-operatively, and indicated increased preterm labor risk due to increased prostaglandin release. On Hospital Day 1, excision and grafting was performed in the operating room. Intraoperatively, the patient was positioned with left uterine displacement, general anesthesia was maintained with total intravenous anesthetic, pressure control ventilation was used, and fluid resuscitation was achieved with colloid and crystalloid solutions. Post-operatively the patient returned to the ICU and was extubated on HD 2. She continued to recover with well-healing grafts and was transferred to the burn ward. The patient was discharged on HD 8 with continued follow-up in the burn clinic; she a candidate for plastic surgery to improve upper extremity mobility but all surgical intervention was delayed until after pregnancy. The patient delivered a healthy baby at term.

Burn injury combined with maternal physiology present unique considerations. Delivery of viable pregnancies should be considered as this may improve pulmonary mechanics and hemodynamics. Euvolemia should be maintained; overresuscitation can lead to pulmonary edema and underresuscitation can lead to release of posterior pituitary hormones increasing the chance of uterine contractions. Carboxyhemoglobin levels greater than forty-eight percent have been associated with adverse fetal outcomes and inhalational injury can further complicate difficult airways in pregnancy; carbon monoxide and cyanide poisoning can lead to fetal hypoxemia with decreased maternal-fetal oxygen transfer. Mechanical ventilation should maintain physiologic changes of pregnancy including increased minute ventilation and respiratory alkalosis. Early skin grafting and appropriate antimicrobial prophylaxis lead to improved outcomes.

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Abstract #: F-27**Anesthetic Management for Vaginal Delivery Post-Cardiac Transplantation****Presenting Author:** Michael Dasu, DO**Presenting Author's Institution:** The Ohio State University Wexner Medical Center**Co-Authors:** Ling-Qun Hu, MD - Ohio State University Wexner Medical Center

Joseph L. Reno, MD - Ohio State University Wexner Medical Center

Case: A 35 year old G2P1 at 36 weeks gestation presented with preeclampsia with severe features including severe range blood pressures and acute kidney injury. The patient's history of dilated cardiomyopathy had resulted in a heart transplant 18 years ago. Her transthoracic echocardiogram unremarkable including a left ventricular ejection fraction of 65%. The transplant cardiology was consulted and, adjusted her antirejection regimen and recommended pulse dose corticosteroids in the event of hemodynamic decompensation. After induction of labor, she requested an epidural for pain control which was successfully placed at L3/4. The epidural was loaded with 10 mL bupivacaine 0.125% with 2mcg/mL fentanyl, followed by an infusion of 12mL/hr bupivacaine 0.0625% + 2 mcg/mL fentanyl. This achieved a bilateral T10 level, and the patient had good analgesia during the unremarkable labor course with successful vaginal delivery.

Discussion: Worldwide, an estimated 20% of heart transplants occur in women, and 25% of those are for women of childbearing age (1). Not surprisingly, there are women in this population who desire pregnancy. Labor and delivery introduce significant hemodynamic changes that have implications in this population. It is estimated that at least 50% of patients have atherosclerotic disease 5 years following transplant (2). Performing an adequate block becomes important in maintaining an appropriate balance between myocardial perfusion and oxygen demand. An inadequate block may lead to a hemodynamically significant response which would lead to an increase in myocardial oxygen demand (2). Further the sympathectomy from a high block can lead to vasodilation that could limit coronary perfusion (2). Following transplantation, conduction will not cross the atrial suture line (3). Therefore, the donor atrium is considered denervated but does maintain its intrinsic mechanisms (2). One major implication of this is Bainbridge reflex, one of the mechanisms involved in compensation of supine hypotension, will be absent and the heart loses its ability to increase HR, making aortocaval syndrome more profound (4). The transplanted heart has a unique physiology that is capable of compensating for labor and delivery.

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Abstract #: F-28

Marfan's Syndrome and Aortic Dissection During Pregnancy

Presenting Author: TomMario A. Davis, MD

Presenting Author's Institution: UT Southwestern Medical Center, Parkland Hospital - Dallas, Texas

Co-Authors: Kara Bennett, MD - UT Southwestern Medical Center, Parkland Hospital

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Case: A 26 YO G3P2 at 7w5d with Marfan's Syndrome and Type B aortic dissection following the delivery of her last child was admitted to Labor & Delivery service with complaints of substernal chest pain worst with inspiration. CT angiogram demonstrated a stable Type B dissection. Cardiology and Vascular Surgery were consulted to discuss the risks of maintaining current pregnancy. Due to high risk of maternal mortality, she was offered and opted to terminate the pregnancy to avoid fatal complications such as aortic rupture. CT surgery was consulted and notified of planned D&C.

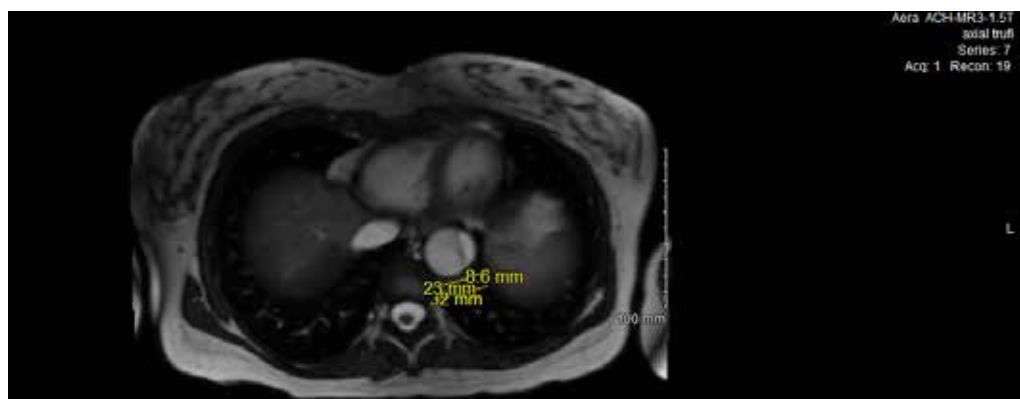
Patient underwent D&C and BTL for sterilization given maternal mortality and morbidity risk. She was closely monitored in OB step down unit post-op by cardiology where they titrated metoprolol to 50mg BID over the course of her stay. She remained asymptomatic and met post-op goals. She was discharged with MFM and Cardiology clinic follow-up.

Intraop: Patient arrived to OR where standard ASA monitors were applied. Arterial line was placed in right radial artery using sterile technique. During this period, esmolol was used to maintain heart rate between 60-70bpm. CSE was placed with 1.2 cc of 0.75% hyperbaric bupivacaine and 20 mcg of fentanyl intrathecal at 0800. Epidural catheter was placed 5cm greater than the LOR distance. Patient placed in supine position found to have T6 level block. At 0830 she complained of pain. Chloroprocaine 5ml was given through epidural catheter at 0831,0835,0838 with no effect. Midazolam 2mg was given at 0834 and 30mg, 20mg boluses of propofol at 0835,0838 due to failure of neuraxial. Procedure ended at 0849.

Discussion: Marfan's syndrome is an autosomal dominant disorder with high penetrance and variable expression. The syndrome is caused by a mutation in the FBN1 gene, which is essential for correct formation of connective tissue. This mutation in fibrillin can lead to complications such as aortic dilation and dissection and contribute to increased cardiovascular mortality. The risk for aortic dissection is greatest in late pregnancy and post-partum period, most of which present with Type A dissection, while type B is less common[1]. Patients with Marfan's syndrome frequently have concomitant scoliosis and Dural ectasia. Dural ectasia is the widening of the Dural sac with associated herniation of nerve root sleeves and this can effect the efficacy of neuraxial anesthesia. Greater than normal volume of CSF in the lumbar theca impedes the spread of the intrathecally injected local anesthetics and is thought to be one of the main reason for spinal anesthesia failure [2].

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Abstract #: F-29

Ex-Utero Intrapartum Treatment for Severe Retro- Micrognathia and Congenital High Airway Obstruction Syndrome in Breech/Vertex Dichorionic-Diamniotic Twins

Presenting Author: Suzan Ergun, MD, FRCPC

Presenting Author's Institution: McMaster University

Co-Authors: Annemaria De Tina, MD, FRCPC - McMaster University

Mark Osmond, MBBS MPhil PhD MRCOG - McMaster University

Stephen Puchalski, MD, FRCPC - McMaster University

Ex Utero Intrapartum Treatment (EXIT) is a surgical technique developed to safely establish cardiopulmonary support at delivery by maintaining and utilizing placental bypass. Indications include EXIT-to-airway, EXIT-to-resection, EXIT-to-extracorporeal membrane oxygenation, and EXIT-to-separation of conjoined twins. Anesthetic technique can be challenging and prior to the procedure interdisciplinary planning is key. The anesthetic approach is often tailored to the invasiveness of the intervention and can range from monitored care to general anesthesia.

We present a case of fetal EXIT-to-airway in a 28 G1P0 female at 35 weeks and 6 days with breech/vertex dichorionic-diamniotic twins. Twin B was diagnosed with severe retro-micrognathia on 26-week ultrasound. In addition, MRI at 30 weeks confirmed severe congenital high airway obstruction syndrome with an oropharyngeal diameter of 2 mm. Maternal comorbidities included obesity (BMI 43) and gestational hypertension managed well with labetalol. For our procedure uterine relaxation, maintenance of maternal-fetal circulation, and fetal immobilization were key for successful twin delivery and a general anesthetic was chosen. Epidural for post-operative analgesia was avoided due to risk of hemorrhage and subsequent coagulopathy. Interdisciplinary consultation and planning amongst Maternal Fetal Medicine, Obstetric Anesthesia, Pediatric Anesthesia, Pediatric General Surgery, Neonatology, and ENT Surgery occurred. Our obstetric anesthesia plan consisted of 4 chronological phases.[1] Our plan and goals for each stage were presented in several multidisciplinary meetings and prior to surgery during our surgical safety checklist. Our anesthetic goals and subsequent plan centered around 4 clearly defined phases of the operation: 1) maternal induction of anesthesia and delivery of Twin A, 2) tocolysis and safe delivery of Twin B, 3) re-establishment of uterine tone and treatment of possible post-partum hemorrhage, and 4) post-operative analgesic plan for a low transverse incision (transversus abdominis plane blocks) and emergence. The anesthetic stages went to plan, twin B was successfully intubated and progressed well, and the caesarean was completed without complications. To date, there is one other case report of fetal EXIT in twins with congenital high airway obstruction syndrome. Our case is the first to apply an organized anesthetic framework with chronological phases and the corresponding anesthetic plan to assist in the complexities of operative planning and execution.

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Abstract #: F-30

Spontaneous Coronary Dissection in a Healthy Pregnant Patient

Presenting Author: Naucika Desouza, MD

Presenting Author's Institution: Resident physician

Co-Authors: jessica Thompson, MD - Attending physician

Introduction: Acute coronary dissection is a rare cause of acute myocardial infarction (MI) in the general population[iv]. However, in pregnant patients, acute coronary dissection accounts for about 25% of total MIs during pregnancy. Although acute myocardial infarction is a rare event in women of reproductive age, pregnancy increases the risk 3 to 4-fold [i]. Mortality is high at 49%, with sudden cardiac death as initial presentation in 28% of cases[iii]. Coronary dissection during pregnancy can happen prepartum, peripartum, or postpartum. The mean onset for prepartum coronary dissection is at 23 weeks and for postpartum is at 23-26 days after delivery. Coronary dissection was the primary cause of myocardial infarction in the peripartum period, and it occurs in patients that are healthy with few if no cardiac risk factors presenting with chest pain.

Case Presentation: A 29 year old female, G5P2022 at 34w3d, with history of asthma, presented with chest pain and sudden onset dyspnea (on 11/3). EKG showed ST-elevations, with an initial troponin being negative but a repeat troponin was 5 ng/mL. She was taken for an urgent left-heart catheterization, which showed left main dissection. She received a bare metal stent to the left circumflex and LAD to LM. She had VF in the cath lab, requiring defibrillation x5 with eventual return of ROSC. She was then loaded with Clopidogrel (and aspirin/heparin). Initial post-procedure TTE was notable for EF of 30%. She developed contractions later that night and on post-MI day 1, (11/4) EF was 25-30%, with severe hypokinesis of septal, anterior, and apical wall. She underwent c/s under GA on 11/8. A femoral sheath was inserted prior to induction in the event that Impella or ECMO was needed. The patient was induced with fentanyl, propofol, and rocuronium and was an easy intubation. The infant was delivered with minimal bleeding and no complications. TEE placed with EF noted to be around 25% and was started on epinephrine and norepinephrine.

Discussion: Pregnancy-related spontaneous coronary dissection is thought to be due to an excess of progesterone, leading to biochemical and structural changes to the vessel wall involving damage to the elastic and reticular fibers [ii]. The increase in cardiac output and blood volume during pregnancy may increase shear forces in the vessels having an increased risk for dissection [ii]. The mean age of presentation for an acute coronary dissection is 33 years old with the majority of women being multiparous. Coronary dissection can be limited to one vessel or can involve multiple vessels. When it involves one vessel, it typically involves the left main coronary artery (iii). However, some cases involve multiple vessels.

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Abstract #: F-31

Severe pre-eclampsia associated with posterior reversible encephalopathy syndrome and atypical hemolytic uremic syndrome

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Atypical Hemolytic Uremic Syndrome is a complement mediated thrombotic microangiopathy that can be triggered by pregnancy. We report a case of a 49 year old G1P0 at 36 weeks gestation, who presented to labor and delivery with a severe headache, altered mental status, right upper quadrant pain, and elevated blood pressures in the severe range for pre-eclampsia (210/110). Laboratory studies showed thrombocytopenia (95K) and elevated LFT's. She was emergently delivered via cesarean section for the presumptive diagnosis of HELLP syndrome and underwent general anesthesia. Given her symptoms of headache and altered mental status, immediately post cesarean section she underwent a CT scan of the head for the suspicion of stroke. The CT scan was negative for intracranial hemorrhage but was significant for PRES, and she was admitted to the ICU. In the ICU, she subsequently developed acute kidney injury requiring hemodialysis and microangiopathic hemolytic anemia. The patient received immunosuppressive therapy with Eculizumab and she responded well.

Abstract #: F-32**Complex Labor Analgesia and Hemorrhage Management in the Setting of Thrombocytopenia****Presenting Author:** Monica DiLorenzo, MD**Presenting Author's Institution:** Mount Sinai Hospital - New York, New York**Co-Authors:** Daniel Katz, MD - Icahn School of Medicine at Mount Sinai

A 41 year old female G8P7007 presented to labor and delivery at 39 weeks gestation for induction of labor due to known immune thrombocytopenic purpura (ITP). She requested labor analgesia, with a preference for an epidural, as she had had them twice in the past. A platelet count and viscoelastic testing were obtained and it was determined that the risks of neuraxial analgesia outweighed the benefits, resulting in her choice of nitrous oxide for pain management. Following vaginal delivery, the patient experienced a rapid post-partum hemorrhage, which anesthesia and obstetrics treated in the setting of ITP. At the conclusion of her care, the patient compared various forms of labor analgesia, offering a unique insight across eight deliveries including epidural analgesia, no medical analgesia, and nitrous oxide. The case presented unique challenges for pain management and hemorrhage management in the setting of a known coagulopathy and scant supportive guidelines or literature.

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Abstract #: F-33**A Case Report of Subdural hemorrhage after seemingly uncomplicated epidural placement****Presenting Author:** Elysha Dinh**Presenting Author's Institution:** VCU Health**Co-Authors:** Geoffrey Fisher - VCU Health

Aaron Lim - VCU Health

38 y/o G3P2 admitted for elective induction of labor. Epidural placement at L2/3 was uncomplicated and patient had an uneventful delivery. PPD1: she reported headache consistent with post dural puncture headache (PDPH). Symptoms improved with conservative management and patient discharged. PPD4: patient returned with ongoing headache (HA) consistent with PDPH. Epidural blood patch (EBP) was performed at L3/4 with 20 mL of autologous blood. She had significant relief of symptoms within minutes. PPD24: she returned to the hospital with blurry vision reporting that since discharge she had been having milder, intermittent headaches which were no longer positional. MRI showed chronic bilateral subdural hemorrhages (SH). She went to the OR for burr hole washout. Patient had marked improvement of symptoms on POD1 and was discharged POD3.

Prompt diagnosis of SH can be challenging. Even in cases with *no signs of obvious injury* to the dura at the time of epidural placement, high clinical suspicion must be maintained for prompt diagnosis. Though imaging is often unnecessary in evaluation of PDPH, a reasonable approach suggested by Szeto et al would be to consider imaging patients with

1. Change from postural to non-postural HA
2. Not improving/worsening HA after EBP
3. Postural HA > 1 week
4. Neurologic signs/symptoms¹

Case reports have discussed use of EBP as a treatment for SH due to CSF leakage². Although this patient's PDPH was appropriately and promptly treated with EBP, SH still developed and progressed, requiring surgical intervention. This underscores the importance of close follow-up after neuraxial anesthesia, even in straightforward cases or cases in which seemingly successful treatment is delivered.

Perhaps the most valuable lesson is that headaches after neuraxial anesthesia should be monitored closely not only during hospitalization, *but also after discharge*. The duration between dural puncture and diagnosis of SH ranges anywhere from 4 hours to 29 weeks³. Therefore, all PDPHs (even after successful EBP) should be extensively counseled to present for re-evaluation if any red flag symptoms occur (vision changes, convulsions, focal neurologic signs)⁴. Education on more subtle presentations (HA lasting greater than 1 week, change from postural to non-postural, and HA that fails to resolve after EBP) should be provided. Consider following up after discharge via phone if resources are available.

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Abstract #: F-34

When Best-Laid Plans Go Awry: Intraoperative Management of New-Onset Panic Attack During Scheduled Cesarean Delivery

Presenting Author: Olga I. Diomede, MD, MS

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Laurie Sutherland, MD - Maine Medical Center - Department of Anesthesiology and Perioperative Medicine

A 40 y.o. G5P2022 female at 37w3d gestation with a past medical history of GERD presented to L&D Triage for a scheduled repeat Cesarean section and bilateral salpingectomy. Her pregnancy had been complicated by advanced maternal age and history of two prior Cesarean deliveries. Both of her prior Cesarean deliveries were notable for challenging placement of the spinal anesthetic. Her second Cesarean delivery was complicated by deep myomectomy of a large uterine fibroid with significant blood loss requiring post-operative blood transfusion. Anesthetic plan included delivery under spinal anesthesia, which would be placed by an experienced anesthesiologist as per patient's request. Patient's vital signs were stable prior to the operation. Laboratory data were within expected parameters. NPO status, allergies and medications were reviewed. No contraindications to neuraxial anesthesia were identified. Following uneventful placement of spinal anesthetic, Cesarean section proceeded as planned, and a healthy infant was delivered without any complications. Shortly after the delivery and initiation of skin-to-skin, the patient became tearful, restless, agitated and started complaining of severe dyspnea, chest tightness, and paresthesia in both hands. Her vital signs were notable for tachypnea and sinus tachycardia to 164 bpm but were otherwise stable. After careful review of the patient's psychiatric history, no prior history of generalized anxiety disorder, PTSD, specific phobias, panic disorder, or other mental illnesses were identified. Given concern for a new-onset panic attack, the patient was reassured of her safety as well as safety of the infant and promptly given 2 mg midazolam. Her symptoms were relieved almost instantaneously, and the operation was finished in a normal fashion. At the conclusion of the case, she was transferred to the recovery area, as planned. The remainder of her hospital stay was uneventful, and she was discharged home on POD #3.

Panic disorder is a subgroup of anxiety disorders characterized by recurrent spontaneous panic attacks. Despite being fairly uncommon among pregnant women, its incidence among parturients is estimated to be in the 0.2-5.2% range. Prompt recognition and treatment of peripartum anxiety, phobia(s), and panic attacks is vital to ensuring patient safety and improving maternal and fetal outcomes as well as overall satisfaction with birthing experience.

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Abstract #: F-35

Cardiac Myxoma in a Parturient

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Co-Authors: Lester Chua, MD - University of Massachusetts Medical School - Baystate

Introduction: Atrial myxomas are the most common benign tumors of the heart and occur primarily in the atria. The incidence in pregnancy is low and raises concern of embolization in the hypercoagulable state of pregnancy. Prompt resection of myxomas is recommended¹ and these risks must be weighed against the risk of the parturient undergoing cardiopulmonary bypass (CPB). We report a case of a parturient with a left atrial myxoma who underwent a caesarean delivery with resection of the atrial myxoma.

Case Report: 39 year old female G2P1 34+1 who presented to the hospital for abnormal echo results following baseline echo for Takayasu arteritis. Past medical history includes depression, GERD, migraine and obesity. During her 1st trimester she developed severe right foot and leg pain as well as palpitations and was diagnosed with Takayasu arteritis treated with steroids. An echo was done on EGA 34+1 and was significant for a 5.5 cm myxoma in her left atrium prolapsing through the mitral orifice. At this time, the patient was asymptomatic. An interdisciplinary meeting was held with anesthesiology, maternal fetal medicine, cardiology and Cardiothoracic surgery. The discussion was centered on timing and mode of delivery. Given her morbid obesity and last vaginal delivery 8 years ago, risk of a failed induction would be high. She then underwent caesarean delivery under spinal with an estimated blood loss of 800mL. She then proceeded to cardiac surgery for left atrial myxoma removal with patent foramen ovale closure at 3 days post op c-section.

Conclusions: Myxomas can present in a variety of clinical manifestations as obstructive, embolic or constitutional. Given its unique situation, no consensus recommendation exists as to the preferred and the optimal mode of delivery, or for the timing of cardiac surgery in pregnant women with atrial myxoma. CPB early in pregnancy has reduced maternal risk but may result in preterm labor or fetal death. Delaying cardiac surgery may increase the risk morbidity and mortality. There are strategies that have been developed for parturients undergoing CPB which include; MAP greater than 70mmHg, maintaining left uterine displacement and high flow rate (2.5 L/min per m²) to maximize uteroplacental perfusion². Several cases have been described³ with 26 reported deliveries with either c-section (n = 19) or vaginal delivery (n = 7), 20 (76.9%) were event-free survival, 4 (15.4%) were complicated, and 2 (7.7%) died. Neonatal outcome was not different between the modes of delivery or the timing of the cardiac surgery in relation to delivery.

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Abstract #: F-36

Achondroplasia in the Parturient

Presenting Author: Nicholas Dunn, MD

Presenting Author's Institution: The Ohio State University Wexner Medical Center

Co-Authors: Blair H. Hayes, MD - Ohio State University Wexner Medical Center

Case: Our patient is a 23-year-old, G3P0020 woman with a PMH of HTN, depression, anxiety, and achondroplasia who presented at 40w GA for a scheduled IOL. She was 99.1cm tall and weighed 47.2 kg. Her obstetric history included two prior spontaneous abortions. For her achondroplasia, she underwent two limb-lengthening surgeries as well as a total spinal fusion reportedly complicated by a hardware infection. She was a Mallampati III, with good neck mobility. Despite unpredictable efficacy due to PSH of instrumentation, patient was offered and subsequently declined epidural analgesia. Her cervical exam reached 4-5cm/70%/-2 and failed to progress. She proceeded with the recommended cesarean delivery under spinal anesthesia performed at the L4-5 level. Spinal dose included 1ml of 0.75% bupivacaine and 0.05mg of PF morphine and was administered on the first attempt. A T4 surgical level of anesthesia was achieved and remained sufficient through the 95 minute case. Both the intra- and post-operative courses were uneventful and the patient was discharged POD3.

Discussion: Achondroplasia is the most common bone dysplasia in humans with a prevalence of 1 in 15,000-20,000 live births (1). It is an autosomal dominant condition, however around 80% of cases arise from a spontaneous mutation (2). The clinical features include: short stature (adults typically measuring less than 120 cm), macrocephaly, and long-bone shortening predominantly affecting the proximal aspect of the upper and lower extremities.

Given the variability in phenotypes seen with achondroplasia, no consensus exists regarding preferred anesthetic technique or ideal dosing for neuraxial anesthesia in the obstetric patient. We chose our spinal dose given it was a primary cesarean delivery and because her torso measured to be shorter than the average patient. Various forms of neuraxial anesthesia have been reported as well, such as single-shot spinal anesthesia (2), continuous labor epidural anesthesia (4), and combined spinal-epidural anesthesia (3). Especially in a parturient with instrumentation, neuraxial anesthesia may be procedurally difficult and complicated by unpredictability of medication spread.

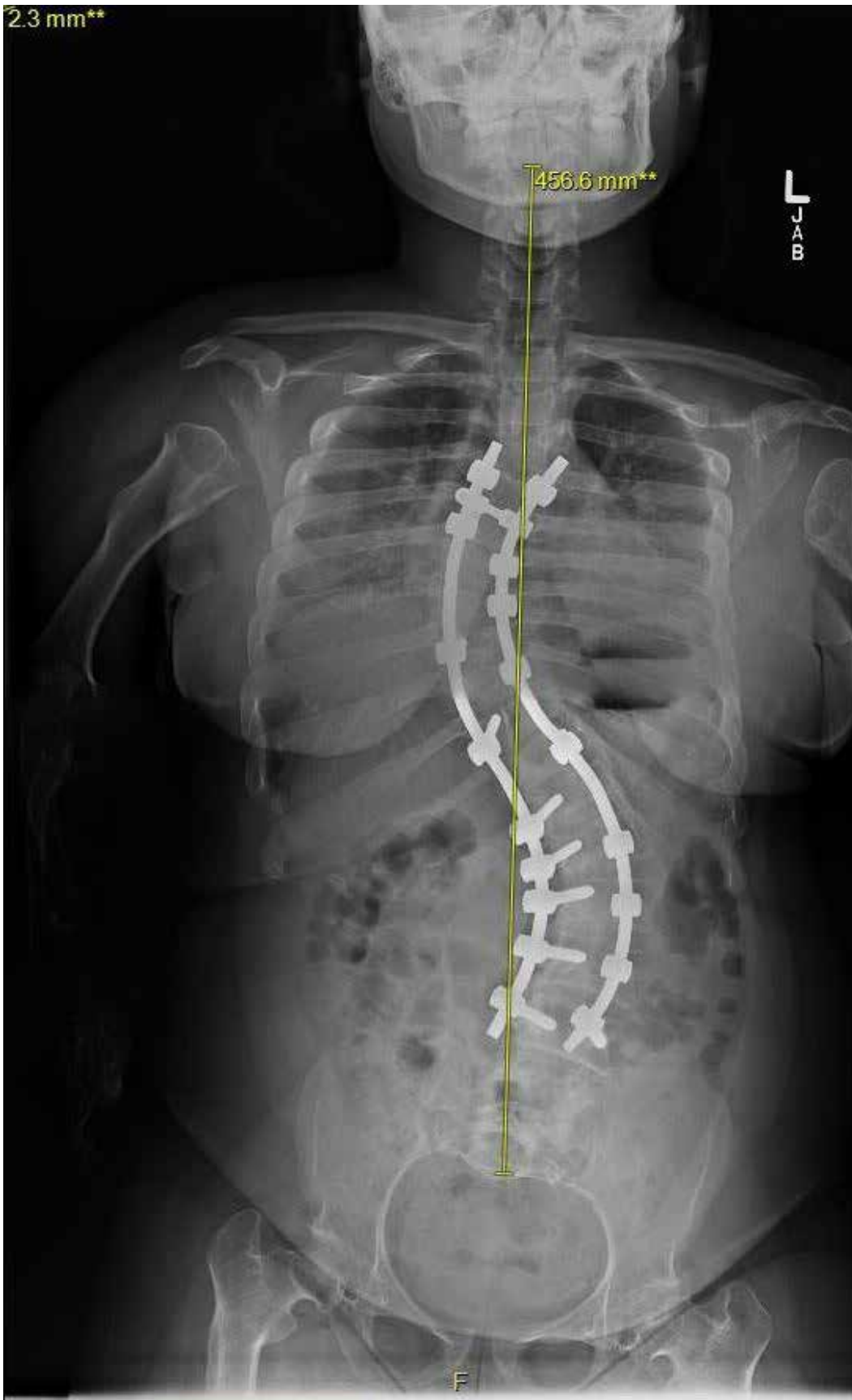
The other major anesthetic concern is airway management. Case studies have reported success with general endotracheal anesthesia (5), although multiple airway considerations exist, especially in the parturient. Patients with achondroplasia can have limited oral opening, cervical spine limitations, macroglossia, enlarged tonsils and adenoids, and OSA, all making airway management more difficult.

Achondroplasia can pose significant anesthetic challenges in the obstetric patient. Our case demonstrated the safety and efficacy of single-shot spinal anesthesia in this population.

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Abstract #: F-36



Abstract #: F-37

A Pregnant Transgendered Patient with Critical Bicuspid Aortic Stenosis

Presenting Author: Robyn Dwan, DO

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Introduction: Cardiac disease is a top contributor to maternal mortality and morbidity in the US.¹ Bicuspid aortic valve (BAV) is the most common congenital heart lesion, affecting 0.5%-2% of the population.² We present a case of management of a transgender (TG) female to male patient with limited pre-natal care undergoing primary cesarean delivery (CD) due to severe aortic stenosis (AS) secondary to BAV.

Case: A 22 yo TG male, biologically female, G1P0 with a history of BAV presented at 32+5wks GA due to lightheadedness, angina, and SOB. He had limited prenatal care and no cardiology follow-up since childhood. TTE revealed BAV with a mean gradient of 56 mmHg and AVA 0.5 cm². By 33+2wks GA, he was experiencing NYHA class III symptoms with worsening angina and orthopnea and decision was made to proceed with delivery. A multidisciplinary team was assembled, consisting of MFM, congenital cardiology, CT surgery, nursing, and OB and CT anesthesia. CD under general anesthesia in a cardiac OR was planned with femoral cannulation and ECMO standby. Following rapid sequence induction and intubation with McGrath laryngoscope, the patient remained hemodynamically stable on norepinephrine infusion. A 2110g fetus was delivered, with Apgars of 7 (1min) and 8 (5min). The patient tolerated delivery without decompensation. Intra-operative TEE showed AVA 0.6 cm², mean gradient 48 mmHg, and normal biventricular function. Uterine tone was maintained with misoprostol and oxytocin, and EBL was 500 mL. At the conclusion of the procedure the patient was transferred to the cardiovascular ICU on propofol and dexmedetomidine. He was extubated on POD 0 and was discharged from the hospital on POD 3. The patient returned on POD 9 for successful balloon valvuloplasty.

Discussion: Stenotic valvular disease is poorly tolerated in pregnancy due to physiologic changes related to increased blood volume and decreased SVR. Using the CARPREG II risk index, this patient had a 40-45% risk of any cardiac complication during pregnancy.³ Unfortunately, TG individuals frequently postpone medical care citing discrimination, lack of insurance, and even refusal of care in nearly 20% of patients.⁴ Lack of preconception counseling and cardiology follow-up in this case likely contributed to significantly increased risk to mother and fetus. As growing numbers of TG males choose to conceive and carry pregnancies, efforts must be made to break down barriers to care in order to improve outcomes. Despite late entry to care and advanced stenotic valvular disease, we present a successful peripartum course in a TG patient with critical AS, highlighting the importance of a multidisciplinary team approach in patients with complex medical and obstetric histories.

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Abstract #: F-38

Shared Decision Making in the Face of Uncertainty: Spinal Anesthesia for Cesarean in a Parturient with Arnold-Chiari Malformation, Cervicothoracic Syringomyelia, Tethered Thoracic Cord, and Scoliosis

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Introduction: Uncertainty poses a challenge to decision-making and preserving patient autonomy.¹ This case involved anesthesia for cesarean delivery (CD) in a patient with very complex neuropathology, which, on the surface, might be assumed to contraindicate neuraxial anesthesia.

Case: Anesthesia consult was sought 2 weeks before scheduled CD at 39 weeks for 30y pharmacist G1, 81 kg, with uncomplicated pregnancy. Scoliosis, diagnosed age 12, was treated with brace. Progressive neurologic symptoms led to imaging, age 18, revealing Chiari malformation (CM) and cervicothoracic syringomyelia (CTS). Despite CM decompression and syrinx-subarachnoid shunt, spasticity persisted, so shunt was removed. After years of symptom management with high-dose antispasmodics, inadequate CM decompression and circumferential tethered thoracic cord were diagnosed. She had vast improvement after repeat CM decompression, duraplasty, and partial cord untethering via laminectomies, at age 27. Follow up MRI: reduced diameter of CTS, well-decompressed CM. Her neurosurgeon deemed pregnancy safe, but recommended CD to limit cord stretch injury and advised "caution with epidural use." MRI in pregnancy was stable: C3-T11 syrinx; conus termination L1-L2; mild dextroscoliosis; no signs of intracranial hypertension. She claimed right-arm burning, hot/cold insensitivity, fatigue, and numbness.

A search yielded only case reports/series and no evidence definitive in guiding best anesthetic technique.^{3,4} We discussed with her neurosurgeon (distant city) and neurology consultant locally; both endorsed offering her a choice. We achieved consensus among our group by circulating a detailed consultation draft for review. Finally, we discussed all of this with the patient. Having assumed neuraxial was contraindicated, she was hesitant yet pleased with the option of experiencing childbirth with husband present. She deliberated, and 2 weeks later, presented for CD and chose spinal (25G Pencan, 1.65 mL 0.75% bupivacaine/D8.25%, 15 mcg fentanyl, 150 mcg morphine). Anesthesia, CD, and recovery were uneventful. Neurologic symptoms improved by 2-month follow up.

Discussion: Although unique, this case exemplifies a common challenge: decision making amidst great technical uncertainty (lack of guiding evidence).² Consensus building is one strategy to manage uncertainty¹ and was achieved in this case, important since the specific anesthesiologist to provide her care was yet to be determined. This helped ensure she be afforded a choice upon presentation, rather than be denied due to tendency to adhere to "medical orthodoxy" (refuse to offer neuraxial) in presence of uncertainty.¹ Preserving patient autonomy and SDM are easier when one option is clearly superior, or when options are equally safe/effective. Uncertainty makes this much more difficult, especially when stakes are high (e.g. neurologic injury), regardless of how rare or theoretical.

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Abstract #: F-39

Practice at Odds with Recommendations for Preventing Contraceptive Failure after Sugammadex Exposure: Survey of Provider Knowledge, Practices, and Views on Patient Autonomy and Shared Decision Making

Presenting Author: Robyn Dwan, DO

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Co-Authors: Britany Raymond, M.D. - Vanderbilt University Medical Center

Michael Richardson, MD - Vanderbilt University Medical Center

Introduction: Although neostigmine (NEO) remains available, sugammadex (SG) became the neuromuscular block (NMB) antagonist of choice in our hospital in Feb 2017. Since SG also binds progesterone with high affinity, risking unintended pregnancy in women using hormonal contraception (HC), alternative contraception is recommended for 7 days after SG exposure. Some have urged proactive management of this interaction by anesthesiologists.^{1,2} We surveyed anesthesiology providers about knowledge of this drug interaction, how they apply it clinically, and who makes/should make choices in the matter.

Methods: REDCap was used to survey 4 groups: 54 residents (R), 34 SRNAs (S), 79 CRNAs (C), 92 attending anesthesiologists (A). The survey included 29 questions regarding experience using NEO, knowledge about the SG-contraceptive interaction, pre-/post-op counseling, clinical management, and shared decision making (SDM) regarding the use of SG vs NEO.

Results: Overall completion was 153 of 259, 59% (85%R, 53%S, 60%C, 46%A). Nearly all respondents (164/165) knew SG interferes with oral HC. Far fewer accurately identified SG interference with hormone IUD (44%) and 2 specific implants (55%, 54%). The recommended 7-day duration of alternative contraception was correctly identified by only 71-77%, most others reporting longer durations (10-30 days). Most (71-93%) agreed/strongly agreed that potential SG interference with contraceptive effectiveness should be discussed pre-op. Most (70-94%) endorsed SDM or patient choice of SG vs NEO. In stark contrast, many respondents reported rarely or never having discussed this drug interaction with patients in practice, pre- or post-op (fig). Most also reported rarely or never intentionally administering NEO to avoid this drug interaction (fig). Of note, R group reported little if any experience/familiarity administering NEO (). 90% females and 69% males denied difficulty discussing the topic with patients.

Conclusions: Rare inquiry regarding contraceptive use combined with lack of accurate knowledge of SG interference with hormone IUDs and implants is problematic, especially since the latter are often absent from medication lists. Most providers endorsed pre-operative counseling regarding this drug interaction, and support patient autonomy and SDM regarding choice of NMB antagonist. Yet, in practice, the same respondents reported rarely, if ever, actualizing these positions. Values-based practice³ and quality⁴ lenses help to clarify reasons for such conflicting findings in a complex system. Both also suggest strategies to address tensions between technical evidence (NMB antagonism safety; drug interactions), individual values, and ethical principles—e.g., prioritizing patient needs/values, patient autonomy, free flow of info, sharing of knowledge, information technology, education/professional development, and safety as a system property.

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Abstract #: F-39

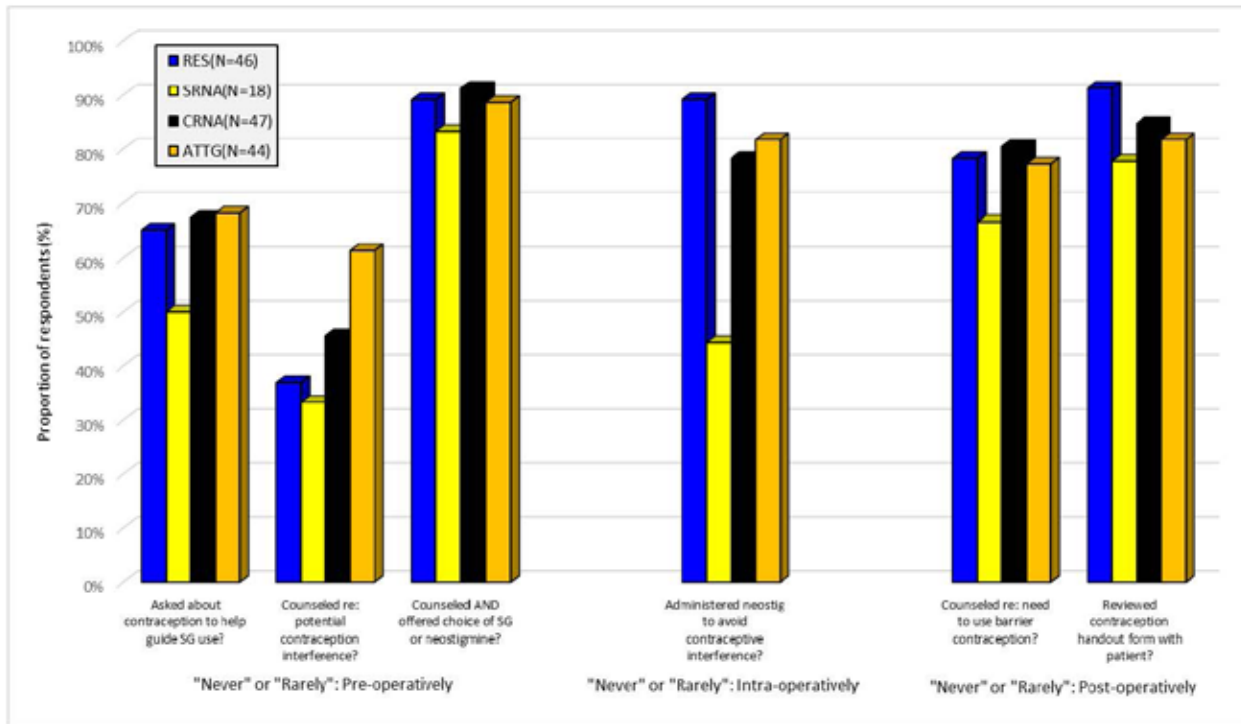


Figure: Proportion of survey respondents reporting "never" or "rarely (<10%)" to questions about their clinical practices: "With patients taking hormonal contraceptives, how often have you..."

Abstract #: F-40

A Case Study of the Birth Justice Movement in The US and its Implications for Obstetric Anesthesiology

Presenting Author: Nwadiogo Ejiogu, MD, MA

Presenting Author's Institution: McGaw Medical Center of Northwestern University

Introduction: Despite rates of pregnancy related deaths declining worldwide, the US has seen an increase in maternal mortality. This increased risk of mortality unevenly impacts black women who are thrice more likely to die from pregnancy related causes than white women (1). It is thought that there are many factors that contribute to this disparity requiring solutions such as policy changes, standardized data collection, expanding insurance coverage and addressing implicit bias. While black birthing people are often mentioned in discussions of this inequity, it is rare that their expertise is highlighted. This case study wishes to center black-led initiatives to solve this human rights issue.

Case Study: Birth justice is a growing black-led social movement that seeks to empower parents and eliminate disparities experienced by black, low-income and LGBTQ parents (2). The increased rates of poor health outcomes experienced by black birthing parents are one of many health equity issues that birth justice activists seek to address. And while birth justice activists have similar recommendations to those proposed by researchers there are some key differences.

The birth justice movement:

1. Places inequities in birthing outcomes within a historical context of slavery and segregation.
2. Uses an intersectional framework to reduce pregnancy related health inequities.
3. Rejects biological notions of race that use genetic explanations to understand this disparity and asserts the problem is not with black bodies but instead with institutionalized inequities.
4. Advocates for the expansion of access to doula support and midwifery care.
5. Involves black parents in maternal health research, care solutions, policy design and review processes.

Discussions: Cardiovascular pathologies are the leading causes of maternal mortality in the US-conditions that OB anesthesiologists have expertise in managing. It is for this reason that OB anesthesiologists are becoming advocates in efforts to reduce maternal mortality (3). Considering anesthesiologists are participating in public health interventions, understanding pregnancy related inequities is crucial to implementing change. For instance, a birth justice framework in OB anesthesiology would prioritize black leadership in developing research questions and designing policies. This perspective calls for data collection that requests stratification not just based on language, racial/ethnic identities, but on a range of intersecting identities. Incorporating a birth justice perspective could lastly incentivize hospitals to reduce care disparities by making it criteria for quality measures.

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Abstract #: F-41

Risk factors for the development of uterine atony following vaginal or cesarean delivery: A systematic review

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INTRODUCTION: Postpartum hemorrhage (PPH) affects 3-10% of all deliveries and contributes significantly to maternal morbidity and mortality, accounting for nearly 20% of maternal deaths.^{1,2} Early identification of clinical risk factors (RF) for PPH can improve preparedness and response times to reduce morbidity and mortality.³ Uterine atony accounts for nearly 70% of all PPH cases.⁴ However, among clinical investigations that identify PPH RF, many are conflicting and/or analyze all-cause PPH risk. Delineation of RF specific to atonic PPH might allow providers to better shape risk stratification tools to more precisely predict and prepare for patients at risk of atonic PPH. We performed a systematic review of the literature to identify RF specifically related to the development of atony or atonic PPH following vaginal or cesarean delivery.

METHODS: The PubMed, CINAHL, EMBASE, and Web of Science databases were searched in December 2018 for English language studies without restriction on publication date. PubMed MeSH headings included but were not limited to postpartum hemorrhage, uterine hemorrhage, uterine inertia, causality, epidemiology, incidence, methylergonovine, misoprostol, oxytocin, prevalence, risk factors, and risk, along with corresponding keywords. The PubMed search was translated for CINAHL, EMBASE, and Web of Science. Eligibility for inclusion was limited to prospective randomized, observational, retrospective cohort, and case-control studies with pregnant patients who delivered a viable gestation fetus and developed postpartum atony, atonic PPH, or severe atonic PPH. Included studies reported either odds ratios or raw data allowing calculation of odds ratios for RF in patients with and without atony, atonic PPH, or severe atonic PPH. Two blinded authors (HE,JL) reviewed abstracts and full-text articles; then a third blinded author (JB) resolved conflicts. Abstract and full-text screening were done using the Raayan web application. Risk of bias assessment was conducted using a validated tool by two initial authors (HE,DC), and conflicts were resolved by a third blinded author (JB).⁵

RESULTS: Overall, 1239 abstracts were screened, and 29 studies were included in the final analysis. Thirty-one distinct RF were identified. Information regarding the total number of studies reporting on each factor, the number of studies that found the factor to increase risk significantly, and the range of odds ratios are reported in the Table.

CONCLUSION: The risk of atony or atonic PPH is increased by factors related to maternal demographics, maternal comorbidities, pregnancy-related conditions, and delivery-related factors. Risk prediction tools should be based on the odds of developing atonic PPH and should be validated in the research and clinical environments.

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Abstract #: F-41

Table: Risk factors associated with postpartum atony, atonic PPH, or severe atonic PPH

Risk factor	Number of studies evaluating risk factor	Number of studies showing increased risk	Odds ratio range (low)	Odds ratio range (high)	Outcome(s) assessed
MATERNAL DEMOGRAPHICS & HISTORY (9)					
Young age	7	1	1.8	1.8	saPPH
Old age	7	2	1.13	1.7	aPPH, saPPH
Hispanic ethnicity	4	4	1.15	2.26	aPPH, saPPH
AAPI ethnicity	3	2	1.31	1.71	aPPH, saPPH
Native American ethnicity	1	1	2.0	2.0	aPPH
African American race	3	2	1.14	1.18	aPPH, saPPH
Multiparity	5	1	2.47	2.47	aPPH
Nulliparity	5	1	1.51	1.51	aPPH
Prior atony or PPH	4	3	1.74	6.35	atony, aPPH, saPPH
MATERNAL COMORBIDITIES (5)					
Hypertensive disorders of pregnancy	9	7	1.44 (aRR)	4.90	atony, aPPH, saPPH
Diabetes	3	2	1.28 (aRR)	7.67	atony, aPPH
Anemia	4	2	1.15	2.46	atony, aPPH
Obesity	5	1	2.25	2.25	atony, aPPH
Fibroids	3	1	1.84	1.84	saPPH
PREGNANCY-RELATED FACTORS (5)					
Polyhydramnios	7	3	1.46 (aRR)	1.9	atony, aPPH, saPPH
Multiple gestation	8	6	1.86	9.45	atony, aPPH, saPPH
Placental disorders (previa, retained, other)	4	4	1.48	3.91	aPPH, saPPH
Antepartum hemorrhage	1	1	3.8	3.8	saPPH
Macrosomia	7	4	1.44 (aRR)	2.03	atony, aPPH
DELIVERY-RELATED FACTORS (12)					
Gestational age	4	1 (>41w)	1.29	1.29	atony
Chorioamnionitis	6	5	1.56 (uOR)	2.77 (aRR)	atony, aPPH, saPPH
Pre-delivery oxytocin exposure	9	6	1.09	1.94	atony, aPPH, saPPH
Induction of labor	12	7	1.16	15.22	atony, aPPH, saPPH
Prolonged labor	9	7	1.27	4.06	atony, aPPH, saPPH
Episiotomy or perineal trauma	4	4	1.27	8.37	aPPH, saPPH
Instrumented vaginal delivery	3	2	1.23	4.27	aPPH
Cesarean delivery	6	3	1.15	1.88 (aRR)	aPPH, saPPH
Stillbirth	2	1	1.34 (uOR)	1.34 (uOR)	aPPH
Epidural anesthesia	2	1	1.05	1.05	aPPH
Magnesium exposure	2	1	1.17	1.17	aPPH
Delayed care	1	1	1.29 (uOR) call OB>10min	1.81 (uOR) oxy>20min	saPPH

AAPI = Asian American and Pacific Islander, PPH= postpartum hemorrhage, aPPH = atonic PPH, saPPH = severe atonic PPH (EBL>1500ml and/or requiring transfusion)
aOR unless otherwise noted

Abstract #: F-42

Management of Pregnancy-Induced RVOT Ventricular Tachycardia During Labor

Presenting Author: Peace Eneh, MD

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Co-Authors: Paul Davis, MD - Mayo Clinic

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Background: Hormonal effects, changes in autonomic tone, and increasing venous return/cardiac output may increase the incidence of various cardiac arrhythmias during pregnancy.¹ Ventricular tachycardia (VT) originating from the right ventricular outflow tract (RVOT) is the most common form of VT seen in pregnancy and can carry significant morbidity².

Case Report: A 31 year old G2P1001 was admitted at 38w5d for induction of labor secondary to history of non-sustained RVOT ventricular tachycardia. Home medications included flecainide and metoprolol. On admission, the ECG was notable for occasional premature ventricular contractions with self-limiting runs of tachycardia up to 114 bpm. Twelve hours into her induction with misoprostol, a Foley bulb and artificial rupture of membranes, she was noted to have increasing ventricular ectopy with runs of sustained monomorphic VT (figure 1). Her blood pressure remained stable, but she developed palpitations and anxiety. The fetal heart rate tracing was category II with late and variable decelerations. She was transferred to the ICU for initiation of an esmolol infusion which was titrated to a heart rate of 60-100 bpm. A dural puncture epidural was performed and the patient was transferred back to the labor floor once a stable dose of esmolol was achieved. As labor progressed to the second stage, the patient became more hypotensive (SBP 70-100s) and developed sustained ventricular tachycardia. A 90 mg IV bolus of lidocaine was given to attempt rhythm stabilization prior to pushing but was poorly tolerated by the patient secondary to CNS symptoms. Shortly thereafter, she had a spontaneous vaginal delivery. Apgar scores were 8 and 9 at 1 and 5 minutes, respectively. She was transferred to the ICU for cardiac monitoring. In the postpartum period she had ventricular trigeminy but converted to sinus rhythm after six hours and esmolol infusion was discontinued. She was discharged on post-partum day two and underwent cardiac ablation 1 month later.

Discussion: This was a complex case of a parturient with worsening RVOT tachycardia requiring esmolol, lidocaine and multidisciplinary care. Early neuraxial analgesia can decrease catecholamine release and may prevent arrhythmias during labor; however, this patient developed sustained VT in the setting of a working epidural. In the setting of hemodynamic instability, electrical cardioversion should be considered but pharmacological therapy should be used if hemodynamically tolerated. Beta blockers are often first line and esmolol is short acting and titratable. Lidocaine was used but verapamil is an alternative agent.² Cesarean delivery should be reserved for obstetric indications or maternal or fetal compromise. Multidisciplinary care and early neuraxial analgesia is recommended in parturients with arrhythmias in pregnancy.

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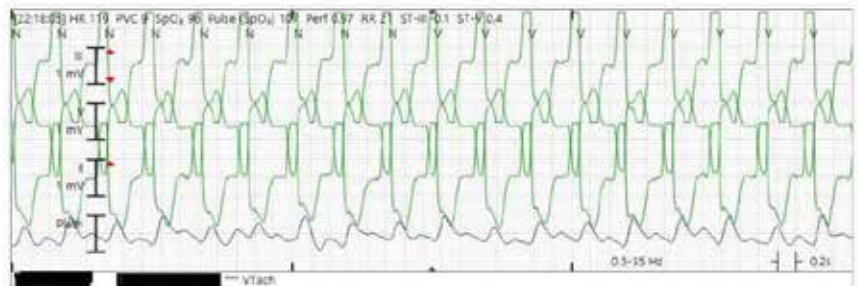


Figure 1: Intrapartum cardiac monitoring strip showing sustained ventricular tachycardia.

Abstract #: F-43

Worsening advanced stage heart failure and cardiomyopathy in a patient advised to have an early first trimester life-saving termination of pregnancy

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Heart failure in pregnancy is a fairly common finding in the United States and 13% of cases present in the antepartum period. There is significant morbidity and mortality associated with advanced stages of heart failure and early detection is paramount to improving outcomes. Physiologic and gross anatomic changes associated with advanced heart failure include a 30-50% increase in both cardiac output and blood volume. The heart itself can increase up to 30% in size which could potentially worsen mitral regurgitation. If a pregnancy is allowed to continue when severe symptoms are ongoing, disastrous outcomes could potentially be expected for both the mother and fetus. Further complicating the issue is the fact that certain treatments necessary to stabilize and possibly down-grade the stage of heart failure are contraindicated in pregnancy, thus limiting the ability to control symptoms if a pregnancy were to continue. According to the WHO guidelines on heart failure in pregnancy, patients with a left ventricular ejection fraction less than 30% with or without NYHA Class III or higher symptoms results in a Class IV contraindication to pregnancy.

We present the case of a 30-year-old G3P2 female with a history of Stage C non-ischemic cardiomyopathy, stage IIIA heart failure with an ejection fraction of 21%, and severe mitral regurgitation being medically managed. The patient had an ICD placement in 2016 and was not considered a heart transplant candidate due to ongoing smoking. In April, 2019 she was informed that she should not pursue any more pregnancies given her poorly controlled heart failure symptoms. The following month, however, she presented to the obstetric clinic pregnant at 9 weeks gestation. She was seen by our multidisciplinary critical care and advanced heart failure teams and was advised to consider a life-saving, early first trimester termination of the pregnancy. A risk versus benefit discussion led the patient to decide that termination was deemed the safest course of action. She underwent her surgical procedure two weeks later.

We elected to perform a low-dose combined spinal-epidural anesthetic with bupivacaine and fentanyl. We opted against general anesthesia due to the higher potential for impaired cardiac preload and severe hypotension upon induction. We further believe this was the ideal anesthetic strategy in order to titrate our anesthetic precisely and respond to changing hemodynamics.

This case demonstrates the importance of understanding the profound physiologic derangements present in pregnant patients with severe systolic heart failure and how to manage them peri-operatively using an advanced multidisciplinary obstetrics-centered critical care team headed by an obstetrical anesthesiologist.

Abstract #: F-44

Labor Epidural Placement After Epidural Blood Patch: A Case Report.

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Co-Authors: Immanuel Jacques, MD - Indiana University School of Medicine

Magdalena J. Skrzek, MS - Indiana University School of Medicine

Introduction: Accidental dural puncture (ADP) during labor epidural (LE) placement is a substantial complication that needs to be addressed and treated if symptoms occur. Administration of epidural blood patch (EBP) is standard of care for post dural puncture headaches (PDPH).¹ Autologous EBP works in two ways: it displaces the volume of cerebrospinal fluid (CSF) that was lost, therefore increasing the CSF pressure and it forms a clot that closes off the punctured dura.² Administration of an EBP followed by a placement of subsequent LE has not been sufficiently investigated in gravid patients and more research needs to be directed towards this unusual circumstance.³

Case: A 30yo G1P0 parturient was admitted for spontaneous labor at 37wks estimated gestational age. Patient had a BMI32 and no PMH or PSH. An oxytocin infusion was started to augment labor. Patient requested LE at 4cm dilation. LE placement was attempted using a 16-gauge Touhy needle at L3-L4 via intervertebral approach, which resulted in ADP. Ensuing LE catheter placement at L4-L5 was successful and confirmed by a negative test dose of 3ml lidocaine 1.5% with epinephrine. Infusion was set at 8ml/hr with 0.25% ropivacaine. OB staff decided to abandon labor 12hr after commencing oxytocin treatment, due to lack of progress. Oxytocin and LE was ceased and patient was monitored for further progress. Patient complained of severe PDPH 2hrs after removal of LE catheter. EBP was administered in L3-L4 region, 24hrs after initial LE placement. Patient experienced immediate relief of PDPH. Labor activity resumed approximately 16hrs after EBP treatment and patient requested LE for a second time. Patient was consented for risks associated with LE after EBP and approved LE placement. Epidural catheter was placed successfully at L4-L5 via midline approach and confirmed by a negative test. Infusion with 0.25% ropivacaine was set at 6mg/hr. Patient's vaginal delivery was uneventful. Mother and newborn did not suffer any further complications or PDPH.

Conclusion: This is a unique case of administering EBP to a pregnant patient, followed by a subsequent LE within a 48hr period. There are currently no recommendations for the time frame when a LE can be placed after a recent EBP for PDPH.³ LE placement after a recent EBP can be challenging due to risks of infections, uncertainty in level of analgesia and increased chance of PDPH.^{1,3} It is important to further investigate the safety and efficacy of this treatment method for PDPH in gravid patients.

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3. Whitwell, et al. Successful Neuraxial Analgesia After Recent Epidural Blood Patch. *A&A Case Reports* 2015, 5(4), 51-53

Abstract #: F-45**More Than Just Baby Brain: Alzheimer's in Pregnancy****Presenting Author:** Candy Ezimora, MD, MBA**Presenting Author's Institution:** University of North Carolina Hospitals**Co-Authors:** Jeremy Gue, MD - University of North Carolina Hospitals

Kathleen Smith, MD - University of North Carolina Hospitals

A 41-year-old G6P5 woman with a history of familial early-onset dementia presented at 36w0d for abdominal pain. She was not in labor but was found to have a right leg DVT. History provided by her 18-year-old daughter revealed a woman with 2 years of progressive neurocognitive decline (similar to several of the patient's siblings) who was dependent for all ADLs. Due to the complexity of her situation, the patient was admitted to the hospital to start Lovenox. A multi-disciplinary team including Ethics, Legal, Social Work, Anesthesiology and Obstetrics convened to discuss her case. Induction of labor was planned for 39w0d with neuraxial anesthesia as needed. Consent for cesarean delivery, transfusion of blood products, general and neuraxial anesthesia, and postpartum IUD placement was obtained from the patient's 18-year-old daughter. The patient labored spontaneously at 38w5d and delivered a healthy baby. Epidural analgesia was contraindicated due to anticoagulation. An IUD was placed postpartum and her baby was placed in foster care. She remains in the hospital pending safe disposition.

This case highlights the importance of multidisciplinary care in complex social situations involving pregnant women. The patient was an undocumented immigrant with poor neurocognitive function, later confirmed to be autosomal dominant Alzheimer's Type 3 by genetic testing. She was in an abusive relationship with the father of her baby, who was the primary caretaker of their other child. She completely relied on her 14-year-old daughter for all ADLs, with major social and educational consequences for the teen. Her husband and the father of her eldest 4 children had been deported years ago and her 20-year-old daughter refused to be involved in her life. The multidisciplinary care team was charged with a number of tasks, including: assigning an appropriate surrogate decision-maker for the patient, caring for her during her pregnancy, safely delivering the baby and finding a safe disposition for the patient and her baby. The search for a safe disposition is ongoing. Her 18-year-old daughter plans to file for legal guardianship of her 14-year-old sister.

Early-onset dementia is characterized by neurocognitive decline that begins before age 65 and is usually caused by Alzheimer's or frontotemporal dementia. Memory loss is the commonest and earliest sign of Alzheimer's. As the disease progresses, patients lose the ability to care for their own basic needs and often develop personality and behavioral changes. Death from malnutrition or pneumonia typically occurs within 8 to 10 years. There is conflicting evidence on the relationship between parity and the risk of late-onset Alzheimer's. Currently, there is very little information about the effects of pregnancy on early-onset Alzheimer's disease.

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Abstract #: F-46

From Boston to Hanoi and Back by Video Conference: A Low-Cost Model for Continuing Medical Education in Middle Income Countries

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Introduction: The implementation of evidence-based care in middle-resource countries can be delayed compared to high-resource countries (1). One barrier to implementation is that cost and geographic distance limit opportunities for physicians in middle-resource countries from participating in continuing medical education (CME) that is routinely provided in higher-resource settings. Internet-based video conferencing may provide an effective method for providing CME in an interactive fashion at low cost to many physicians who practice in middle-resource countries. Here we describe a collaboration between one of the largest obstetric hospitals in Hanoi, Vietnam (delivery volume approximately 40,000/year), and a tertiary hospital in Boston, Massachusetts to implement internet-based CME in Vietnam.

Methods: Over the past year, a collaboration was built between obstetric anesthesiologists at two large obstetric hospitals in Hanoi, Vietnam and Boston, Massachusetts with the goal to establish a live, internet-based video conference once every 3 months. An in-person, international obstetric anesthesiology conference was held in Hanoi Vietnam prior to the initiating the video conferences. The steps taken and to plan, and progression of these conferences are shown in the Figure.

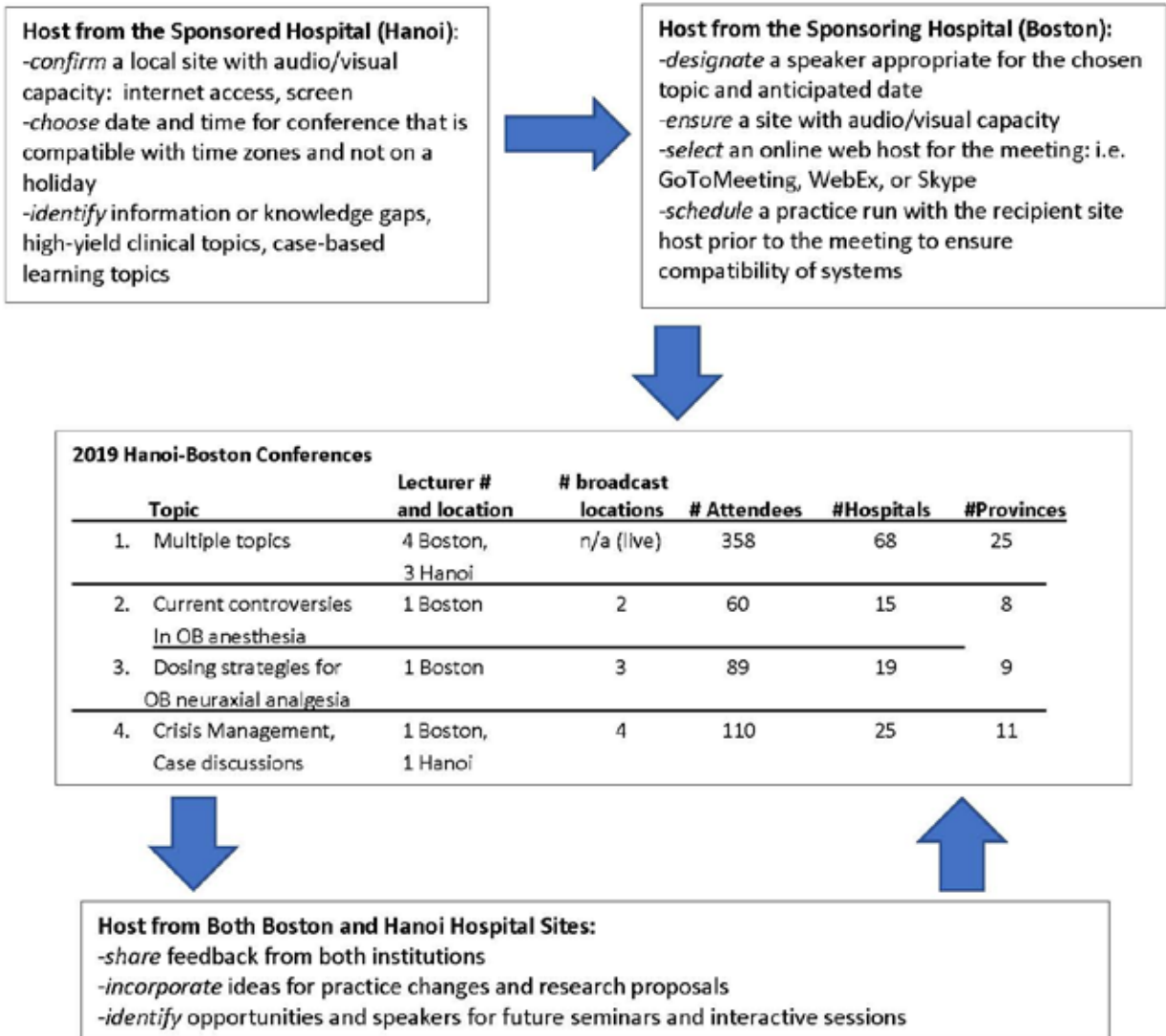
Results: Four successful conferences were conducted in 2019: one in-person conference in Hanoi, Vietnam followed by 3 live, internet-based conferences between Boston, Massachusetts and Vietnam (Figure). The conferences were attended in Vietnam by anesthesiologists, nurses, obstetricians, midwives, medical students, and hospital administrators. After the inaugural conference, subsequent sessions were expanded to attendees from three additional Vietnamese medical schools and attendees from other provinces across Vietnam. Use of internet-based conferencing enabled the number of Vietnamese attendees, hospitals, and provinces to increase over time (Figure). Quarterly conferences have been scheduled in the coming year. Time and cost expenditures to enable this collaboration were minimal, including an initial trip to Vietnam by four Boston physicians for one week, followed by 2-3 hours per session to plan and execute the internet-based webinars.

Conclusion: This successful implementation of internet-based video conferencing between Hanoi and Boston has provided an opportunity for interactive CME to physicians in Vietnam, a middle-resource country with internet access and audiovisual capacity. An enriched environment of mutual learning has been established with very little expenditure other than physician time for planning, conferencing, and internet capability. The online sessions have changed clinical practice at the host site in Vietnam and many additional hospitals throughout the country. This successful model can be adopted by other countries in order to promote high-quality maternal care and maternal safety.

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Figure. Steps to Implementing an International Video Conference Series



Abstract #: F-47

Lipid emulsion for treatment of neurologic symptoms of systemic bupivacaine toxicity after labor epidural placement

Presenting Author: Elizabeth Fouts-Palmer, MD

Presenting Author's Institution: Weill Cornell Medicine

Co-Authors: Jennifer Wagner - New York Presbyterian

Local anesthetic systemic toxicity (LAST) is a complication of neuraxial analgesia with potentially catastrophic consequences. Due to physiologic changes of pregnancy, parturients are at increased risk of LAST. Prompt treatment with lipid emulsion has been established as a life-saving treatment for severe LAST events, but there is limited evidence for its safety in pregnancy. While it is clearly indicated in cases of cardiovascular collapse, the role of lipid emulsion for treating milder neurologic symptoms remains unclear (1). We present the case of a parturient who was treated for LAST with lipid emulsion therapy after exhibiting neurologic symptoms secondary to an intravascular epidural catheter.

A healthy 31yo primiparous woman at 39 weeks' gestation presented to our labor floor with premature rupture of membranes. After initiation of an oxytocin infusion, an epidural catheter was placed for pain relief. Aspiration of the catheter revealed no blood or fluid, and a test dose of lidocaine with epinephrine was administered with no noted effects. 10mL of 0.25% bupivacaine was then administered in divided doses with improvement in her labor pain. One hour after initiation of a dilute bupivacaine/fentanyl epidural infusion she complained of worsening pain accompanied by dizziness, metallic taste and perioral numbness. Free-flowing blood was aspirated from the epidural catheter at this time. Although there were no EKG changes, the patient reported worsening dizziness and somnolence. A 100mL lipid emulsion bolus was administered with symptomatic improvement within 15 minutes. Once symptoms resolved fully, a combined spinal-epidural was placed without further complications. Seven hours later a female infant was delivered vaginally with Apgars 9/9. The infant was briefly admitted to the NICU due to presumed maternal chorioamnionitis, but both mother and baby were discharged on post-partum day 2 in good condition with no apparent complications.

While there are several published reports of the use of lipid emulsion therapy in laboring patients (2,3), our case is unusual in that the clinical diagnosis of LAST was made early, when the patient was exhibiting mild neurologic symptoms. Given that this patient was relatively stable, the question of the effect of lipid emulsion treatment on utero-placental circulation and neonatal outcomes becomes more pertinent, and is difficult to answer based on available evidence. Our patient was successfully treated with lipid emulsion with no apparent adverse effects, and this case adds to the body of evidence for the safety and efficacy of lipid emulsion for treatment of LAST in pregnancy.

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Abstract #: F-48**A patient with a history of lumbar spinal tuberculosis is requesting an epidural! or The Importance of an Early Anesthesia Consult****Presenting Author:** Suzanne Panayiotou, CRNA**Presenting Author's Institution:** New York Presbyterian/Lower Manhattan Hospital**Co-Authors:** Elizabeth Fouts-Palmer, MD - Weill Cornell Medicine

Pott's disease, also known as tuberculosis (TB) spondylitis, is a rare infection causing osteomyelitis and arthritis to the vertebrae. Although Pott's spine represents a small fraction of overall TB cases, it is a common and dangerous form of skeletal TB (1). If untreated, severe functional impairment leading to significant morbidity can occur. There are published reports of severe complications of neuraxial anesthesia in patients with untreated Pott's disease (2,3). However, literature is scarce on the safety of neuraxial analgesia in patients who completed antimicrobial therapy (4). We present a case of uncomplicated neuraxial labor analgesia in a patient with a history of Pott's disease of the lumbar spine.

A 32 y/o primiparous woman presented to our labor unit at 39 weeks' gestation for induction of labor for decreased fetal movement, pruritus and non-reassuring fetal heart rate tracing. The anesthesia team was consulted for management of labor pain. The patient reported a history of tuberculosis infection of her lumbar spine, which presented as bilateral leg weakness seven years prior when she was residing in India. She reported that she was treated with antibiotics and all symptoms resolved, but was unsure if she had finished the prescribed course. She had printed copies of an MRI report noting a lesion in the L3 vertebral body. Her neurologic exam was normal.

There was an extensive discussion of potential risks with epidural placement given the unclear duration of treatment. The patient's family located additional medical records documenting a completed 18-month course of treatment. The potential risks of epidural anesthesia and the alternatives of inhaled nitrous oxide or remifentanyl PCA were discussed. The patient initially attempted to delay epidural placement and considered nitrous oxide, but as her labor progressed she elected for an epidural. A lumbar epidural was placed at the L4-L5 interspace, after initial attempts at L5-S1 were unsuccessful. She reported good pain relief, and delivered a healthy infant 12 hours later (Apgars 1/9/9). She was discharged home on postpartum day 2 with no apparent complications.

This case provides additional support for the safety of neuraxial analgesia in patients with a history of fully treated spinal tuberculosis. It also highlights the importance of early anesthesiology consultation for parturients with a history of spinal cord pathology.

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Abstract #: F-49

PERIPARTUM STRESS-DOSE STEROIDS IN PARTURIENTS WITH POTENTIAL HYPOTHALAMIC-PITUITARY-ADRENAL AXIS SUPPRESSION

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Co-Authors: Blair H. Hayes, MD - Ohio State University Wexner Medical Center

Case: Our patient is a 33-year-old G2P1 with PMH celiac disease, GERD and anemia who presented prior to her scheduled repeat cesarean delivery (CD) as an anesthesiology and hematology consult due to her history of immune thrombocytopenic purpura (ITP). Her platelet count historically ranged between 79,000 to 150,000. As her platelet count never reached extremely low numbers, she denied history of epistaxis, mucosal bleeding, bright red blood per rectum, melena, or hematuria. Should her platelet count drop below its current range, she would incur a slightly elevated risk for neuraxial hematoma compared to the general population (1). She was counseled on the increased risk and potential alternatives. Hematology elected to treat her with high-dose prednisone, 70 mg/day, for nearly one month prior to her scheduled CD. Platelet count improved from 79k to 120k by her delivery date. This enabled her to receive spinal anesthesia and she underwent an uneventful CD after receiving 50 mg stress-dose hydrocortisone with a subsequent prednisone taper after delivery.

Discussion: The role of exogenous stress-dose steroids (SDS) in adrenal insufficient (AI) surgical patients is a topic with a wealth of data; however, information regarding their role in the care of the parturient undergoing vaginal or cesarean delivery is scarce.

In the non-parturient, stress stimulation of the hypothalamic-pituitary-adrenal axis (HPA axis) causes an increase in corticotropin-releasing hormone (CRH) secretion from the hypothalamus which in turn increases adrenocorticotropic hormone (ACTH) release from the anterior pituitary gland. ACTH then triggers the release of corticosteroids from the adrenal glands (2). The HPA axis in the pregnant patient involves significant alterations from baseline. The placenta itself produces ACTH and a form of CRH that is not involved in negative feedback to the hypothalamus leading to increased levels of circulating cortisol, corticosteroid-binding globulin (CBG), CRH, and ACTH above normal. Even among parturients, there is variability in cortisol levels as those undergoing vaginal birth demonstrate higher levels of cortisol in the peripartum period compared to those who undergo scheduled CD (3).

We chose to administer 50 mg hydrocortisone as we considered CD a moderate-stress surgical procedure. This is common practice for other procedures of similar stress (eg total joints, colon resection, abdominal hysterectomy)(2). Further investigation should be performed to optimize the dosing regimen in this population.

OB anesthesiologists should be versed in the HPA axis anatomy and physiology and its alterations in the pregnant population.

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Abstract #: F-50

Anesthetic management of a parturient with type 2 von Willebrand disease, myasthenia gravis and lupus

Presenting Author: Thais Franklin dos Santos

Presenting Author's Institution: University of Miami/Jackson Memorial Hospital

Co-Authors: David Birnbach - University of Miami/Jackson Memorial Hospital

Daria Moaveni - University of Miami/Jackson Memorial Hospital

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Reine Zbeidy - University of Miami/Jackson Memorial Hospital

Introduction: Hematologic, neuromuscular and connective tissue disorders alone can have significant implications in the management of the obstetric patient. Here we present a case of a parturient with type 2 von Willebrand disease, myasthenia gravis and lupus.

Case report: A 41 year-old G2P1001 at 38.3 weeks of gestation presented for scheduled repeat cesarean delivery with history of type 2 von Willebrand disease, myasthenia gravis, lupus and chronic hypertension. She had mild seronegative lupus, she denied having any systemic manifestations as well as synovitis and she was not on chronic steroids. Two years prior to this pregnancy she began experiencing proximal leg weakness, difficulty swallowing and jaw weakness worse with use. Neurology diagnosed her with double seronegative myasthenia gravis and did not recommend treatment with pyridostigmine. She had hyperreflexia and clonus at the ankles, she had no ocular symptoms and she had good exercise capacity with no respiratory symptoms. At young age she was diagnosed with type 2 von Willebrand disease managed with antihemophilic factor/von Willebrand factor concentrate (AF/vW) for monthly periods. Hematology was consulted on admission and she was given 100% replacement with AF/vW because her factor levels did not increase significantly with pregnancy. After she received 5000 units of AF/vW and thromboelastogram revealed normal values she underwent cesarean delivery under combined spinal epidural anesthesia. She was premedicated with metoclopramide and sodium citrate. 15mcg of fentanyl, 11.25mg of bupivacaine and 0.1mg of morphine were given intrathecally and a T4 level was obtained. Estimated blood loss was 900mL. She received oxytocin and carboprost as uterotonics and she had no complications and no blood products were given. She had mechanical prophylaxis for deep venous thrombosis. Hematology managed her AF/vW doses postoperatively. She received 3000 units every 8 hours until postoperative day two, then 2000 units every 12 hours until postoperative day three. She was discharged on postoperative day three with a prescription to continue AF/vW 2000 units once a day for four more days and she continued hydroxychloroquine and labetalol. The patient had no respiratory complications and her jaw weakness as well as her difficulty swallowing improved following delivery.

Conclusion: Thorough perioperative planning and a multidisciplinary approach involving anesthesia, obstetrics, neurology, hematology and rheumatology was crucial in this case in order to evaluate neuromuscular involvement from myasthenia gravis and need for treatment, to rule out severe systemic manifestations from lupus, and to optimize coagulation status in order to minimize bleeding and to make neuraxial anesthesia a feasible option as it would help avoid the risks related to general anesthesia.

Abstract #: F-51

Case report of an atypical presentation of headache following dural puncture

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Co-Authors: David Birnbach - University of Miami/Jackson Memorial Hospital

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Introduction: Postdural puncture headache (PDPH) remains a primary cause of morbidity and increased duration of hospital stay. The diagnosis is not always straightforward and other possibilities need to be excluded.

Case report: A 31 year-old G1P0 was admitted to the labor floor in active labor at 37 weeks of gestation, following an uneventful pregnancy. The epidural space was identified with a loss of resistance to saline using a 17-gauge Tuohy needle and an epidural catheter inserted. There was no obvious dural puncture during the procedure.

Twenty-four hours after delivery the patient complained of mild neck stiffness. She was afebrile. There were no other neurological signs or symptoms. The following day she developed an occipital postural headache. The patient's headache was paradoxical in that it worsened when she was in the recumbent position and it improved when she sat upright. The patient rated her pain as seven out of a possible ten. She denied photophobia, weakness, vomiting, numbness or tingling sensation. A provisional diagnosis of PDPH was made and she was treated conservatively with oral analgesics, bed rest and was advised to increase oral fluid intake. No significant improvement was reported. Neuroimaging ruled out cerebral hemorrhage, neuraxial hematoma and intracranial venous thrombosis.

The next day she developed marked right-sided hearing loss. She agreed to have a blood patch. A senior anesthesiologist performed the procedure. She experienced nearly instantaneous improvement of the headache and a return of her hearing acuity to normal.

Discussion: The clinical course of PDPH varies and although most headaches resolve within a few days, the distress experienced when symptoms are severe justifies active treatment to foreshorten suffering. Classic symptoms consist of postural headaches, often associated with neck stiffness and photophobia, nausea and vomiting, tinnitus or diplopia. The diagnosis is usually made from clinical picture alone. However, the differential diagnosis is extensive and other causes should be ruled out before the diagnosis of an atypical presentation of PDPH diagnosis is made. In this atypical presentation, an epidural blood patch was both diagnostic and therapeutic.

Abstract #: F-52

Fever of Unknown Origin in a Parturient: An Unexpected Case of Plasmodium Falciparum Malaria

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Introduction: Malaria infection during pregnancy is a serious health problem in most of the world's tropical regions. It can have serious repercussions for both mother and fetus.

Case Report: A 32 year-old, G2P0010, at 39-weeks of gestation presented to a US hospital with a one week history of intermittent fever, shaking chills, headache and cough. Between febrile episodes, she reported malaise, but was otherwise asymptomatic. She had no other significant medical history and her pregnancy was uncomplicated. The only recent travel was a trip to Haiti five months earlier. On admission her blood pressure was 95/50 mmHg, heart rate 160 bpm, respiratory rate 40 breaths/min and temperature of 103 F. Blood culture, urine culture, chest x-ray and malaria blood smear were ordered. She was started on wide-spectrum antibiotics (vancomycin and piperacillin-tazobactam) plus intravenous fluids. No maternal anemia or thrombocytopenia was reported. Kidney and liver functions and coagulation profile were normal. She developed severe late fetal heart rate decelerations after approximately 6-hrs of labor and underwent emergent cesarean section under general anesthesia, with rapid sequence induction using etomidate and succinylcholine. Monitoring consisted of pulse oximetry, ECG and direct intra-arterial blood pressure measurement. She remained stable throughout the surgery and was extubated in the OR, then transferred to the ICU. She was started on quinidine and doxycycline because of a clinical suspicion of malaria although microbiology results were not immediately available. A peripheral blood smear eventually confirmed the diagnosis of malaria, by showing plasmodium falciparum infestation and a parasitic index of 1%. The patient was switched to chloroquine one gram orally for 48hours for a total of four doses. Complete recovery was achieved in one week.

Discussion: Malaria caused by *P. falciparum* is the most dangerous form of malaria. Early diagnosis and multidisciplinary management are essential. Malaria and pregnancy influence each other. Malaria can cause abortion, preterm labor, stillbirth and serious maternal morbidity and mortality. After the third month of pregnancy, the placenta is highly susceptible to malaria infection. The maternal sinusoids allow parasites to develop in the sequestered erythrocytes. Although our patient was a US citizen admitted to a hospital in Miami, she traveled to a malaria-infested area when she was nineteen weeks pregnant. General anesthesia was chosen because she exhibited signs of systemic sepsis prior to confirming the diagnosis of malaria. The role of regional anesthesia is controversial because of the possibility of seeding the CNS with the parasite.

Abstract #: F-53

Anesthetic management of cesarean delivery for a patient with a history of mast cell activation syndrome and spine surgery

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Introduction: MCAS is a non IgE mediated hypersensitivity reaction involving mast cell degranulation and histamine release. It is an uncommon disorder, and limited information exists in the anesthesiology literature about the subject. Reaction severity ranges from mild to life threatening. Degranulation may occur spontaneously or secondary to triggers (pain, temperature changes, medications including morphine, codeine, meperidine, nonsteroidal anti-inflammatory drugs, mivacurium, atracurium). We report the anesthetic management of cesarean delivery for a parturient with MCAS and a history of spine surgery.

Case report: A 33 year old G1P0 with MCAS was referred to our service at 34 weeks of gestation. She had frequent spontaneous flushing and hives during pregnancy. Two years prior to pregnancy, she underwent L4-S1 instrumentation for disk herniation and spondylolisthesis without anesthetic complications.

A multidisciplinary discussion for her delivery planning included her obstetrician, immunologist, orthopedic surgeon, and obstetric anesthesiologists. Labor epidural analgesia was highly desired to minimize pain and the risk of mast cell degranulation. However, the previous spine surgery could interfere with local anesthetic spread and effective analgesia. The decision was made for scheduled cesarean delivery at 39 weeks with spinal anesthesia.

She continued her daily medication regimen to prevent mast cell degranulation. She was also premedicated with montelukast, famotidine and diphenhydramine and serial doses of prednisone and hydrocortisone. A difficult airway cart, a defibrillator and epinephrine were available.

Potential medication mast cell degranulation triggers were avoided. An arterial line was placed under remifentanyl sedation. Spinal anesthesia was performed with intrathecal fentanyl and bupivacaine. She received ondansetron, clindamycin, oxytocin and intravenous acetaminophen. Normothermia was maintained.

Postoperatively, she had transversus abdominis plane blocks with liposomal bupivacaine. Hydromorphone was given as an alternative to morphine. The intrathecal route was avoided due to concerns of its prolonged duration in the event she developed any serious reaction (although unlikely). A small dose of intravenous hydromorphone was given; she had no reactions and was started on hydromorphone patient controlled analgesia. She also received scheduled oral acetaminophen. She had an uneventful postoperative course and was discharged home on postoperative day 3.

Conclusion: Peripartum planning for parturients with MCAS involves optimizing labor analgesia and/or optimizing intraoperative anesthesia and postoperative analgesia. Preparation includes avoiding mast cell degranulation triggers and having emergency equipment available should a severe reaction occur.

Abstract #: F-54**Anesthetic Considerations for a Super-Morbidly Obese Parturient for Cesarean Delivery****Presenting Author:** Anna Gabrielian**Presenting Author's Institution:** Allegheny Health Network**Co-Authors:** Erica Coffin, MD - Allegheny Health Network

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Parturients with super morbid obesity, defined as a BMI >50, represent a growing population that has nearly doubled in the last 10 years. The preponderance of obesity has challenged anesthetic and surgical care providers as a result of a multitude of comorbidities associated with it. Moreover, obesity accentuates the already stressed physiologic changes of pregnancy. This places both the parturient and the fetus at greater risk for complications and requires careful planning and interdisciplinary cooperation.

We describe the complexity of anesthetic care in a parturient with a BMI of greater than 100. She initially underwent a primary cesarean delivery at our institution, followed by a repeat cesarean 1.5 years later following the same protocol. Deliveries occurred at 34.1 weeks gestational age, with in-hospital admission and monitoring prior to delivery. Our patient's comorbidities include anemia, chronic hypertension with superimposed pre-eclampsia, insulin dependent diabetes, obstructive sleep apnea with asthma, respiratory compromise in the supine position, and antiphospholipid antibody syndrome. On the day of surgery, the patient was transported on a bariatric stretcher to the operating room and was placed in the sitting position for a combined regional and general anesthetic approach. The patient's upper back pannuses were retracted for a pre-induction ultrasound guided epidural. Loss of resistance was obtained at 13cm, and incremental doses of local anesthetic were administered. Central venous access and arterial catheterization were obtained using sedation with dexmedetomidine and propofol, maintaining spontaneous ventilation. The patient could not recline greater than 30 degrees without becoming hypoxic and was positioned on a large ramp. She was intubated using direct laryngoscopy with video laryngoscopy available. A clamp test was used to confirm adequacy of the epidural. General anesthesia was then induced with dexmedetomidine, remifentanyl, propofol. The surgical approach was via supra-umbilical vertical midline incision. The fetus was delivered with subsequent intubation and transfer to NICU. The epidural catheter remained in place for post-operative analgesia.

We estimate mortality to be at least 50% in these surgical cases due to the large risk of hemorrhage, airway compromise, embolic events, and respiratory arrest. While vaginal delivery could theoretically have been considered, a conversion to unplanned/emergent cesarean section would have been catastrophic for the patient and fetus owing to lack of appropriate staffing, equipment, and lack of physiologic reserve. Thus, a planned cesarean section was overall the safest course of action.

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Abstract #: F-55

Anesthesia for Cesarean Delivery in a Primigravida Patient with Niemann Pick Disease Type B

Presenting Author: Michele Gaertner, M.D.

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We present a case of a 33 year old female with past medical history significant for Niemann Pick Disease (NPD) Type B and mild asthma who presented for urgent cesarean delivery given breech presentation in the setting of spontaneous onset of labor. Briefly, NPD Type B is a rare autosomal recessive lipid metabolizing disorder that is caused by a mutation in the SMPD 1 gene resulting in shortage of acid sphingomyelinase. This leads to an accumulation of sphingomyelin causing impaired functioning of tissues and organs including the brain, lungs, spleen and liver. ²

The patient was followed closely in the obstetric clinic and underwent an anesthesia consultation one week prior to delivery. During the consultation, the patient reported that she is relatively asymptomatic from NPD Type B, due to an unusually high amount of functioning sphingomyelinase (25% compared to 5%). She also has a history of mild asthma, with most recent pulmonary function tests showing a mildly reduced diffusing capacity with a mild underlying obstruction. She denied any personal or familial complications with anesthesia. Given the association of NPD and thrombocytopenia, it was discussed that her platelet count would be assessed on the day of delivery. In addition, it was planned to use either ketamine or etomidate for an induction agent in the event general anesthesia was required. This was discussed given the potential risk of further increasing triglycerides with the use of propofol in patients with lipid metabolizing disorders. ¹

As the patient presented in spontaneous onset of labor with baby in the breech position, she required an urgent cesarean delivery. Pertinent labs were as follows: platelets 181, AST and ALT were normal with elevated cholesterol, triglycerides, and LDL. Airway examination was reassuring. Risks, benefits, and alternatives of spinal anesthesia were discussed and the patient consented. Spinal anesthesia was performed in the sitting position with a midline approach. Back was prepped with chlorhexidine and a Pencan 25 gauge needle was passed successfully on the first attempt at the L3-L4 interspace. Anesthetic dose included 1.6 ml of bupivacaine-dextrose PF 0.75%-8.25%, 15 mcg fentanyl and 0.15 mg of morphine. Patient tolerated the procedure without complication and underwent an uneventful cesarean delivery. On postoperative day one, she was hemodynamically stable and denied sensory/motor deficits, and there were no signs of neuraxial infection or hematoma.

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Abstract #: F-56**Use of ROTEM in the management of disseminated intravascular coagulation following an amniotic fluid embolism during an elective second trimester dilatation and evacuation.**

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Amniotic fluid embolism (AFE), is a rare but serious condition that occurs when amniotic or fetal material, enter the mother's bloodstream. The presentation often includes a triad of hypotension, hypoxia and coagulopathy. Although the cardiorespiratory collapse may be quickly recognized, the coagulopathy that often ensues is not. Rotational thromboelastometry (ROTEM) can be used to quickly confirm the presence of coagulopathy and guide transfusion management. AFE is most likely to occur at term during delivery or in the immediate postpartum period, but it has been reported during elective second trimester dilation and evacuation (D&E).¹

A 22-year-old G2P0010 with an unplanned pregnancy presented to our facility for an elective D&E at 23 weeks and 3 days. The patient was induced and during the procedure she experienced a brief episode of and hypotension and decrease in end-tidal CO₂. During this time ST depression changes were noted in EKG. After treatment with vasopressors, the blood pressure and ST depressions were corrected. Upon arrival to the post anesthesia care unit, a significant amount of bleeding was noted. The presence of a coagulopathy was suspected and laboratory work including prothrombin time (PT), partial thromboplastin time (PTT), fibrinogen, ROTEM, and troponin were sent. Within 10 min ROTEM revealed a prolonged clotting time in the INTEM and EXTEM at 256 and 182 s, respectively. The amplitude at 10 min (A10) for INTEM and EXTEM were noted to be 20 and 22 mm, respectively. A FIBTEM A10 was noted to be 2 mm. At ~45 min the PTT and fibrinogen were noted to be 114.6 and < 60. The PT was reported as no clot formation noted. Troponin levels was elevated 0.13. By the time laboratory work other than ROTEM was reviewed, 3 units (U) of packed red blood cells, 2 U of cryoprecipitate, 1 U of platelets and 3 U of fresh frozen plasma were transfused. Given ongoing bleeding, the patient was transported to interventional radiology where a uterine artery embolization was successfully performed. After transfusion, the second ROTEM demonstrated marked improvement. ROTEM results are summarized in Figure 1. The estimated blood loss was 2L and after a brief ICU admission, the patient was discharged on post-operative day 2.

The diagnosis of AFE requires both a high level of clinical suspicion as well as exclusion of other causes of cardiopulmonary collapse.¹ Once there is a clinical suspicion, the detection of coagulopathy can help narrow the differential diagnosis and start goal-directed transfusion. The implementation of a goal-directed transfusion strategy for the management of severe hemorrhage is associated with decrease use of blood products.² The use of ROTEM allowed us to quickly identify a coagulopathy and facilitated guided blood product administration and the reversal of this consumptive coagulopathy.

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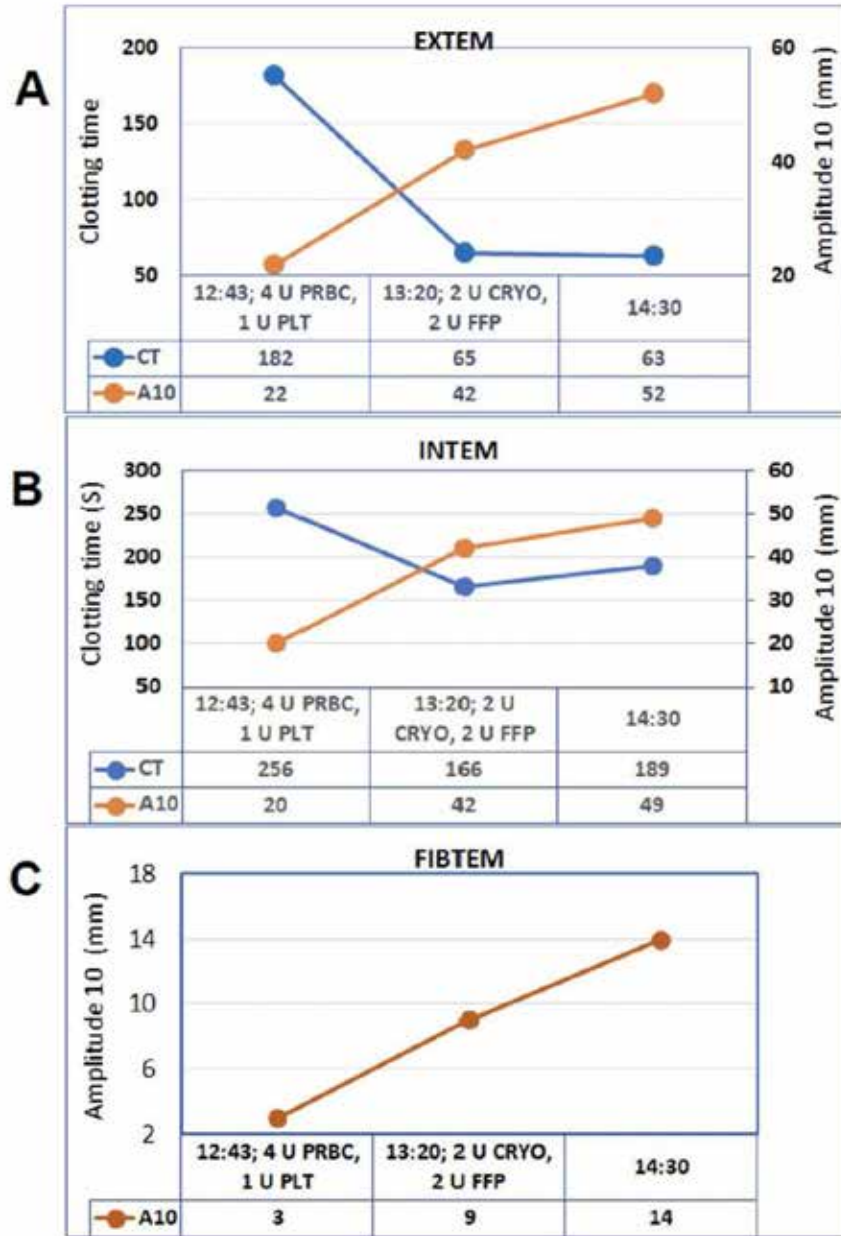


Figure 1A. EXTEM - Clotting time and Amplitude at 10 min, in seconds (S) and millimeters (mm), respectively. Reference range for Clotting time 43-82 S and 46-67 mm for Amplitude at 10 min. IB. INTEM - Clotting time and Amplitude at 10 min, in seconds and millimeters, respectively. Reference range for Clotting time 122-208 S and 46-67 mm for Amplitude at 10 min. IC. FIBTEM - Amplitude at 10 min in millimeters. Reference range for Amplitude at 10 min 7-22 mm.

Abstract #: F-57

Gravid Hysterectomy of Cesarean Scar Ectopic Pregnancy

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Co-Authors: Nicole Higgins, MD - Northwestern University Feinberg School of Medicine
Jack M. Peace, MD - Northwestern University Feinberg School of Medicine

Introduction: Population-level data suggests the rate of peripartum hysterectomy is 1 in 1000 deliveries in the United States.^[1] Cesarean scar pregnancy is a rare cause of abnormal placentation and often results in peripartum hysterectomy. We present the anesthetic management of a patient diagnosed with cesarean scar ectopic pregnancy necessitating gravid hysterectomy.

Case: A 30-yo, G11P3164 with a history of obesity, three prior cesarean deliveries, and two prior ectopic pregnancies presented at 22.2 weeks gestation. Initial presentation was seven days prior to an outside hospital with painless vaginal bleeding and lethargy. Ultrasound demonstrated cesarean scar ectopic pregnancy, placenta previa, and placenta accreta spectrum disorder. The patient was counseled regarding termination of pregnancy but declined and elected transfer for definitive care.

On presentation, the patient was afebrile and stable without vaginal bleeding. Lab values were notable for a leukocytosis of 15.9WBC/dL and a hemoglobin of 9.5g/dL. MR of the pelvis demonstrated a cesarean scar ectopic pregnancy with complete placenta previa and a focal placental percreta (Fig. 1). The patient wanted to prolong the pregnancy until a viable gestational age with full resuscitation for her infant. After multidisciplinary discussion and consideration of the maternal and fetal risks including infection, hemorrhage, poor prognosis, and maternal death, the patient consented to a gravid hysterectomy. The patient had an active type and screen and crossmatch with equipment available for central line placement, cell-salvage, and rapid blood infusion. Adequate intravenous access was established, and the patient was taken to the operating room. General anesthesia was initiated with rapid sequence endotracheal intubation and a radial arterial line was placed. Laparotomy revealed placental tissue adherent to the bladder dome requiring extensive dissection. The uterus was removed en bloc. The patient tolerated the procedure well with an estimated blood loss of 1500mL and was discharged from the hospital on post-op day three.

Discussion: The anesthetic management and surgical approach can vary substantially between a gravid hysterectomy and cesarean hysterectomy. For this reason, management of cesarean scar ectopic pregnancy requires an integrated discussion amongst the obstetric, anesthetic, and pediatric providers and patient to provide optimal care. Interdisciplinary cooperation, preparation, and coordinated execution were essential to the outcome of this case.

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Abstract #: F-57

Figure 1: MRI pelvis without contrast (axial, sagittal). Placental tissue visualized abutting the rectus abdominis muscle (red arrow) and the bladder dome (blue arrow).



Abstract #: F-58

Management of a Rectus Sheath Hematoma Postpartum - When is Conservative Management Appropriate

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Introduction: When a postpartum patient becomes hemodynamically unstable, an interdisciplinary approach is crucial for prompt diagnosis and management. A rare etiology for instability after a cesarean delivery is rectus sheath hematoma (RSH). Although relaparotomy following cesarean delivery is exceedingly rare, RSH is a leading indication (as high as 28.6%¹.) Unfortunately, relaparotomy after cesarean delivery is associated with high maternal morbidity and mortality². We present a medically complicated patient with a postpartum course complicated by a RSH that was recognized in a timely fashion and treated with conservative management.

Case Presentation: Our patient is a 33yo morbidly obese (BMI 60) G4P0 F @ 37+1 with a PMH of cHTN, and asthma who presented as scheduled for a primary C/S for di-di twins. Following admission to L&D, the patient was dx with pre-E with SF and magnesium therapy was initiated. Intraoperative course with CSE was complicated by 1050 mL EBL and the patient was administered 2200mL crystalloid and maintained hemodynamic stability. Eight hours PP, the patient was altered with seizure-like activity with periods of lucidity. Magnesium was stopped and vitals demonstrated BPs as low as the 60s/40s with no source of bleeding identified. POC TTE was performed, revealing vigorous cardiac contractility but near-empty (kissing) ventricles on parasternal long and short access. IV resuscitation immediately followed with phenylephrine support. FAST scan was performed with fluid noted in abdomen. A prompt multidisciplinary discussion regarding whether to proceed to the OR or stabilize and optimize resulted in the latter option as the patient was responding to treatment. The patient received 3L IVF, 3u RBCs and 1L albumin, and was weaned off vasopressor support. POC Hgb analysis guided resuscitation. Once stable, a CTH ruled out an intracranial bleed and a CTAP was done to evaluate the fluid collection, revealing a 20.7x11.3cm RSH. Multidisciplinary discussion allowed for close patient monitoring and delay of relaparotomy due to stable coagulation profile and hemodynamics, appropriate UOP, and reassuring serial POC TTE. Patient required minimal further transfusions and laparotomy was avoided.

Discussion: RSH is a rare complication of cesarean delivery and the combination of a lack of visible bleeding in a super morbidly obesity with preeclampsia may make early diagnosis based on vitals and physical exam unlikely. POC ultrasound can be extremely helpful to direct care when determining the etiology of hemodynamic instability. This case highlights how consistent interdisciplinary discussion, swift recognition, and optimization resulted in a safe outcome and avoided potential further blood loss or difficulty in intubation had the patient undergone relaparotomy.

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Abstract #: F-59

Weighing the Risk of Anesthesia: A Case of a Parturient with Arnold Chiari Malformation and Hereditary Hemorrhagic Telangiectasia

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Presenting Author's Institution: University of Kansas Medical Center - Fairway, Kansas

Co-Authors: Molly Cason, MD - University of Kansas Medical Center

Introduction: This case describes the challenges of anesthetic planning for a parturient with both Hereditary Hemorrhagic Telangiectasia (HHT) as well as symptomatic Arnold Chiari Type 1 Malformation (CM-1). HHT is a disorder of abnormal arteriovenous malformations (AVMs) with a prevalence of 1 in 5,000 to 10,000. The condition results in increased vascular pressure with subsequent risk of severe bleeding, with an increased risk in parturients due to the physiologic changes of pregnancy. While these AVMs are most commonly found on skin and mucosa, they are also found in the brain, lungs, liver, GI tract, and spinal cord. Chiari malformations involve downward displacement of the cerebellar structures through the foramen magnum. This risks further exacerbation in the setting of increased intraabdominal pressure associated with labor and inadvertent dural puncture with neuraxial anesthesia.

Case: A 20-year-old G1P0 with past medical history of HHT and symptomatic CM-1 presented for delivery. Special attention was given to avoidance of hemorrhage from possible AVMs, while simultaneously reducing the risk of herniation given symptomatic CM-1. Multidisciplinary evaluation revealed pulmonary AVMs as well as a recommendation to avoid increased intracranial pressure and worsening of Chiari malformation. The patient underwent successful cesarean section with neuraxial anesthesia to decrease risk of brain herniation associated with valsalva and vaginal delivery.

Discussion: Multidisciplinary planning for this case involved high-risk obstetrics, anesthesia, neurosurgery, neurology, ENT, and pulmonology. MRI evaluation at 38 weeks for CM-1 revealed stable tonsillar descent with low risk for further herniation in the event of accidental dural puncture with neuraxial techniques; however, neurosurgical evaluation led to a recommendation to avoid Valsalva and need for decompression surgery following birth. Workup for HHT included echocardiogram with agitated saline suggestive of pulmonary AVMs and MRI negative for spinal AVMs. ENT video laryngoscopy was without evidence of airway vascular malformations. Based on patient preference after multidisciplinary recommendations, c-section was planned with epidural analgesia resulting in successful delivery of a male infant with 1200cc blood loss. The patient's Chiari Malformation remained stable without exacerbation of neurological symptoms. CT angiogram completed after birth and revealed multiple pulmonary AVMs which required coil embolization. For this case, it was necessary to weigh the risks of anesthesia for our patient in light of her history of HHT and CM-1, as both conditions have the potential for exacerbation and devastating consequences during labor and delivery.

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Abstract #: F-60

Massive Intra-Abdominal Venous Thromboembolism following Intrauterine Death secondary to Preeclampsia.

Presenting Author: Deirdre Guerin, FFA,RCSI

Presenting Author's Institution: Royal London Hospital - London

Co-Authors: Kara Bruce-Hickman, FFA - Royal London Hospital

A 30 year old primiparous lady was admitted with PET and IUGR at 25+1 gestation. Her blood pressure was 150/90 mmHg, she was asymptomatic and wasn't taking antihypertensive medication. However, her PCR was 490 gms. She had a history of hypothyroidism and was taking thyroxine. She had a normal BMI, had no allergies, was a non smoker and didn't consume alcohol.

At 27+1/40, the foetal heart was absent on Ultrasound scan. Therefore labour was induced and delivery uneventful. The patient was discharged two days later whilst continuing to take Labetalol.

She represented 12 days postpartum with pyrexia and upper abdominal and right lower back pain. Her inflammatory markers were raised and she continued to spike pyrexias despite intravenous antibiotics and paracetamol. The differential diagnosis included endometritis, pyelonephritis and Tuberculosis as her flat mate had recently been diagnosed with this. However, CXR was clear except for a small right sided effusion, and abdominal ultra showed a small amount of free fluid with no evidence of appendicitis or cholecystitis. The patient improved clinically and was discharged having been afebrile for six days. Her blood pressure was 125/65 mmHg at this point and the labetalol was reduced to a twice daily dose with a plan to review by the patient's family doctor.

She was again admitted a week later with severe abdominal pain. Contrast CT of her abdomen revealed extensive occlusive thrombus of the portal, splenic and superior mesenteric veins leading to venous ischaemia of the caecum and small bowel. Following multidisciplinary discussion, it was felt the patient was unsuitable for thrombectomy or thrombolysis and therefore the following day she underwent laparotomy, small bowel resection and ileostomy. Her anaesthetic was uneventful apart from requiring two doses of labetalol intraoperatively.

The patient returned to theatre 48 hrs later when she had a limited right hemicolectomy and closure of the small bowel stoma. She was fully anticoagulated with low molecular weight heparin the following day.

An Inferior Vena Cava Filter was inserted a week later and this was removed after approx ten weeks.

Haematological investigation showed the patient is a homozygous carrier for the FV Leiden Mutation and is weakly positive for Lupus Anticoagulant. She needs long term anticoagulation aiming for an INR of 2-3.

Portal Vein Thrombosis is a rare occurrence in Pregnancy (1). Add to this superior mesenteric vein and splenic vein thrombosis, and one must become suspicious of underlying coagulation factor defects. (2) (3) While there are reports highlighting individual aspects of this case, we are unable to find any that bring together all aspects.

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Abstract #: F-60



Abstract #: F-61

Bilateral Forearm Compartment Syndrome following uneventful massive transfusion in a patient with undiagnosed Placenta Accreta.

Presenting Author: Deirdre Guerin, FFA,RCSI

Presenting Author's Institution: Royal London Hospital - London

Co-Authors: Kara Bruce-Hickman, FFA - Royal London Hospital

We present the case of a 35 year old woman booked for elective caesarean section due to a history to 3 previous sections.

Ultrasound examination showed the placenta to be anterior and high. The patient's first language was Bengali and she spoke limited English.

At induction a 16G cannula was sited on the dorsum of her left hand and a combined spinal epidural was sited uneventfully resulting in a good block. After delivery, placenta accreta was diagnosed the attachment of which was away from the site of her previous caesarean section scars. This resulted in a 4L blood loss. A second 16G cannula was sited on the dorsum of the patients right hand and a 20G arterial line placed in her Left Brachial Artery. She was successfully resuscitated using 3L of Hartman's solution, 4 units of Red Blood Cells, [left sided cannula] 4 units of Fresh Frozen Plasma and 2 units of Cryoprecipitate [right sided cannula]. Standard uterotonics were administered, a Bakri Balloon inserted and the epidural catheter was left in situ. The patient received a further 2 units RBC in the obstetric High Dependency Unit. Three hours following the beginning of the caesarian section, it was found that the patients heft hand had become swollen and painful. However, both cannulas flushed perfectly. The arterial line showed a good trace and flushed painlessly. The patient continued to bleed and prior to being transferred to Interventional Radiology now 7 hours since the beginning of the original procedure, it was noted her left arm had become swollen and painful with some reduction in power. The cannula was removed from her left hand but in the interest of resuscitation the arterial line was left in place. Two further 16G cannula were sited in her right arm and both flushed uneventfully. Uterine artery embolisation was facilitated by epidural top up, a Triple lumen trauma line was inserted, and a further 4 units RBC, 5 units of FFP, 2 units of cryoprecipitate were administered. The patient was transferred to Obstetric HDU where she was cardiovascularly stable but had severe pain in both her swollen forearms. The patient was reviewed by the plastic surgeons who diagnosed bilateral compartment syndrome and so twelve hours after her initial procedure she underwent General anaesthesia for bilateral fasciectomy of her forearms. These were closed and the wounds skin grafted four days later.

The aetiology of the arm oedema is difficult to diagnose. It has been hypothesised that this could have been an unusual transfusion reaction although no case reports in the literature can be found to back this up. There are case reports of lower limb compartment syndrome following massive obstetric haemorrhage but non describing similar in the upper limbs. (1,2)

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Abstract #: F-62

Cesarean Section Utilizing a Slow-Load Epidural Technique in a Parturient with Severe Aortic Stenosis due to Congenital Bicuspid Aortic Valve

Presenting Author: Jeffrey Wharton, MD

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Eric Nelson, DO - Medical University of South Carolina

Joel Sirianni, MD - Medical University of South Carolina

William Sumner, MD - Medical University of South Carolina

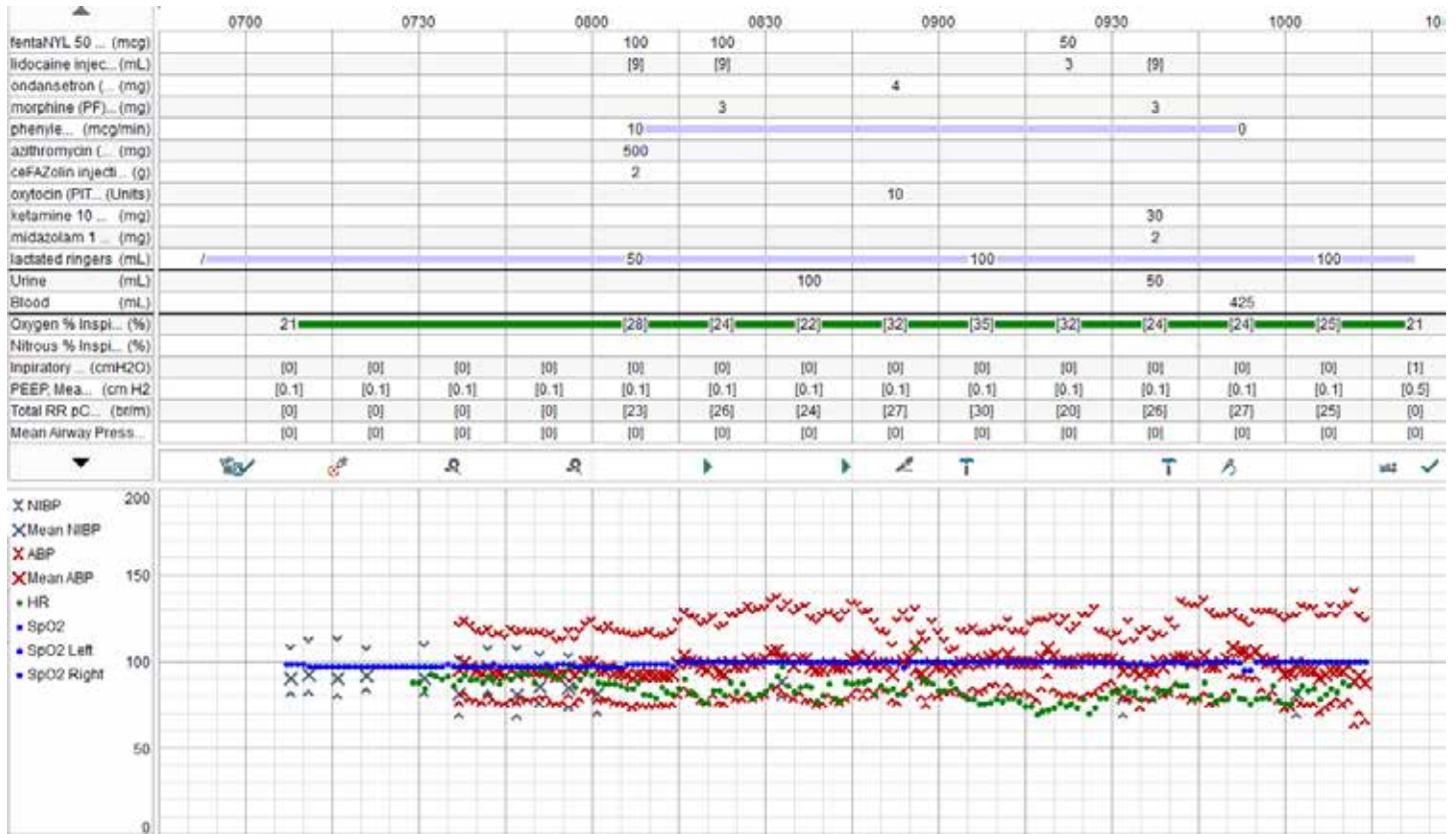
Introduction: Severe aortic stenosis (AS) is rarely seen in pregnancy. This is a good thing since “pregnancy in women with aortic stenosis is associated with marked increase in maternal morbidity and unfavorable effect on fetal outcome.”¹

Case Report: We present the case of a 32 year old G3P1 with a history of morbid obesity and AS with bicuspid aortic valve presenting for repeat cesarean section. Prior to her operation, trans-thoracic echocardiography showed a bicuspid AV with AVA of 0.8 cm², mean gradient of 52mmHg, and EF of 65% consistent with severe AS. On the day of surgery, an epidural, right radial arterial catheter, and a triple lumen central venous line were placed prior to surgery. Phenylephrine infusion was started and her epidural was loaded with 3ml aliquots of 2% lidocaine every 5 minutes. A T4 surgical level was achieved after a total of 18ml over 25 minutes. The delivery was unremarkable with mean blood pressures remaining within 10% of baseline. The patient was then transferred to the ICU for postpartum monitoring and she was ultimately discharged 3 days later. Discussion: Bicuspid aortic valve affects approximately 1% of the population and is associated with the development of aortic stenosis, aortic regurgitation, and aortic root or ascending aorta dilation. Indications for replacement in patients with AS generally include patients with severe AS who are symptomatic with exercise, concomitant EF < 50%, or patients with severe AS undergoing other cardiac surgery². Our patient was followed closely by her cardiologist but hadn't undergone valve replacement given her young age, which would likely necessitate repeat replacement later in life. Unfortunately she became symptomatic with pre-syncope during pregnancy and had increasing mean and peak AV gradients secondary to the increased circulating blood volume and increased cardiac demand during pregnancy. The goals of care intraoperatively were to use the slow load epidural to tightly control hemodynamics, maintain the preload, prevent rapid afterload reduction, sinus rhythm, and a slower heart rate to allow for ventricular filling. Conclusion: Careful multidisciplinary planning and slow-load epidural techniques can allow for safe delivery of parturients with severe cardiac lesions

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Abstract #: F-62



Abstract #: F-63

Cesarean Section in a Parturient with Marfan Syndrome, Severe Aortic Root Dilatation (5.2cm), and Persistent Refractory Arrhythmia

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Introduction: Marfan syndrome is an autosomal-dominant connective tissue disorder that predisposes patients to aortic dilation and dissection. Current recommendations are that women with Marfans who are planning pregnancy should undergo replacement of the ascending aorta and the aortic root if the diameter is greater than 4.0 cm.

Case Report: We present the case of a 28 year old G7P1 at 27 weeks gestation who presented with severe chest pain and SOB. She had a past medical history of Marfan syndrome, asthma, anxiety, post-traumatic stress disorder, and chronic pain syndrome. Her clinical workup revealed paroxysmal ventricular tachycardia (SVT) as well as a severely dilated left ventricle with ejection fraction of 56%. MRI of the chest showed severe aortic root dilation with a diameter of up to 5.2cm.

Due to her chest pain and in the setting of a high-risk pregnancy, she was admitted and her clinical status was optimized by a large multidisciplinary team. She remained stable for 3 weeks before once again developing sharp chest pain with sustained SVT in the 160's-180's, not amenable to IV beta-blockade. The decision was then made to deliver her at 31 weeks.

The suggested anesthetic plan was slow epidural for greater hemodynamic stability but despite numerous conversations, the patient ultimately declined neuraxial anesthesia and requested that her case be done under general anesthesia.

On the day of surgery, the patient had a pre-induction arterial line inserted. She was then intubated in rapid sequence fashion with a cocktail including propofol, fentanyl, lidocaine, succinylcholine, remifentanyl, and esmolol. Intra-op maintenance was with propofol and remifentanyl infusions as well as low dose diltiazem as per cardiology recommendations. Transesophageal echocardiography was used intraoperatively to monitor the aortic root diameter. The cesarean section was performed without issue and the patient was extubated at the end of the procedure. She spent the next 2 days in the ICU for close observation and was discharged on post-op day 5 with plans for elective aortic root repair in 4-6 weeks.

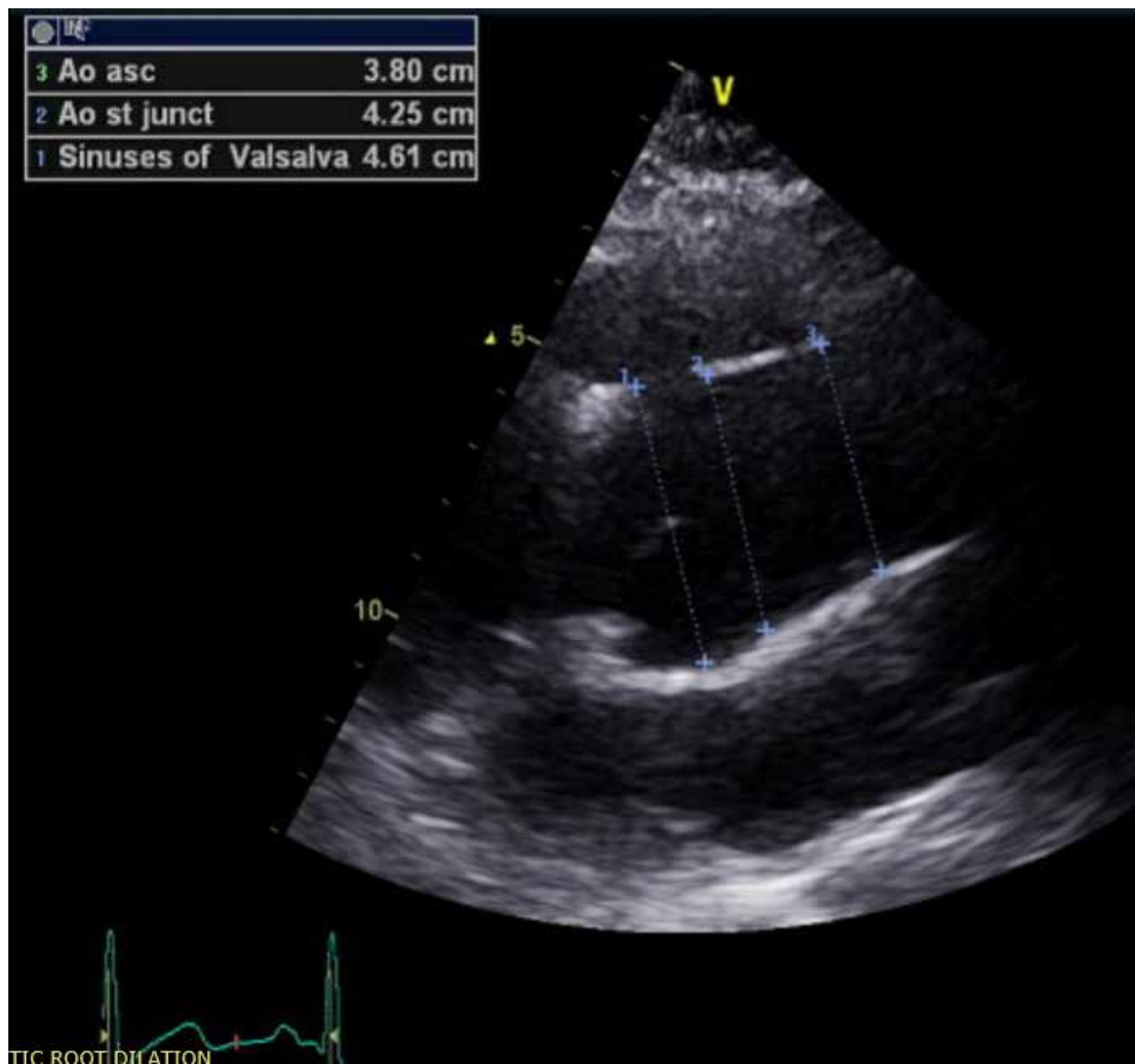
Discussion: The goal of anesthetic management in a parturient with Marfan syndrome is to minimize any increase in aortic root shear forces and to monitor and prepare for possible aortic dissection. Induction and emergence from general anesthesia, as well as uterine auto-transfusion, are the times when the patient is at highest risk of cardiovascular decompensation.

Conclusion: Cesarean section in a parturient with Marfan syndrome requires extensive multidisciplinary communication, mobilization of additional resources, and collaborative execution of an agreed-upon delivery plan to ensure the health and well-being of both mother and baby.

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Abstract #: F-63



Abstract #: F-64

Caesarean Section in a Parturient with Hypertrophic Obstructive Cardiomyopathy (HOCM), Morbid Obesity, and Non-Sustained Ventricular Tachycardia.

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Introduction: Hypertrophic obstructive cardiomyopathy (HOCM) is an autosomal dominant heart condition and is the most common type of inherited cardiomyopathy. Severity of disease is quantified by clinical symptoms and echocardiographic findings including ventricular septal thickening, left ventricular outflow tract gradient, and anterior motion of the mitral valve during systole. Most complications associated with HOCM and pregnancy includes supraventricular and ventricular arrhythmias, heart failure, and ischemic stroke. Maternal rate of complication or worsening of symptoms with pregnancy has been reported as high as 29%¹, with mortality being 0.5%². With the large hemodynamic changes seen during delivery, the interdisciplinary planning, procurement of resources, choice of anesthetic, and execution of the game-plan is of utmost importance.

Case Report: We present the case of a 35 year old G2P0101 at 34 weeks with a history of morbid obesity, non-sustained ventricular tachycardia, and newly diagnosed HOCM. The patient was diagnosed with HOCM at 5 weeks gestation after experiencing chest pain and erratic heartbeats. This was confirmed via echocardiogram and genetic testing as she had an extensive family history of sudden cardiac death and was initially counseled about termination of pregnancy.

Echocardiogram demonstrated 1.3-1.5 cm septal thickening and systolic anterior motion of the mitral valve with peak LVOT gradient of 83 mmHg. The patient was scheduled for an elective Caesarean section at 34 weeks and neuraxial anesthesia was the preferred method of delivery.

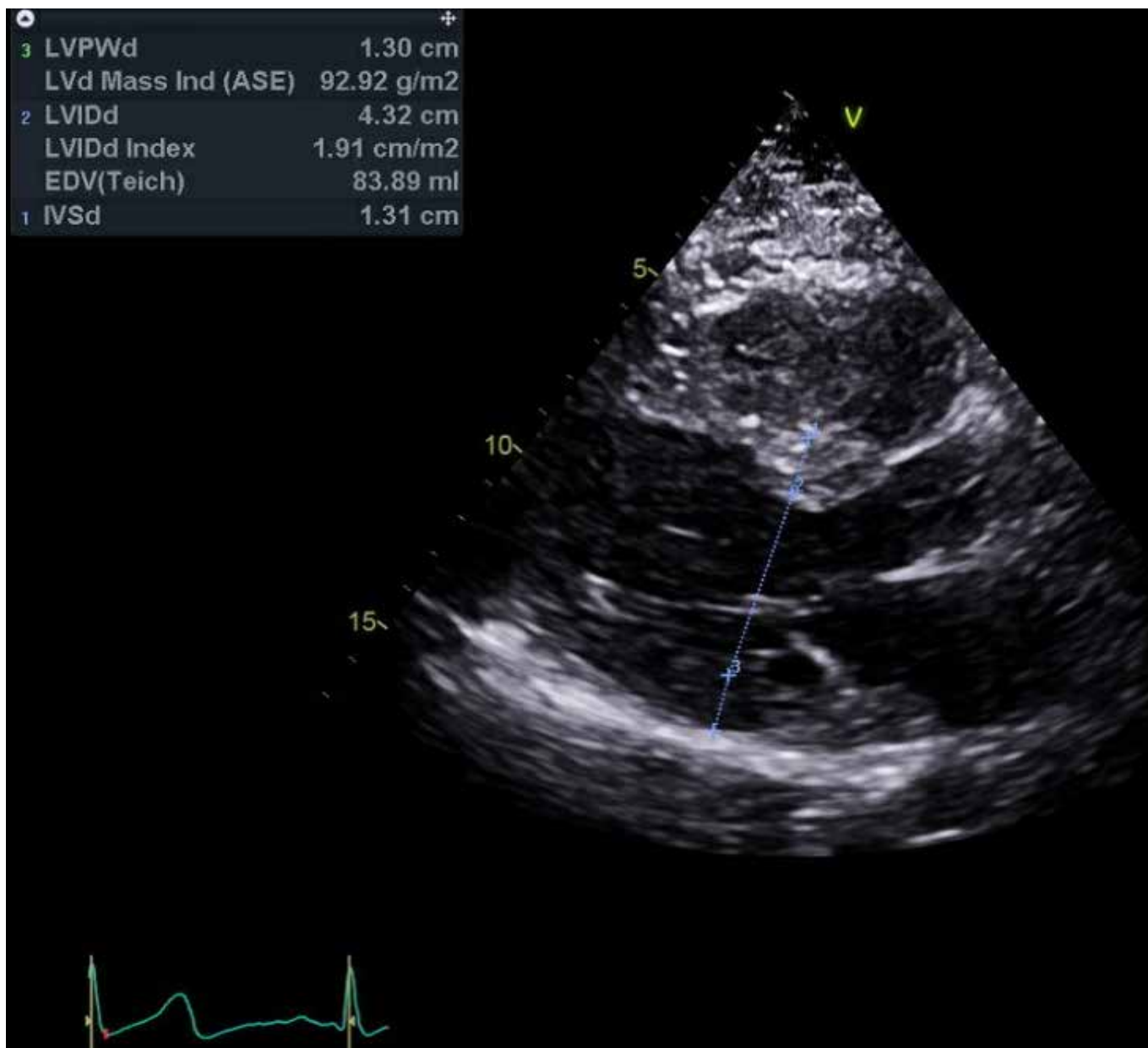
On the day of surgery, the patient had a left radial arterial line inserted as well as two large-bore IVs and a L4 epidural catheter. Over the next 30 minutes, the epidural was bloused with 60 mg of 2% lidocaine 5 minutes apart until a T4 level was achieved. A phenylephrine infusion was started and titrated to maintain mean arterial pressures (MAPs) at patient's baseline of 90. The delivery was uneventful and the patient was discharged 3 days later.

Discussion: Neuraxial anesthesia can cause significant hemodynamic changes. Small, incremental boluses of lidocaine through an epidural can be used to achieve an appropriate surgical level and avoid the major rapid cardiovascular alterations that could be detrimental to a patient with HOCM. Extensive pre-operative planning and effective execution is of paramount importance to best ensure the health and well-being of both mother and baby.

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2. SchinkelAF. Pregnancy in women with hypertrophic cardiomyopathy. *Cardiology Review*. 2014; 22: 217- 222

Abstract #: F-64



Abstract #: F-65

Cesarean Section in a Parturient with Repaired Congenital Aortic Stenosis and Dilated Aortic Root

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Introduction: Aortic root dilation during pregnancy is most commonly seen in patients with Marfan syndrome pathology and presents increased risk of dissection or rupture as increases in stroke volume, heart rate and histologic remodeling of the aorta occur¹. Literature discussing aortic root dilation in the non-Marfan parturient is sparse. Below is a discussion of a patient with aortic root dilation after a Ross procedure for congenital aortic stenosis (AS).

Case Report: We present the case of a 32-year-old G1P0 female at 37 weeks with a history of congenital bicuspid AS status post neonatal valvotomy and subsequent Ross procedure at age nine, now with neo aortic root dilation. She presented for scheduled cesarean section due to concern for shear forces on her aorta during labor. She was a medically compliant patient with no functional limitation. She was followed by maternal fetal medicine (MFM) and pediatric cardiology throughout her pregnancy with serial echocardiograms, which showed stable aortic root dilation at 47 mm, mild homograft pulmonary valve stenosis with severe insufficiency, and normal systolic function. Weeks prior to her section, a multidisciplinary meeting to finalize the delivery plan took place.

The primary anesthetic plan was slow titration via epidural to allow for controlled hemodynamics using invasive blood pressure monitoring to mitigate transmural pressure of the already dilated aortic root. General anesthesia, less desirable as a primary plan due to potentially significant hemodynamic changes, was discussed as a secondary plan if transesophageal echocardiography was required.

On day of delivery, epidural and arterial line were placed as discussed preoperatively. She was then placed in left uterine displacement. The epidural was slowly bolused with 2-3 cc of 2% lidocaine without epinephrine. Block level was assessed after each bolus until a bilateral T4 level was achieved. A phenylephrine infusion was required to maintain mean arterial blood pressure within 20% of the patient's baseline. Pain was treated with narcotic through the epidural and intravenously to avoid hypertension and tachycardia. Her cesarean was well tolerate and she was taken to recovery in the pediatric cardiac ICU. Post-delivery echocardiogram showed stability of the dilated aortic root and the patient had an uncomplicated hospital course.

Discussion: A multi-disciplinary approach is required for parturients with complex medical history. Our patient benefitted from close pre-procedural planning with a multidisciplinary team. The goal of decreasing transmural pressure of a dilated aortic root was achieved through tight hemodynamic monitoring and slow titration of epidural anesthesia.

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Elkayam U, Gleicher, N. Hemodynamics and cardiac function during normal pregnancy and the puerperium. *Cardiac Problems in Pregnancy*. New York: Wiley-Liss, 1995:23-32.

Abstract #: F-66

Repeat Cesarean Section in a Parturient with Arnold Chiari Malformation and Lumbar VP Shunt, With a Complicated History of Extreme PTSD After a Horrific Primary Cesarean

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Presenting Author's Institution: Medical University of South Carolina

Co-Authors: David Gutman, MD, MBA - Medical University of South Carolina

Abhinava Madamanglam, MD - Medical University of South Carolina

Daniel Young, MD - Medical University of South Carolina

Introduction: Arnold Chiari Malformation Type 1 is a disorder in which the cerebellar tonsils extend into the foramen magnum. A common sequela of this disorder is hydrocephalus requiring insertion of a CSF shunt. Neuraxial anesthesia for labor analgesia or cesarean section (CS) can be erratic and therefore challenging in patients suffering from this severe disease.

Case Report: We present the case of a 29-year-old G2P1 38 weeks with a history of type 1 Arnold Chiari malformation, lumbar ventriculoperitoneal shunt, and extreme anxiety, depression, and PTSD stemming from her primary cesarean section. She presented for a repeat CS in the setting of transiently increased ICP, which neurosurgery determined was most likely secondary to transient occlusion of her shunt by the gravid uterus. Her Arnold Chiari had been diagnosed in her early 20's and had worsened with time, required placement of a lumbar peritoneal shunt, a revision of the shunt two years later, and a partial C1-C2 resection.

The patient's primary c-section was performed under general anesthesia after multiple failed attempts at functional neuraxial anesthesia. She described having severe mental anguish and fear during her delivery, as well as severe post-operative pain resulting in an opioid addiction. She ultimately underwent extensive counseling but described having extreme post-partum anxiety, depression, and feelings of PTSD from the event. After extensive consultation with the neurosurgery, obstetric, and anesthesia team, a plan was put together, with multiple backup plans for polypharmacy, multimodal, and regional anesthetic adjuncts in the event that a general anesthetic was required.

On the day of surgery, a combined spinal-epidural was successfully performed. The spinal portion provided a surgical T4 level bilaterally and the cesarean section was performed without incident. A bilateral TAP block was performed at the conclusion of the procedure, and the patient's post-operative course was unremarkable.

Discussion: Patient histories of complex neurological disorders require a multidisciplinary approach and early consultation with multiple subspecialty teams to best develop an individualized comprehensive care plan. Despite a myriad of reasons for the original neuraxial anesthetics previously failing, we believe that in the absence of hard contra-indications, an effort should be made to perform one, but at the same time to have multiple backup plans in place

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Penney DJ, Smallman JM. Arnold-Chiari malformation and pregnancy. *International Journal of Obstetrical Anesthesia*. April; 10(2): 139-141.

Hopkins AN, Alshaeri T, Akst SA, et al. Neurologic disease with pregnancy and considerations for the obstetric anesthesiologist. *Seminars in Perinatology*. October; 38(6): 359-369

Abstract #: F-67

Hypofibrinogenemia as the First Sign of Severe Postpartum Hemorrhage: A Case Report

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Presenting Author's Institution: Northwestern Memorial Hospital - Chicago, Illinois

Co-Authors: Matthew Hire, MD - Northwestern Memorial Hospital

Emery H. McCrory, MD - Northwestern University

Background: Postpartum hemorrhage (PPH) is a leading cause of maternal morbidity and mortality worldwide¹. Early recognition of postpartum hemorrhage is critical, as it has been shown that delayed treatment of PPH is one of the strongest predictors of poor maternal outcomes, including death¹. Hypofibrinogenemia is an important predictor of severity of postpartum hemorrhage. Fibrinogen levels of less than 2g/dl have shown a positive predictive value for PPH of 100%, and it is the first coagulation factor to fall in massive hemorrhage.² We present a case of severe PPH presenting initially with isolated hypofibrinogenemia.

Case: A 42-year-old G1P0 presented at 34 weeks for scheduled cesarean delivery. Her pregnancy was complicated by vasa previa and chronic hypertension. On admission, she stated approximately 4-5 days of viral symptoms. She had an uncomplicated cesarean delivery under spinal anesthesia with initial estimated blood loss of 850 cc. She received methylergonovine and misoprostol intraoperatively for mild uterine atony. In recovery she was initially hemodynamically stable without ongoing blood loss. Two hours postpartum, she was tachycardic and hypotensive. Manual exploration was unremarkable and abdominal ultrasound was negative for free fluid. Laboratory studies showed fibrinogen 50 mg/dL, platelets of 222 k/ul, and hemoglobin (Hb) of 10.0 g/dl (down from 13 g/dl preoperatively). She was given 1 unit of cryoprecipitate for hypofibrinogenemia. The patient briefly stabilized but hours later was again noted to be tachycardic and hypotensive. Repeat Hb was 3.7 g/dl and fibrinogen was less than 50 mg/dL. She underwent emergent exploratory laparotomy revealing 1 liter of hemoperitoneum without obvious source. She was resuscitated with 5 units of packed red blood cells, 2 units of platelets and 2 units of cryoprecipitate. She was taken intubated and sedated to the surgical intensive care unit where she was given one additional unit of PRBCs but remained stable. She was discharged from the hospital on post op day 7.

Discussion: Hypofibrinogenemia outside of massive transfusion or liver failure signals the onset of disseminated intravascular coagulation (DIC). In this patient, coagulopathy preceded evidence of massive PPH. It is possible that the patient's infectious symptoms represented sepsis masked as physiologic changes of pregnancy, leading to DIC and PPH. There is evidence to support hypofibrinogenemia after the onset of PPH is predictive of severity of PPH, though here it seems to have been a signal for impending hemorrhage². While the ultimate reason for her sudden DIC is unclear, this case highlights the importance of early recognition and treatment of hypofibrinogenemia as it may be early marker of severe PPH, and could alert clinicians to massive bleeding before a drop in Hb.

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3. Levy JH, et al. *Transfusion.* 2014;54(5):1389–405

Abstract #: F-68

Diving Deep: A Parturient with Myocardial Bridging and Repeated Coronary Vasospasm

Presenting Author: Christopher Aiudi, MD, PharmD

Presenting Author's Institution: Massachusetts General Hospital - Boston, Massachusetts

Co-Authors: Kate M. Cohen, MD - Massachusetts General Hospital

Erin E. Haggerty, MD - Massachusetts General Hospital

Introduction: Cardiovascular disease (CVD) is the leading cause of mortality in pregnancy. Acute MI accounts for ~20% of CVD in parturients (incidence of 8.1 in 100,000) and carries a 4.5% mortality¹. Etiology of peripartum MI include coronary atherosclerosis, dissection, in situ thrombus, spasm, and emboli.² However, MI can occur with normal coronaries, clouding the clinical picture. Peripartum MI is related to maternal risk factors such as hypertension, diabetes mellitus, and coronary atherosclerosis. Complications of it include heart failure, arrhythmias, recurrent MI and cardiogenic shock.

Case Report: A 38 yo G4P3 near-term with a PMH of asthma, Guillain-Barre syndrome and recurrent antepartum chest pain presented with SOB and persistent, severe, substernal chest pain. Her PSH included 3 cesarean sections. Cardiac workup revealed elevated troponins and an EKG with ST segment elevation in V5-6 and reciprocal changes in I and AVL. Her TTE showed hypokinesis of the LV lateral wall. A code STEMI was activated. Cardiac catheterization demonstrated 80% luminal narrowing of the LCx. Suspicion for spontaneous coronary artery dissection was low. The cardiac event was attributed to myocardial bridging and subsequent coronary vasospasm. She was treated medically with amlodipine, metoprolol and ASA.

A multidisciplinary team was assembled for a planned term delivery given her high risk for repeat STEMI. She underwent a repeat cesarean delivery and subsequent salpingectomy without cardiac sequelae. Her EBL was 900cc. She continued medical management postpartum.

Discussion: Myocardial bridges occur when a portion of an epicardial coronary artery travels via an intramyocardial route. During systole, myocardial contraction constricts the artery causing decreased blood flow and perfusion to distal myocardium. Increased cardiac work in late gestation can exacerbate the impact of myocardial bridges. Efforts to optimize the cardiac oxygen demand to delivery ratio can reduce the risk of an ischemic event. The hemodynamic goals of lowering heart rate and improving coronary perfusion can be met with rate controlling agents and correcting the underlying defect with bypass grafting, stents, or myotomy³.

References:

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3. *Congenit Heart Dis*. 2017;12(5):619

Abstract #: F-69

Anterior Tonsillar Pillar Perforation During GlideScope® Intubation

Presenting Author: Anne-Sophie Janvier, MD

Presenting Author's Institution: Columbia University - New York, New York

Co-Authors: Ruth Landau

Allison Lee, MD, MS - Columbia University

Background: Videolaryngoscopes improve glottic visualization and success of 1st-attempt and rescue tracheal intubation. [1] Experts advocate their use as 1st-line devices in pregnancy due to higher failed intubation risk.[1] Associated supra- and sub-glottic trauma have been reported in the setting of styletted endotracheal tubes (sETT) but no injuries involving obstetric patients have been published.[2] We present the 1st report of GlideScope®-associated supraglottic injury in the obstetric population.

Case Report: A 39yo G3P2 at 28w5d, BMI 29, with recent DVT on enoxaparin 80mg SQ BID presented with placental abruption requiring emergent cesarean delivery. Neuraxial anesthesia was not an option (last enoxaparin dose was 9h earlier). Her airway was Mallampati class 3 with partial ability to prognath the mandible. Positioned on a Troop™ pillow, GA was induced; a GlideScope® 3 with sETT were used. Immediately following intubation, the sETT was noted to have perforated the anterior tonsillar pillar en route to the glottis; it was left in place. Intraoperative ENT evaluation recommended extubation at the end of the case, which was uneventful. Soft diet, p.o. amoxicillin, chlorhexidine rinses, and viscous lidocaine prn were prescribed. The patient denied pharyngeal pain during 3-day follow-up.

Discussion: Increased airway friability due to pregnancy and anticoagulated status were of special concern in this case. Fortunately, conservative management was sufficient. Enoxaparin was restarted 24-h later.

Notwithstanding clear visualization of the larynx, GlideScopes® may be associated with soft-tissue trauma.[2] Alignment of oral, pharyngeal and tracheal axes are not required, so rigid 60degree ETT stylets matching the curve of the blade are used to navigate the marked angle.[2] The sETT is directed almost perpendicular to the tracheal axis, risking subglottic injury.[2] Perforation of the soft palate, and palatoglossal and palatopharyngeal arches have been reported in non-pregnant patients. [2] Upward force on the laryngoscope may lead to tenting of the tonsillar pillars;[3] attention diverted to the video monitor rather than oropharynx, and unnecessary force while introducing the sETT may have contributed to the injury in this case.

The prevalence of videolaryngoscope-associated injury is believed to be rising with their increasing acceptance. The C-MAC® blade does not require a pre-curved sETT. Higher success and lower tissue trauma were seen with the C-MAC® and McGrath™ vs. 4 videolaryngoscopes in simulated difficult airways.[3] No comparisons of videolaryngoscopes have been conducted in obstetric patients.

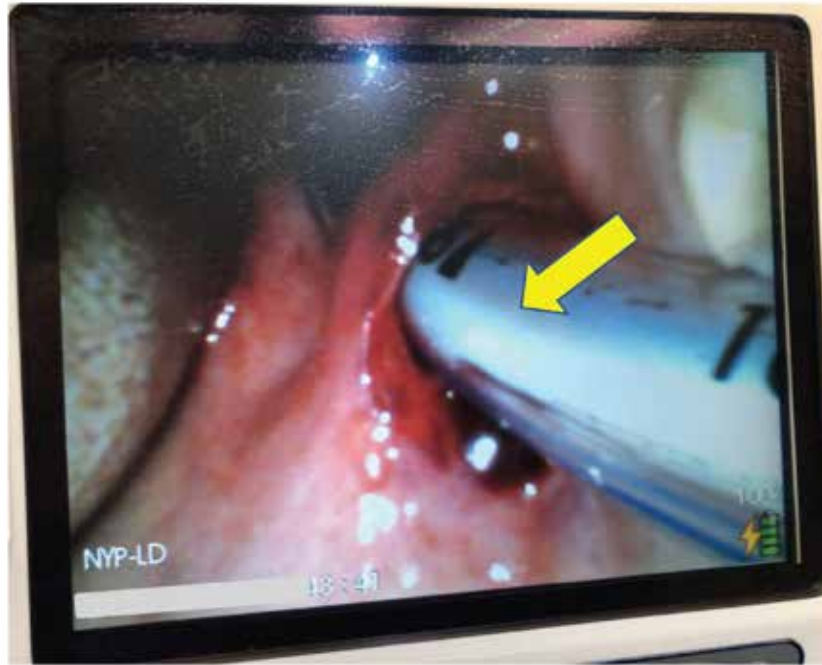
Clinicians must look in the mouth when inserting the blade and sETT, and look at the monitor when advancing both blade and ETT, with awareness that the ETT tip may pass through “blind spots”; excessive force should be avoided.[4]

References:

1. Anaesthesia 2015;70:1286-306.
2. Anaesthesia 2017;72:504-11.
3. Br J Anaesth. 2012 109;439-43.
4. J Clin Anesth, 2010;22:152-4.

Abstract #: F-69

Figure: Endotracheal tube perforating right anterior tonsillar pillar



Abstract #: F-70**Massive postpartum intra-abdominal hemorrhage due to spontaneous splenic rupture****Presenting Author:** Gulnar Mangat, MD**Presenting Author's Institution:** Columbia University - New York, New York**Co-Authors:** Allison Lee, MD, MS - Columbia University

Background: Intra-abdominal hemorrhage post-Cesarean delivery (CD) is a potentially life-threatening emergency, requiring prompt diagnosis and aggressive management. It is the leading indication for re-operation. (1) Primary sources of bleeding include inadequate hemostasis involving the uterus, cervix, abdominal wall, and vesicouterine and epigastric vessels.(1) We present a rare case of post-CD intra-abdominal hemorrhage from spontaneous splenic rupture.

Case Report: A 30yo G3P1 at 38w2d gestation with cholestasis of pregnancy and elevated liver enzymes (AST 98, ALT 119) underwent uncomplicated urgent secondary CD with spinal anesthesia. On postoperative day 1, she had increasing abdominal pain and dyspnea, with a diffusely tender, mildly tympanic abdomen. Her BP deteriorated to 50s-70s/30s-40s mmHg, with HR 80s/min and O₂ Sat 93%. Serum hemoglobin decreased from pre-operative baseline 12.0 to 7.9 g/dL. 100% face mask O₂, IV crystalloid, packed red cells (pRBCs) and a phenylephrine infusion were initiated via 2 18G IVs. Abdominal ultrasound revealed free fluid and clots and she was transferred to the OR for exploratory laparotomy.

General anesthesia and invasive arterial monitoring were established. Upon re-opening the Pfannensteil incision, massive hemoperitoneum was evacuated; bleeding was originating from the left upper quadrant of the abdomen. General surgeons were consulted. A splenic laceration was identified after extending the incision vertically, and splenectomy was performed. Estimated blood loss was 4L; a total of 3L lactated Ringers, 6units pRBCs and 6units fresh frozen plasma were given. Post-operatively she was transferred, mechanically ventilated, to the ICU and was extubated uneventfully the next day. She was discharged home on postoperative day 9.

Discussion: Splenic rupture in pregnancy is rare, but is a well-documented phenomenon, with >100 cases described in the literature since 1880.(2,3) Most cases are due to splenic artery aneurysm rupture or a complication of preeclampsia. Rupture with no other underlying cause is rare (2.2% of cases). (4) Misdiagnosis is common, due to non-specific signs and symptoms. Presentation is typically in the 3rd trimester or early postpartum and is associated with increased fetal and maternal morbidity and mortality.(5)

Splenic enlargement and increased maternal blood volume of pregnancy, and intrapartum trauma, especially during CD, have been implicated in the pathogenesis. (2,5,6) Identifying the cause of acute onset of shock post-CD is a clinical challenge- although rare, splenic bleeding must be considered. This case emphasizes that a full evaluation of the abdomen, including the upper quadrants should be performed in the setting of hemoperitoneum.

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6. Pan African Med J. 2015; 21: 312.

Abstract #: F-71

Labor Management for a Patient with Palliated Hypoplastic Left Heart

Presenting Author: David Saldivar, MD

Presenting Author's Institution: West Virginia University, West Virginia

Co-Authors: Jonathan Bond - WVU

Andrew Criser - West Virginia University

Summer Niazi - West Virginia University

Lance Parks - West Virginia University

Manuel Vallejo - West Virginia University

Hypoplastic left heart is a congenital condition that presents as an underdeveloped left ventricle, mitral valve, aortic valve, and with a stenotic aorta. Hypoplastic left heart is rare, with an incidence of 1 in 3,841 births in the United States annually.

We present a 20-year-old patient with a palliated hypoplastic left heart. Her palliation included a Norwood, Glenn, and Fontan procedure performed during infancy and childhood. She also required a pacemaker for complete heart block. The patient was lost to follow-up during her teenage years; however, she returned at the age of 20 once she became pregnant. A multidisciplinary team including high-risk obstetrics, pediatric cardiac anesthesiology, obstetric anesthesiology, pediatric cardiology, and pediatric intensivists discussed the delivery plan and postpartum course including admission to the intensive care unit. Our management of her labor will be discussed here.

She was scheduled for induction of labor at 37 weeks with the placement of an arterial line for close hemodynamic monitoring. The anesthetic plan was to use an intrathecal catheter with 0.125% bupivacaine and 2mcg/mL fentanyl infusing at 1mL/hr. Placement was complicated by multiple patient factors, including limited landmarks, poor cooperation, and positive aspiration for heme in the subarachnoid space. However, the test dose proved to be positive for subarachnoid placement so the intrathecal catheter was utilized for management.

The patient tolerated labor throughout her stay, however, she failed vacuum-assisted and forceps-assisted delivery. The decision was then made to take her for a cesarean section with cardiopulmonary bypass on standby. The epidural infusion was discontinued and 1.5% lidocaine was bolused through the catheter at a dose of 30mg for surgical anesthesia. She tolerated the procedure well but intraoperatively post-delivery the patient began to undergo significant ST changes requiring dopamine and milrinone infusions. No further complications were encountered and the patient was admitted to the Pediatric ICU after surgery for close monitoring. No post-operative issues arose and the patient was successfully discharged home on postoperative day three.

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Abstract #: F-72

Successful Combined Spinal Epidural Placement in a Patient with Achondroplasia for Repeat Cesarean Section: A Case Report and Review of the Literature

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Introduction: Achondroplasia is the most common cause of dwarfism caused by a mutation in the FGF3 gene and inherited in an autosomal dominant fashion. Patients with achondroplasia pose many challenges to the anesthesiologist who is considering either general or neuraxial anesthesia for obstetric or non-obstetric procedures. We present a unique case of a patient with achondroplasia presenting for cesarean section, which was managed successfully with neuraxial anesthesia despite abnormal anatomy.

Case: A 32 year-old G2P1 female at 37 weeks gestation presented for scheduled repeat cesarean section. Her medical history included achondroplasia, chronic hypertension, and bipolar disorder. She was 101.6cm tall and weighed 52.3kg. Airway exam was MP3, adequate thyromental distance, full neck range of motion, and edentulous. Cesarean section was performed two years prior under general anesthesia due to lumbosacral deformity. Review of lumbar spine MRI demonstrated horizontal orientation of the sacrum with exaggerated lumbosacral angle. Given the concern for prolonged lysis of adhesions and exposure of the fetus to inhalational anesthetics, the decision was made to proceed with neuraxial anesthesia. Combined spinal epidural technique was used to allow extension of spinal blockade and to prolong block duration. Combined spinal epidural was performed using loss of resistance technique at L3-4. Then, 15mcg of fentanyl and 0.5mL of 0.75% hyperbaric bupivacaine were administered intrathecally, and 2mL of 1.5% lidocaine with 1:200,000 epinephrine was administered via epidural route as a test dose after assessment of spinal block level. A total of 2mL of 2% lidocaine with 1:200,000 epinephrine was administered via epidural route to maintain surgical anesthesia to the T5 dermatomal level throughout the procedure. The patient was hemodynamically stable during the perioperative period and was discharged on postoperative day 2.

Discussion: Few cases of patients with achondroplasia undergoing cesarean section using neuraxial anesthesia have been reported. Unlike prior reports, our patient had a shorter stature and underwent repeat cesarean section, posing unique anatomic and technical challenges. Narrow epidural and intrathecal spaces, exaggerated lumbar lordosis, and spinal stenosis in patients with achondroplasia further complicate the technique, necessitating a thorough understanding of the anatomic variation in such populations. Intrathecal and epidural medication doses should be adjusted to avoid high spinal/epidural level. Following successful neuraxial placement, anesthesiologists must be aware of the specific difficulties associated with general anesthesia in patients with achondroplasia, such as enlarged head and tongue, cervical kyphosis, atlantoaxial instability, and thoracic kyphoscoliosis, and be ready to convert to general anesthesia when needed.

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Abstract #: F-73

Paralyzed and Pushing: Management of a Parturient with Guillain-Barre Syndrome

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Case Presentation: 33yo G5P4 parturient at 32 weeks presents with progressive upper and lower extremity weakness following Epstein-Barr virus (EBV) mononucleosis. CSF revealed elevated protein content, and nerve conduction showed a demyelinating polyneuropathy. The results, along with history of EBV, lead to a diagnosis of Guillain-Barre Syndrome (GBS). Over 10 days, she developed SVT episodes that were treated with labetalol. She progressed to bulbar weakness and was intubated for respiratory failure. She was treated with intravenous immunoglobulins (IVIg) 400mg/kg and plasmapheresis. At 33+5 weeks gestation, preterm contractions began, she quickly progressed to 10cm cervical dilation, and was brought to the OR for vaginal delivery (VD). She had 4 previous uneventful VDs without neuraxial analgesia. Standard ASA monitors were placed and she was connected to a ventilator. IV fentanyl 25mcg was given intermittently. Esmolol and nitroglycerine were readily available for dysautonomia episodes. Vacuum-assisted vaginal delivery was successful. Infant was born with APGAR scores 7 and 9. In the week postpartum, the patient's symptoms worsened and she required a tracheostomy.

Discussion: GBS is a progressive peripheral demyelinating disease, beginning in the lower extremities and advancing proximally. Rarely occurs in pregnancy with 1.2 incidences per 100,000 in the US, but 6-24 per 100,000 in poorly developed countries. There is high maternal mortality (3%) secondary to respiratory failure due to increased metabolic demands and reduced lung capacity during pregnancy.¹ It is often associated with gastroenteritis (*Campylobacter jejuni*), mononucleosis (EBV), or respiratory infection (Cytomegalovirus) 2-4 weeks prior to development of symptoms.² Treatment is IVIg or plasmapheresis, along with supportive care. Continuous fetal tracing is required as plasmapheresis can lead to placental hypoperfusion. Dysautonomia presents as SVT and hypertension. Thromboprophylaxis is critical due to the hypercoagulability of pregnancy and immobility of GBS. Anesthetic management goals are primarily respiratory support. Succinylcholine should be avoided due to postsynaptic receptor upregulation and hyperkalemia. There are no contraindications to neuraxial anesthesia.³ Postpartum, as the immune system returns to baseline function, symptoms often worsen, as seen with this patient.

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Abstract #: F-74

Hyperkalemic Periodic Paralysis in a Parturient: Anesthetic Considerations for a Safe Delivery

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INTRODUCTION: Hyperkalemic periodic paralysis (HPP) belongs to a group of familial myopathic disorders called the periodic paralyses that result in intermittent weakness and/or paralysis. HPP results from a gene mutation in the SCN4A sodium channel in skeletal muscle, leading to excessive depolarization, accumulation of extracellular potassium, and poor muscle tone (1).

Factors that trigger episodes of weakness in HPP include general anesthesia, succinylcholine, hypoglycemia, extremes of temperature, exercise, and iatrogenic administration of potassium (2). Concerns specific to the parturient with HPP include weakness of the upper body (impaired ventilation), lower body (impairing delivery of the fetus), and development of cardiac arrhythmias (3).

CASE PRESENTATION: We present the case of a primiparous woman with known history of HPP which was diagnosed after many years of intermittent weakness, particularly after prolonged exercise or fasting. She described the worst episode as “total paralysis” where she was unable to move any of her extremities. After diagnosis, she had not experienced a serious episode as she treated prodromal symptoms promptly with sugar.

The patient presented for induction of labor (IOL) at 39 weeks for oligohydramnios and variable decelerations. She was placed on continuous cardiac telemetry with neurological exams every 2 hours and monitoring of serum potassium every 8 hours. Clear liquid diet was allowed throughout labor and warm dextrose-containing IV fluids were used for maintenance.

Combined spinal-epidural (CSE) was placed early to minimize the stress of labor. She had a prolonged course, requiring replacement of her CSE and subsequently underwent Cesarean Delivery (CD) for arrest of descent and chorioamnionitis. The epidural was dosed incrementally with 2% lidocaine plus 1:200,000 epinephrine until a T4 sensory block was achieved. Serum potassium was 4.0 on admission and ranged from 3.5 to 3.9 throughout labor and delivery. She breastfed for the first few days, however noted episodes of weakness every time she pumped or fed her baby which resolved upon cessation of breastfeeding.

DISCUSSION: Successful management of HPP during labor and CD has previously been described (4). Our patient benefited from multidisciplinary planning prior to delivery which allowed us to formulate a plan to prevent episodes of paralysis. It is critical to ensure the epidural is functioning well, as it reduces the stress of labor and can help avoid a general anesthetic if the parturient requires CD. Treatment of hyperkalemic episodes are aimed at reducing serum potassium levels which can be accomplished with furosemide, insulin (plus dextrose), beta agonists, and calcium gluconate (2).

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Abstract #: F-75

Superficial cervical plexus block for awake large-bore central line placement in parturients

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INTRODUCTION: Pregnant patients with high-risk conditions including abnormal placentation and cardiovascular disease undergoing cesarean delivery often require large-bore central venous access. Central lines are generally inserted while patients are awake to minimize fetal exposure to anesthetic medications and provide safe maternal neuraxial anesthesia. Despite aggressive local infiltration, large-bore central venous access causes anxiety and discomfort, and we have had to abort procedures or convert to general anesthesia several times due to severe patient discomfort.

Superficial cervical plexus block (SCPB) has been described for tunneled central venous catheters in awake patients (1), hemodialysis catheter placement in pediatric patients (2), and awake invasive neck surgeries including carotid endarterectomy (3) and thyroidectomy (4). SCPB targets the lesser occipital (C2), greater auricular (C2), transverse cervical (C3), and supraclavicular (C4) nerves (5) and results in anesthesia from the external auricular area to the clavicle after a single-dose, superficial injection of local anesthetic.

CASE PRESENTATION: We present a case of a parturient with known abnormal placentation who was scheduled to undergo cesarean hysterectomy. We performed a right-sided SCPB with ultrasound guidance and administered 10 mL of 0.5% ropivacaine in the preoperative area. The patient was subsequently moved to the operating room for neuraxial block followed by line placement. She experienced no discomfort during central venous introducer sheath placement and did not require any supplemental local anesthetic. She was offered low dose anxiolytics during the line placement which she declined.

Following delivery of the baby, she was diagnosed with placenta percreta and underwent cesarean hysterectomy, salpingectomy, partial cystectomy. She received 6 units of blood and 1 FFP intraoperatively. She was extubated and the introducer sheath removed in the post-anesthesia care unit. On postoperative day 1, she reported that the central line was not painful and attributed much more discomfort to her radial arterial line placement.

DISCUSSION: To our knowledge, this is the first report of utilizing SCPB for a parturient requiring awake central line placement. Of note, older descriptions of SCPB actually describe blockade of the intermediate cervical plexus. We injected local anesthetic next to both which resulted in profound analgesia. We would recommend SCPB are offered to all awake parturients to alleviate the pain and discomfort of large-bore central line placement. SCPB are technically easy blocks, accomplished with ultrasound-guidance or landmarks and are associated with low reported complication rates.

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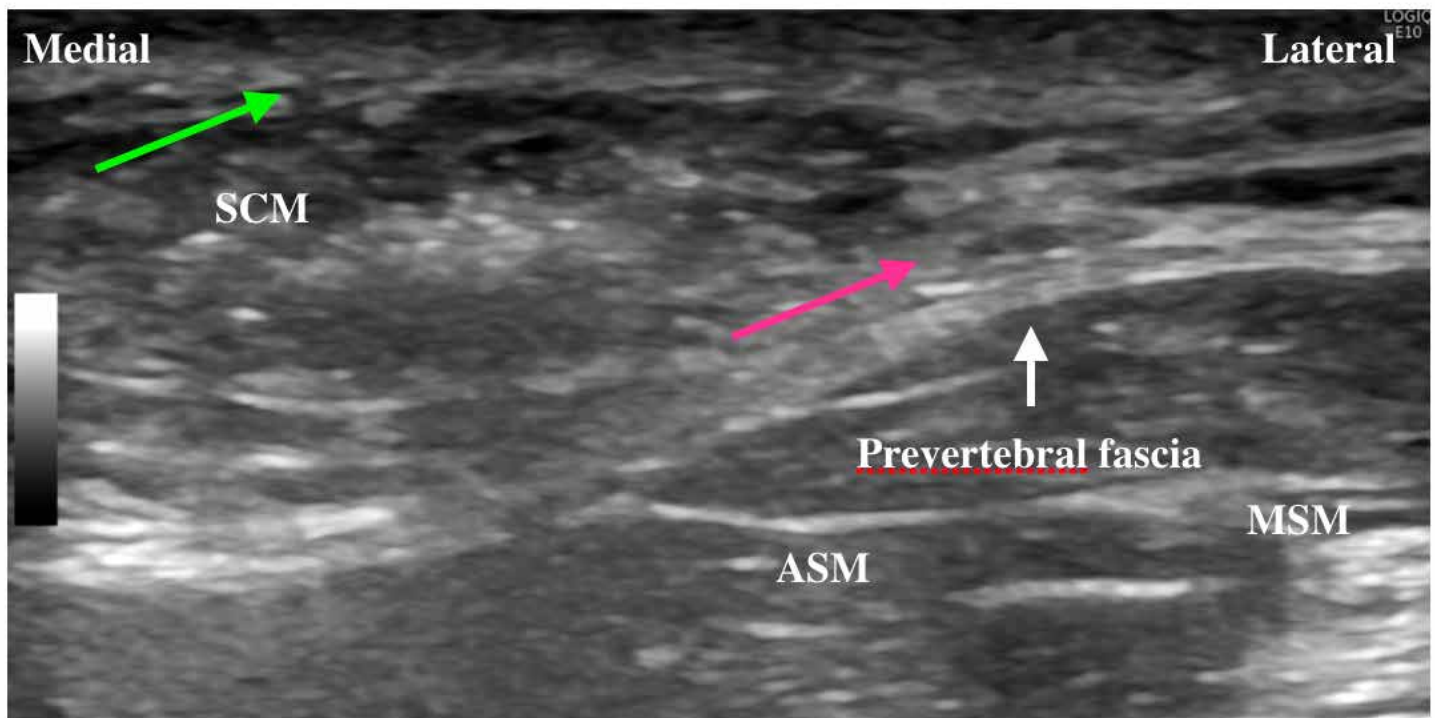


Figure 1: Ultrasound image of our patient's cervical plexus. The superficial cervical plexus (green arrow) lies in the subcutaneous layer of the posterior border of the sternocleidomastoid muscle (SCM) at the level of the thyroid cartilage. The intermediate cervical plexus (pink arrow) lies deep to the SCM and superficial to the prevertebral fascia, middle scalene muscle (MSM) and anterior scalene muscle (ASM).

Abstract #: F-76

Low dose Spinal for Cesarean Section in a Parturient with Congenital Aortic Ectasia and Aortic valve Stenosis.

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Aortic ectasia is a diffuse enlargement or dilation of the ascending aorta which can lead to erosion or loss of function of the aorta. This can lead to valvular abnormalities such as aortic regurgitation or aortic stenosis. Hypertrophy or dilation of the heart can result from these valvular lesions which can result in heart failure or a significant arrhythmia especially in the setting of cardiovascular changes of pregnancy.

CASE: A 30 yo G3P2 at 38 weeks with history of congenital aortic ectasia with severe aortic insufficiency, status post bioprosthetic aortic valve replacement and aneurysm repair in 2010, presented to the labor and delivery unit. She had two prior C-sections, with uncomplicated neuraxial techniques. TTE revealed moderate prosthetic valve stenosis (mean gradient of 31mmHg and AVA of 1.5) with post-surgical sinus of Valsalva to RVOT shunt and EF of 56%. Stress test was negative with a normal resting blood pressure. Cardiology cleared her for a C-section via general or neuraxial with caution of complications including heart failure or arrhythmia. Plans for redo AVR and shunt repair were recommended postpartum if left ventricle dimensions enlarged.

Intraop Course: Two large bore IVs were placed pre-operatively and standard ASA monitors were applied with BP set to cycle every 2 minutes. A low dose CSE was placed with 1.4 cc of 0.75% hyperbaric bupivacaine and 20 mcg of fentanyl intrathecal. Blood pressure was maintained (MAP >70 or 10% of baseline) with intermittent boluses of phenylephrine. Epidural test dose was given 90 minutes post spinal injection. Intraop course was notable for EBL of 1750 cc secondary to lysis of adhesions. She was hemodynamically stable and euvolemic. Post-partum, she remained asymptomatic and discharged home on post-operative day 3.

Discussion: The goal in anesthetic care for these patients is to maintain hemodynamic stability to avoid complications such as aortic dissection, myocardial infarction, or acute heart failure. A major concern with neuraxial anesthesia is spinal induced hypotension, which can precipitate nausea/vomiting, decreased placental perfusion, or cardiovascular complications. The frequency and degree of hypotension is influenced by the dose of subarachnoid local anesthetic¹. There have been several studies using low dose spinal injections. Defining "low-dose" is not straightforward and there has not been a consensus in the literature. Research of the "optimal dose" of subarachnoid local anesthetic, defines "low dose" as one mg below the ED₉₅, which is 11 mg for hyperbaric bupivacaine and 13 mg if isobaric^{2,3}. In summary, employing a low dose intrathecal technique is more likely to reduce the occurrence of induced hypotension and the subsequent maternal/fetal complications, but may be at the cost of decreased duration and slower onset of anesthesia, increased requirement for supplementation and possible conversion to general anesthesia.

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Abstract #: F-77

Difficult diagnosis of PRES due to language barriers in a severely pre-eclamptic patient with HELLP syndrome: A Case Report

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Robyn Dwan, DO - Vanderbilt University Medical Center

Introduction: Pre-eclampsia affects between 5-8% of pregnancies.¹ Posterior Reversible Encephalopathy Syndrome (PRES) affects many pre-eclamptic and up to 100% of eclamptic patients but often goes undiagnosed and unreported.²

Case Report: A Spanish speaking 37 year old, G3P1102 at 36 weeks gestation presented to obstetric triage complaining of right upper quadrant pain and headache. An induction was planned for suspected pre-eclampsia and fetal growth restriction. Vital signs and physical exam were notable for an elevated blood pressure of 188/112mmHg, 1+ deep tendon reflexes, and 2+ lower extremity edema. Labs revealed leukocytosis, elevated hematocrit, thrombocytopenia, elevated transaminases and renal dysfunction confirming the diagnosis of pre-eclampsia with HELLP syndrome. As the patient continued to be monitored closely, obstetric providers noticed she was becoming somnolent and paused her magnesium infusion. While her responses to questions were appropriate, her family became increasingly concerned and notified the translator that the patient was not herself. The obstetric team ordered a stat MRI secondary to the patient's altered mental status, which demonstrated hyperintensities congruent with PRES. Upon returning to the labor and delivery unit, a prolonged fetal deceleration prompted an obstetric emergency to be called and the patient was taken to the operating room for a stat cesarean section. Due to the emergent nature of the situation and thrombocytopenia, her c-section was performed under general anesthesia. The patient's intra-operative course was grossly unremarkable other than hypertension, which resolved after delivery. In the postoperative period, the patient had significant lab abnormalities, including peak transaminases >1000units/L, platelet nadir 53,000/mcL, and creatinine up to 0.88mg/dL. Remarkably, the patient did not require an ICU stay and was stable for discharge home on post-op day 5 with no residual deficits.

Discussion: PRES can be difficult to diagnose in pregnancy due to presenting neurologic symptoms such as headache, visual disturbances, and impaired consciousness or seizures, being indistinguishable from pre-eclampsia with severe features or eclampsia.¹ This case follows the course of a patient with HELLP syndrome and PRES to highlight the differential diagnoses for altered mental status in obstetric patients, anesthetic management strategies for PRES, and considerations when treating patients with altered mental status while utilizing translation services.

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Abstract #: F-78

Rapid Identification of Known Difficult Airway is Critical for Successful Management of Obstetric Emergencies in Morbidly Obese Women

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Introduction: Prevalence of obesity in pregnancy is estimated as high as 28%.¹ It increases risk of cesarean delivery (CD), hypertension, preeclampsia, aspiration, difficult intravenous access, and difficult airway.^{1,2} Risks are compounded by emergency situations, and early care should be taken to mitigate their consequences. This case follows the timely identification and management of known difficult airway in a morbidly obese patient requiring urgent CD.

Case: A 39yo G9P3 at 32 weeks gestation presented to OB triage with abdominal pain, vaginal bleeding and loss of fetal movement. She had a BMI of 56, associated comorbidities (hypertension, DM, OSA), and a history of two prior classical CD. This pregnancy was complicated by polyhydramnios (AFI 44cm) for which she had declined amnioreduction. Initial exam was significant for hypertension (152/63 mmHg), tachycardia (104 bpm), oxygen saturations of 94-97%, and diffuse abdominal tenderness. Labs were normal except for hemoglobin of 10.2 g/dL. Placental abruption was suspected and MFM specialists confirmed fetal demise on ultrasound. Prior to expectant management, the patient's husband mentioned a difficult airway and an anesthesiologist found a difficult airway alert linking to the last airway note in her medical record. This note mentioned moderately difficult mask ventilation with four attempts at direct and indirect laryngoscopy by both a trainee and attending physician who, despite use of a ramp, bougie, and Parker endotracheal tube, eventually utilized a supraglottic airway for the duration of the case. With this knowledge, a decision was made to proceed with urgent CD with awake fiberoptic intubation followed by arterial and large bore venous access. After induction of anesthesia, the patient was found to have extensive adhesive disease, the fetus and placenta were in the abdomen, and the uterus was ruptured but contracted behind the fetus. Large-volume resuscitation was not required and the patient had a short intensive care unit stay prior to discharge.

Discussion: Obesity is a risk factor for failed intubation and maternal mortality.³ For patients with a difficult airway, educating the patient on the difficulty of her airway as well as having electronic medical records that easily identify prior difficulty facilitate a successful outcome in emergent scenarios. This case highlights the perils of physiologic changes in morbidly obese parturients and discusses systems for rapid identification and management of patients with a difficult airway.

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Abstract #: F-79**Postpartum Sepsis—An Unusual Presentation**

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An otherwise healthy 25yo G2P1001 presented at 38w1d after SROM. Her pregnancy was complicated by PTL at 28w, during which she received betamethasone. Upon presentation she was AVSS. An L3/L4 epidural for labor analgesia was placed. During placement, she had transient paresthesias. She had an uncomplicated SVD of a female infant; APGARS 8/9. The epidural was removed 48 minutes after delivery and patient was transferred to postpartum—ambulatory, with pain well-controlled.

Patient reported weakness, chills, nausea and sharp LLQ abdominal pain 20 hours after delivery. Her HR was 120s-140s, otherwise AVSS. She cited similar symptoms after her first SVD referring to it as a “reaction to her epidural.” Patient’s exam was significant for LLQ tenderness with rebound. She developed a fever to 100.8 F and hypotension. She received IVF; blood and urine cultures were sent. Bedside ultrasound revealed fluid in her LUQ concerning for retroperitoneal bleed. A CT AP showed an enlarged uterus with fluid/debris along the endometrial canal. She received gentamycin, clindamycin and ampicillin for suspected endometritis.

Patient’s symptoms progressed—BLQ abdominal pain, back pain at epidural puncture site and leg numbness. OB consulted Anesthesiology to evaluate for epidural hematoma vs. abscess. On exam, patient had lumbar paraspinal tenderness and BLE numbness; motor function was intact. A STAT lumbar MRI was normal. Blood and vaginal cultures were positive for *Streptococcus pyogenes*. The patient was transitioned to vancomycin, piperacillin-tazobactam; discharged home with clindamycin and ceftriaxone.

Discussion: Postpartum infections account for >75,000 annual deaths worldwide. Although GBS is more prevalent, Group A *Streptococcus* (GAS) infections are the most common cause of severe postpartum infections. GAS can be found in the female reproductive tract, but it rarely causes systemic disease. Over the last 20 years, maternal deaths from GAS have risen (1).

Due to the non-specific symptomatology of GAS, diagnosis can be difficult (1). Epidural hematomas present within hours to days of catheter placement or removal with sensory or motor deficits and bladder or bowel dysfunction. Epidural abscesses present after several days with fever and severe backache with or without radiating pain (2,3). Any patient who has these symptoms warrants emergent MRI, which ruled out neuraxial etiology in our case.

Although important to have a broad differential when evaluating postpartum patients, it is imperative to not delay treatment for suspected infection/sepsis. Empiric coverage should include a combination of antibiotics as in this patient’s case (4). A multidisciplinary approach between obstetricians and anesthesiologists can facilitate prompt diagnosis and avoid otherwise deadly consequences.

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Abstract #: F-80

Pre-Eclampsia, Severe Systemic Lupus Erythematosus, or Both? Care, Concern and Challenges of the Parturient with Lupus Nephritis

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Introduction: Patients with systemic lupus erythematosus (SLE) have a higher risk during pregnancy with maternal mortality estimated to be 20 times higher (1). Preterm labor, preeclampsia, pulmonary hypertension and renal failure are all life-threatening complications of severe SLE. In particular, lupus nephritis has been shown to be an independent risk factor for maternal complications (2). Lupus nephritis in pregnancy presents a challenge in management because of related morbidity and confusion with preeclampsia. We present a patient in the second trimester with SLE flare and lupus nephritis.

Case: 35yo G3P1102 at 24 weeks and 6 days gestation transferred from an outside hospital (OSH) for shortness of breath, hypertensive emergency, lupus nephritis secondary to SLE flare, and concern for congestive heart failure. BNP was 412 on admission after diuresis at OSH. PMH included SLE on prednisone 30mg BID and Plaquenil, rheumatoid arthritis, morbid obesity, anemia of chronic disease (Hgb 7.9), hepatitis C, chronic hypertension (HTN) on high dose oral anti-hypertensives. Rheumatology was consulted. Labs were drawn revealing C3 and C4 levels below the limits of detection confirming the diagnosis of lupus flare, versus pre-eclampsia, and prednisone continued. Hospital course was complicated by persistent HTN despite multiple anti-hypertensive agents, acute kidney injury with creatinine peak at 2.01mg/dl, anasarca on high dose diuretics, and mild pulmonary hypertension with an elevated pulmonary artery systolic pressure of 38mmHg. On hospital day 33, non-reassuring fetal heart tones were noted and an urgent cesarean delivery (CD) was performed. The patient had received 7500u subcutaneous heparin two hours prior, therefore, neuraxial anesthesia was contraindicated. Arterial line was placed for blood pressure management and general anesthesia induced with RSI to secure the airway. Incision was made and a female fetus was delivered with Apgars of 0, 2, and 6. 2 units trauma packed RBCs given due to a Hgb of 7.9, stress dose steroids, and IV Lasix. She was normotensive during the duration of the CD without need for additional anti-hypertensives. She remained intubated and was transferred to the SICU. A nicardipine infusion was initiated for hypertension upon arrival and as well as a furosemide infusion for continued diuresis. She was extubated the following day off all infusions with hospital discharge 12 days later.

Discussion: SLE flares during pregnancy present a unique and significant risk to patients. Difficulty lies in diagnosing pre-eclampsia in patients with SLE given their similar clinical manifestations. A multidisciplinary team, including a high-risk obstetrician, obstetric anesthesiologist and rheumatologist should be involved in the patient's care to limit risk of flare and treat potential complications that coincide.

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Abstract #: F-81

Pancreatitis and Preeclampsia: A Slippery Slope

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Introduction: Biliary disease during pregnancy is relatively rare and occurs mainly in the third trimester (1). Need for surgery in pregnancy is controversial and other treatments include conservative management with antibiotics and stent placement via ERCP. Acute pancreatitis is also rare in pregnancy, but can be dangerous. Pancreatitis is mainly caused by gallstones, a small percentage are ERCP related and very rarely a manifestation of a lupus flare. Fortunately, maternal mortality related to acute pancreatitis is less than 1%. Pre-term delivery, however, is around 20% (1). We present a case in which the patient had multiple risk factors for acute pancreatitis including biliary disease, ERCP procedure and possible lupus.

Case: A 21-year-old G2P0010 at 32 weeks 2 days presented with two days of abdominal pain, cholelithiasis and dilated common bile duct (CBD) concerning for cholecystitis. Initial labs prior to antenatal steroids: leukocytosis 15,000 and total bilirubin 1.4. PMH: obesity (BMI 38) and asthma. MRCP confirmed choledocholithiasis. Zosyn started, followed by ERCP for CBD stent. On hospital day (HD) 2, the pain worsened with lipase of 9,000 concerning for post-ERCP pancreatitis. IV fluids increased and epidural placed for pain control with bupivacaine.

On HD 3 the patient became tachypneic with worsening abdominal distention. CT showed pancreatic edema with free fluid and left pleural effusion. In MICU, liver enzymes and bilirubin rose steadily, but TTE demonstrated normal chamber size and systolic function.

On HD 5, she developed severe range blood pressures, increased urine protein, and emesis. With continued abdominal distention and rising liver enzymes, cesarean delivery with a magnesium infusion was performed under general anesthesia for preeclampsia with severe features. Delivery EBL was minimal, and she was extubated in SICU post-operative (POD) day 1. POD 4 a cholecystectomy was performed. Persistent leukocytosis and thrombocytosis despite normal imaging prompted a hepatitis panel, HIV, VZV, EBV, CMV, f-actin and anti-mitochondrial tests - all negative. She did have a positive ANA, titer 1:320 with speckled lupus-like pattern.

Discussion: Pancreatitis in pregnancy is associated with several adverse maternal outcomes with a strong association with preeclampsia and preterm delivery (2). Lupus is a very rare cause of pancreatitis and has only been scarcely reported in literature (3). Treatment mirrors non-pregnant patients with emphasis on fluid resuscitation, initial fasting and pain control. Regardless of cause, prompt treatment improves the outcome of acute pancreatitis in pregnancy (4). Definitive treatment for associated preeclampsia is delivery.

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Abstract #: F-82**Acute Fatty Liver of Pregnancy?! HELLP!****Presenting Author:** Jebran Haddad, MD**Presenting Author's Institution:** Baylor College of Medicine**Co-Authors:** Caitlin D. Sutton, MD - Baylor College of Medicine

Acute Fatty Liver of Pregnancy (AFLP) and syndrome of Hemolysis, Elevated Liver enzymes and Low Platelets (HELLP) are rare (0.01% and 0.1%, respectively), potentially fatal complications of pregnancy that can be difficult to clinically differentiate. We present a case of a patient with elevated liver enzymes whose clinical presentation is suggestive of both AFLP and HELLP.

A 37-year-old G2P1 with well-controlled HIV, hypertension, and twin gestation at 34w 2d presented for glucose tolerance test. She reported daily emesis for 2 weeks with vague abdominal pain. CBC, LFTs and BMP were drawn in clinic, and ranitidine was prescribed for suspected GERD. She was discharged and scheduled to return in 1 week for follow up.

Outpatient lab results showed severe transaminitis (ALT 876), hypoglycemia (68), elevated creatinine (1.7), mild thrombocytopenia (90), INR 1.5, hypofibrinogenemia (127) and elevated LDH (657). Her lab results and clinical signs met both the Swansea Criteria for AFLP and Mississippi Class 2 for HELLP. However, the results were not evaluated until her follow-up six days later when she presented with severe headache and abdominal pain. She was admitted for pre-eclampsia with severe features with concern for HELLP vs AFLP and a magnesium infusion was started. Upon admission, creatinine had increased to 2.5 and TEG suggested factor deficiency. A stat cesarean delivery was performed under general anesthesia in response to non-reassuring fetal heart tones which was complicated by postpartum hemorrhage (EBL 1250) and coagulopathy. She received goal-directed transfusion therapy with 4 units of PRBCs, 6 units FFP, 6 units platelets, 20 units cryoprecipitate, and 2g of fibrinogen concentrate based on point of care testing including TEG.

She was extubated in the OR and had an uncomplicated postoperative course without ICU admission. She was discharged home on the fifth post-operative day and returned to clinic two weeks later with normalized labs.

We wish to use this case with clinical features suggestive of both AFLP and HELLP to review the pathophysiology, clinical distinction, clinical significance, and management of these two serious complications of pregnancy.

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Abstract #: F-83

Neuraxial Placement for Labor Analgesia in a Parturient with Chronic Inflammatory Demyelinating Polyneuropathy

Presenting Author: Lindsay K. Sween, MD, MPH

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Introduction: Chronic inflammatory demyelinating polyneuropathy (CIDP) is a rare autoimmune condition characterized by inflammatory demyelination resulting in symmetric, predominantly motor polyneuropathy involving proximal and distal weakness progressing over at least two months. CIDP's clinical course can be progressive or relapsing-remitting. Treatment includes steroids, plasma exchange, and intravenous immunoglobulin (IVIG) (1). Although safety of neuraxial anesthesia in patients with demyelinating diseases has been questioned, multiple case reports describe its safe use in patients with CIDP (2-4). We report the use of epidural labor analgesia for a woman with CIDP.

Case: A 31 year old G1P0 with history of CIDP and resultant cerebellar ataxia presented in labor requesting epidural placement. At age 15 months, the patient developed fever, weakness and hypotonia that was worse in the lower extremities and associated with areflexia. EEG, CT, MRI and lumbar puncture were normal. EMG showed motor neuron conduction velocities at the lower limit of normal, absent H reflexes and F wave prolongation to the upper limit of normal. She was diagnosed with Guillain-Barre syndrome. She had two subsequent exacerbations of limb and bulbar weakness symptoms. She was diagnosed with CIDP and treated with a 5-day course of IVIG followed by oral prednisone. She discontinued steroids at age 16 and has not had further exacerbations. She regained full motor strength but has ongoing stable cerebellar ataxia and dysarthric speech. MRI head in 2013 showed mild cerebellar atrophy but was otherwise normal. After careful documentation of her neurological deficits, reviewing case reports in the literature, and involving the parturient in the decision-making process after discussion of the potential risks and benefits, an epidural was placed uneventfully. Patient-controlled epidural analgesia with 0.04% bupivacaine and fentanyl 1.67 mcg/mL was used for labor analgesia with good efficacy. Intrapartum and postpartum courses were unremarkable. When the epidural was discontinued after delivery, her gait, sensory and motor function returned to baseline within three hours. She was discharged home on postpartum day 2 and did not report new neurologic deficits in her postpartum follow-ups.

Discussion: Limited case reports exist in the literature to guide the use of neuraxial anesthesia in women with CIDP. A prior case report described prolonged motor blockade in a patient with CIDP who received spinal anesthesia for Cesarean delivery (4). As such, the decision was made to perform an epidural without a spinal dose for labor analgesia. Our patient had an uneventful vaginal delivery and postpartum course without prolonged weakness or CIDP exacerbation. Epidural analgesia may be safe and effective for labor pain in patients with CIDP.

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Abstract #: F-84**Case report of unilateral cranial nerve VII palsy after inadvertent dural puncture possibly improved with epidural blood patch**

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Presenting Author's Institution: University of Alabama-Birmingham

Co-Authors: Mark Powell, MD - University of Alabama-Birmingham

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Introduction: Cranial nerve (CN) palsies associated with neuraxial block are rare, with a reported incidence of 1 to 3.7 per 100,000.¹ Studies that estimated incidence were from data collected in the 1960s through 1980s, and advancements in needle technology have likely resulted in that being an overestimation. CN palsy from large-volume CSF loss resulting in nerve traction or compression due to downward displacement of the brainstem may occur. Many cases had typical post-dural puncture headache (PDPH) symptoms prior to signs of CN palsy. CN palsies associated with PDPH should be offered epidural blood patch, since increased time to blood patch has been associated with prolonged recovery. Despite treatment, some palsies may be permanent.^{1,2}

Case History: A 38-year-old multigravida (G2P1001) at 39 weeks gestation with one prior cesarean section was admitted in spontaneous labor desiring TOLAC, and she requested placement of a continuous lumbar epidural (CLE). An inadvertent dural puncture was created with the epidural needle with return of CSF. The decision was made to thread a catheter for continuous spinal analgesia. The patient reported satisfactory pain control and had a successful VBAC. The patient was noted to have symptoms of PDPH on post-partum day (PPD) 2 but declined intervention and was discharged home on PPD 3. On PPD 4, the patient returned complaining of right facial droop. A code stroke was called, and the patient was evaluated by Neurology. The patient's work-up was negative, and she was diagnosed with Bell's palsy and started on prednisone and acyclovir. Anesthesiology was consulted due to the patient's persistent headache, and an epidural blood patch was performed PPD 5. The patient noted complete resolution of her headache. Approximately six hours later, the patient was evaluated and noted to have improvement of her facial droop. At her one-week follow-up, the patient endorsed improvement in her right facial droop with minimal facial asymmetry.

Discussion: This case illustrates a potentially rare cause of morbidity associated with neuraxial blockade. It is important to emphasize that other diagnoses must be considered in patient's presenting with similar symptoms, such as stroke, dural venous sinus thrombosis, multiple sclerosis, or idiopathic CN palsy (e.g. Bell's palsy). Epidural blood patch may be a reasonable management strategy for patients presenting with PDPH and CN palsy, after other diagnoses are excluded. Consultation with a Neurologist for a patient presenting with a new onset cranial nerve palsy is warranted regardless of cause.

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Abstract #: F-85

Case Series: From Cellulitis to Necrotizing Fasciitis in the Parturient

Presenting Author: Binh Tran, M.D.

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Co-Authors: James Lozada, MD - Vanderbilt University Medical Center

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Laura Sorabella, M.D. - Vanderbilt University Medical Center

Matthew Zapf, M.D. - Vanderbilt University Medical Center

Background: Necrotizing fasciitis during pregnancy is a rare condition with high morbidity and mortality¹ that provides a myriad of challenges for providers.

Case Description: The first patient, 26 year old G4P1021 at 30 weeks gestation, presented six days after failed outpatient oral antibiotics with left lower extremity necrotizing fasciitis after a fall in a cave. The second patient, 27 year old G2P1001 at 27.6 weeks gestation presented as an air flight transfer from outside hospital with worsening right lower extremity necrotizing fasciitis after a fall, 3 days prior, on wooden steps. Both patients presented to our tertiary care center in sepsis. Both proceeded emergently to the operating room, general anesthesia was induced, and surgeons performed extensive debridement. There were no risk factors except for the immunocompromised state of pregnancy.

Conclusion: This case series describes management of a critically ill parturients with necrotizing fasciitis of the lower extremity. Few reports of necrotizing fasciitis during pregnancy exist; most involve cesarean incisions or vaginal lacerations. We plan to facilitate a discussion to compare outcomes of hospital admission with aggressive intravenous antibiotics and surveillance versus surgical exploration and management during pregnancy.

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Abstract #: F-86

Mind Over Matter – A Case Presentation

Presenting Author: Binh Tran, M.D.

Presenting Author's Institution: Vanderbilt University Medical Center - Nashville, Tennessee

Co-Authors: Britany Raymond, M.D. - Vanderbilt University Medical Center

Background: Postpartum neurological deficits can be categorized into obstetric etiologies (1:100), and less commonly, neuraxial complications (12:1,000,000)². Paraplegia after neuraxial placement for labor analgesia has been reported in specific clinical scenarios, such as epidural abscess or hematoma². These are rare, space-occupying lesions that can cause serious and devastating neurological consequences. This case is used to emphasize the importance of timely recognition of serious physical sequela after neuraxial placement, review an algorithm (figure 1) to aid in diagnosis, and to highlight the need to address women's mental health after delivery.

Case Description: A 22-yr-old female G3P2012, BMI 23.2, was transferred to our facility on post-partum day (PPD) 4 after an uncomplicated spontaneous vaginal delivery, for loss of sensation and motor function bilaterally in the lower extremities. She had a labor epidural for her course. Negative imaging was obtained at outside hospital; however, was repeated upon arrival, indicated by history and physical exam. A final diagnosis was made on PPD 6 with the expertise of psychiatry, as their evaluation divulged an element of chronic conversion disorder.

Discussion: The importance of differentiating organic versus non-organic causes dictates treatment pathways. Clinical providers should obtain a detailed history and physical exam when evaluating suspected complications as they can lead to long-term, permanent residual effects without a timely intervention; for example, hematoma evacuation within 12 hours has up to 66% recovery rate³ and spinal epidural abscess within 36 hours³. Conversion disorder is a type of somatoform disorder in which there is dysfunction of a voluntary sensory or motor activity without objective neurologic findings. It is thought to be multifactorial in etiology, but the somatic complaints and symptoms invariably represent an underlying emotional distress, in this case attributed to pregnancy and the delivery. Conversion disorder can obscure a limb-threatening diagnosis because its symptoms manifest similarly to physical examination findings of organic causes. Taking care of these patients requires a multidisciplinary approach with collaboration from neurology, obstetrics, psychiatry, anesthesiology, and physical therapy teams in formulating an appropriate plan to help the patient return to baseline independence postpartum, with some reports of a 20-25% relapse within the first year⁴.

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Abstract #: F-87

Case Considerations: Withholding Care Can Burn

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Co-Authors: James Lozada, MD - Vanderbilt University Medical Center

Britany Raymond, M.D. - Vanderbilt University Medical Center

Background: 1 in 12 pregnancies is complicated by trauma¹, with maternal death due to trauma being the leading cause of non-obstetric mortality². There are many mechanisms for trauma, including motor vehicle crashes (MVC), falls, domestic violence, penetrating trauma, toxic exposure, and burns. We present the case of a parturient who sustained severe burns following a MVC.

Case Report: A 33-year-old G5P4 presented to our level I trauma center following an MVC rollover in which she was ejected and suffered major burns. She was intubated in the field. A trauma computed tomography (CT) scan revealed a 24 week estimated gestation fetus and injuries including a traumatic pneumothorax, closed fractures of multiple ribs bilaterally, closed and nondisplaced fractures of the body of the left scapula, closed fracture of the shaft of the right clavicle, and 17% total body surface area (TBSA) partial and full thickness burns to her bilateral upper extremities, face, and eyes. Her SICU course was complicated by ARDS, difficult airway and ventilator management, diagnosis and management of recurrent seizures, and multiple operations including amputation of both hands.

Discussion: The incidence of burns in the obstetric population is 0.17/100,000 person-years versus 2.6/100,000 person-years in non-obstetric patients.³ Survival of the fetus is dependent upon maternal condition, and mortality increases linearly with TBSA. Multidisciplinary planning of this complicated patient proved essential to help guide delivery planning, and to manage complicated airway, abdominal compartment syndrome and seizures in a pregnant burn patient.

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Abstract #: F-88

Postpartum reversible cerebral vasospasm syndrome in a pregnancy complicated by massive postpartum hemorrhage and eclampsia

Presenting Author: Amy Wang

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Co-Authors: Laurence E. Ring, MD - Columbia University

A 40-year-old woman G4P2 at 34+ weeks gestation presented with pre-eclampsia with severe features and vaginal bleeding requiring emergency cesarean section (CS) under spinal anesthesia. The CS and concurrent tubal ligation was uncomplicated, with a blood loss of 800mL. Her postoperative course was complicated by disseminated intravascular coagulopathy and postpartum hemorrhage requiring emergent exploratory laparotomy (EL) under GA on post-delivery day 1. EL showed active bleeding from the right tubal ligation site. Her blood loss was three liters requiring transfusion of 7U PRBCs, 4U of FFP, 1U of cryoprecipitate, and 1U of platelets. She required postoperative ventilatory support in the intensive care unit (ICU) due to hypoxemia secondary to pulmonary edema. She was extubated on postoperative day two. On the 4th postoperative day, she was transferred back to the obstetrical step down unit where she developed acute altered mental status, severe headache, and self-limited hand twitching. MRA showed luminal irregularity and stenosis in the posterior circulation without any significant edema, without evidence for posterior reversible encephalopathy syndrome (PRES). TCD demonstrated mildly increased flow velocities in the bilateral anterior and middle cerebral arteries, with normal velocities in the posterior circulation. The clinical picture was suggestive of an atypical presentation of eclampsia and reversible cerebral vasospasm syndrome (RCVS). She endorsed headaches, word-finding difficulties, and blurry vision, which resolved after two days of nimodipine. She was transitioned to verapamil for discharge on POD 12 from her CS.

RCVS is rare in the general population, with an estimated 7-9% of all cases of RCVS occurring in the postpartum setting. RCVS is characterized by multifocal cerebral arterial narrowing and dilatation and clinically by severe “thunderclap” headaches. Exposure to vasoactive drugs including sympathomimetic drugs and blood products have been associated with RCVS. RCVS and PRES have similar clinical features. PRES is characterized by reversible vasogenic brain edema in patients with acute neurologic symptoms, whereas RCVS is characterized by reversible narrowing of cerebral arteries. It has been theorized that they represent a spectrum of cerebral vasculature dysregulation. Both disorders are thought to be on a continuum with preeclampsia. Adverse sequelae of both RCVS and PRES include ischemic and hemorrhagic stroke. Nimodipine has been used to treat RCVS and is associated with decreased incidence of headaches. However, it is unclear if treatment with nimodipine significantly impacts cerebral vasoconstriction. Other pharmacologic treatments include verapamil, and magnesium sulfate. In severe cases, intra-arterial administration of nimodipine and epoprostenol and balloon angioplasty have been used with variable success.

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Abstract #: F-89

Anesthetic Management in a Pregnant Patient with Brachyolima Type 3

Presenting Author: Eileen Wang, MD

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Co-Authors: Yelena Spitzer, MD - Montefiore Medical Center

The patient is a 30 year old G6P3023 at 38 weeks and 0 days who presents for repeat cesarean section (C section). She has a history of brachyolmia type 3, three prior C sections, depression, and mild intermittent asthma.

Brachyolima is a group of rare genetic skeletal disorders, characterized by short spine, short stature, platyspondyly (flattened vertebral bodies) and kyphoscoliosis. Degenerative joint disease (osteoarthropathy) in the spine is also common. Radiographic features include severe platyspondyly particularly in the cervical spine, elongated vertebral bodies (overfaced pedicles), broad ilia, and mild metaphyseal irregularity in the proximal femora.

Her physical exam was notable for short stature with a height of 1.448 meters (4 foot 9 inches) and weight of 72.6 kg (160 pounds).

She had anesthetic complications with her first 3 C section. For her first cesarean delivery, spinal anesthesia was administered. She developed a high spinal with arm weakness and shortness of breath, but did not require intubation. For her second cesarean, she once again resulted in a high spinal blockade.

Combined-spinal epidural (CSE) was utilized for the patient's third C section. A lower dose spinal was administered and the epidural was titrated slowly. However her epidural was complicated by accidental dural puncture and post dural puncture headache. The patient reported that neuraxial anesthesia placement was challenging in all three times and required several attempts.

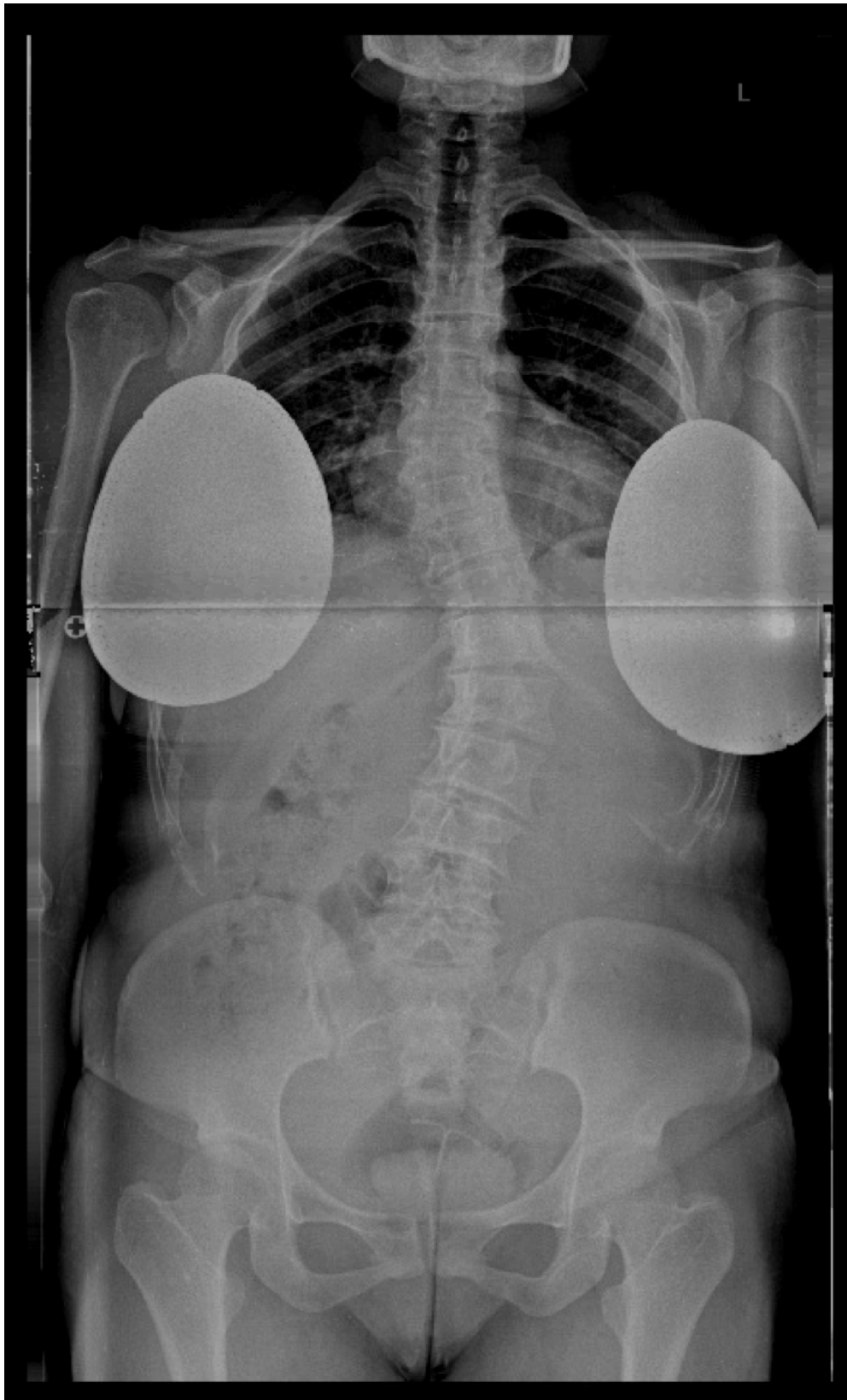
For the patient's fourth C section, a low dose CSE was placed. We dosed the spinal with 1.1 mL of 0.75% hyperbaric bupivacaine, 10 mcg of fentanyl and 150 mcg of morphine with 100 mcg of epinephrine. CSE was uncomplicated, placed with the patient sitting, with a midline approach, in the L4 – L5 interspace and a 17 g Touhy. Loss to air was at 5.5 cm. A Gertie-Marx 26 g needle was used to access the subarachnoid space with good cerebral spinal fluid flow. The epidural test dose was negative. About two hours after the initial spinal dose, 5 ml of 2% lidocaine was given over 7 minutes. The patient had adequate anesthesia without signs of high spinal.

This is the first reported case of a pregnant patient with brachyolima type 3 presenting for neuraxial anesthesia. Careful titration of analgesia to avoid high spinal is imperative due to short thorax, short stature, and flattened vertebral bodies. Short inter-disc spaces as well as kyphoscoliosis will create difficulty in accessing the epidural space. Due to kyphoscoliosis, a paramedian approach may also be utilized. Her X-ray spine survey showed dextrocurvature in the thoracic spine and levocurvature in the lumbar spine in addition to lumbar disc degenerative changes. These skeletal changes associated with brachyolima make the anesthetic management particular challenging.

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Abstract #: F-89



Abstract #: F-90

Fulminant Respiratory Failure in the Third Trimester: A Diagnostic Dilemma

Presenting Author: Benjamin Whiddon, MD, PhD

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Our patient is a 26yo F G1P0 at 29w2d who awoke with chest pain, shortness of breath and hemoptysis. Her medical history is significant for BMI 51, anxiety, depression, and marijuana and tobacco use during pregnancy. On arrival, she had normal SpO₂. Initial CXR had mild diffuse opacities in the left lung, and labs were notable for WBC 15.9 with left shift. Type and screen revealed cold autoantibodies. ECG and TTE unremarkable. Over the next hours, the patient's SpO₂ declined rapidly, and she was intubated, but hypoxemia remained severe. Prior to intubation, patient reported a history of marijuana vaping. She was treated empirically for pulmonary embolism and infection. CTA chest was negative for pulmonary embolism but revealed widespread consolidations bilaterally. The ICU obtained a rotating pronation bed and started methylprednisolone. Oxygenation improved promptly with proning. On Day 2, BAL revealed diffuse alveolar hemorrhage. Infectious and autoimmune workup remained negative. On day 3, proning was discontinued. On Day 5, the patient was extubated to high flow nasal cannula, did well, and was transferred to the floor with a mild transaminitis. The patient clarified that she had only vaped 4 months before admission but had continued to smoke tobacco and marijuana. She was discharged on hospital day 12. Throughout this episode, fetal monitoring was reassuring. Preeclampsia was a constant consideration; however, her hypertension, proteinuria, elevated liver enzymes, and headache were each thought better explained by other elements of her critical illness. A diagnosis of preeclampsia would likely have prompted delivery, which would ultimately prove avoidable. Vaping-associated lung injury was briefly an attractive diagnosis; however, we eventually learned that our patient's vaping occurred outside of the 3-month window that the CDC has characterized (1). Upon careful review, infectious disease suggested that an atypical pneumonia from *M. pneumoniae* could explain transaminitis and cold autoantibodies, even though PCR on BAL fluid had been negative. Indeed, IgM titers for *M. pneumoniae* were high, providing us the most likely diagnosis. The usual course of *M. pneumoniae* is benign for immunocompetent patients, and DAH during pregnancy has been reported from vasculitis but not from *M. pneumoniae*, though pregnant women are known to be more susceptible to ARDS (2). Our patient's ARDS was severe, and proning proved instrumental. We used a specialized proning bed that could relieve pressure on the gravid uterus. Because respiratory decompensation can be especially rapid in the third trimester, it is worth planning this maneuver in advance. Ultimately, we attribute our patient's good outcome to a broad differential reaching beyond the illnesses of pregnancy and collaboration among experts.

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Abstract #: F-91

Management of Parturient with May-Thurner Syndrome

Presenting Author: Jason White, MD

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Co-Authors: Sean Harper - New York Presbyterian Lower Manhattan Hospital

Case: A 38 year-old G1P0 presented to labor and delivery at 39.1 weeks for scheduled induction of labor. Her medical history was significant for a deep vein thrombosis and pulmonary embolism five years prior. During the evaluation of her thromboses, the patient was eventually diagnosed with May-Thurner syndrome and started on anticoagulation. Prior to pregnancy, she was converted to enoxaparin twice daily. Her last dose was self-administered 24 hours prior to induction of labor. The patient requested labor analgesia. Placement of epidural was challenging due to scoliosis, and ultrasound identification of epidural space was utilized to place a combined spinal epidural. Parturient delivered a healthy neonate the following day. Anticoagulation was restarted 12 hours after catheter was removed. Patient was discharged home on post-partum day two with no evidence of complications or thrombosis.

Discussion: May-Thurner syndrome is an anatomic variation of the iliac artery and vein, creating compression of the iliac vein. It is a rarely diagnosed, but not uncommon cause of deep vein thrombosis. Some symptoms of this syndrome are worsened due to normal physiologic changes of pregnancy. Often the compression of the iliac vein is complicated by scoliosis at or around the fifth lumbar vertebra. Because diagnosis requires imaging, spinal anatomic surveys are usually included in the evaluation of these patients. Ultrasound guided placement is a significant aid in patients with scoliosis of lumbar spine. Careful multi-disciplinary planning with Hematology, Obstetrics, and Anesthesiology is essential in these patients. The antenatal Obstetric Anesthesiology consultation is invaluable in this process. Due to hypercoagulability and immobilization during labor, the dosing of and timing of anticoagulation is the key to providing safe and effective neuraxial analgesia and anesthesia. Rapid resumption of anticoagulation is needed to decrease the risk of thrombosis post-partum.

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Abstract #: F-92

Contraception and Consent in Schizophrenic Obstetric Parturients

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Co-Authors: Blair H. Hayes, MD - Ohio State University Wexner Medical Center

Whitney Loggins, MD - Ohio State University Wexner Medical Center

Yen Vuong, MD - Ohio State University Wexner Medical Center

Case: A 39 yo G2P1 at 38w0d presents for repeat cesarean due to IUGR and elevated UA dopplers and gestational thrombocytopenia (PLT 147). Her PMH was significant for schizophrenia, dilated cardiomyopathy, asthma, tobacco use, and morbid obesity. As a ward of the state, a court-appointed legal guardian was contacted for surgical and anesthesia consent. The patient declined sterilization, and although she does not consent for herself, she is able to assent for invasive procedures including sterilization so BPS would not be performed. After assessment of her comorbidities and mental state, she seemed reasonable for a spinal anesthetic which was performed without difficulty. Upon delivery, conversion to GETA was necessary to facilitate replacement of abdominal contents. Patient also endured significant EBL (1250 ml) and transient hypotension but made a full recovery with discharge POD 4 to inpatient psychiatric facility for further management.

Discussion: All methods of sterilization have a risk of failure with an increased rate of failure for younger women. In the US, sterilization is the most prevalent contraceptive method with female tubal sterilization accounting for 72% of all sterilizations(1). Many other methods of contraception are available, each with potential risks and benefits as well as varying levels of success. Additionally, these methods are all nonpermanent and reliant on patient compliance.

Women with schizophrenia do become pregnant, and these pregnancies are often unplanned. These women are more likely to have comorbid medical conditions and are at increased risk of adverse events related to pregnancy including preterm labor and birth, hypertensive disorders, and VTE(2). Counseling regarding sexual health and issues surrounding pregnancy is vital in their care. Prenatal care should emphasize management of antipsychotic medications(3).

Obtaining informed consent from psychiatric patients has several special considerations. Among psychiatric patients, lack of insight is the strongest predictor of incapacity, and schizophrenic patients often demonstrate greater impairment. If it is clear the patient lacks capacity to make his/her own treatment decisions, a substitute decision-maker such as a family member or court-appointed legal guardian must be contacted(4). Guardians of mentally ill patients may often request sterilization; however, sterilization should not be performed on someone who retains the capacity for reproductive decision-making. The majority of petitions for involuntary sterilization on mentally ill individuals are dismissed in favor of the disabled(5).

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Abstract #: F-93**Successful Prevention of Supine Hypertensive Syndrome in Parturients with Supermorbid Obesity****Presenting Author:** Tianna Xia, DO**Presenting Author's Institution:** Ohio State University Wexner Medical Center**Co-Authors:** Blair H. Hayes, MD - Ohio State University Wexner Medical Center

Ling-Qun Hu, MD - Ohio State University Wexner Medical Center

Victoria Olatunji, MD - Ohio State University Wexner Medical Center

Case: We present 2 different cases of patients with preE and supermorbid obesity (SMO) with alternative management techniques for amelioration of supine hypotension s/p neuraxial for cesarean (CS).

First case is a 28 yo G2P1 at 28w6d with PMH of cHTN and SMO (BMI 69.3) who presented for scheduled repeat CS. After her epidural was placed and surgical level was obtained, she was laid supine without LUD to avoid falling. Upon laying flat, she immediately became hypotensive to 70s/30s, and FHR fell to the 80s despite fluid bolus and phenylephrine infusion. Stat CS was able to be performed under epidural anesthesia since she already achieved a surgical level, and infant was delivered with APGARs of 9/9. Remainder of operative course was uncomplicated, and she was discharged POD 4.

Second case is a 25 yo G2P1 at 38w2d with PMH of cHTN and SMO (BMI 56.37) who presented with new onset headache and 1 month of numbness and tingling in her hands. In triage, BP was 200s/120s, requiring multiple doses of IV antihypertensives. Urgent delivery via repeat CS was called for superimposed preE with severe features. Pre-op arterial line was placed for close hemodynamic monitoring and inability to accurately use NIBP cuff. Again, epidural was placed and dosed incrementally with prophylactic phenylephrine infusion going. Patient remained upright with fetal monitoring until a surgical anesthetic was obtained and she adapted to vascular dilation. Levels were confirmed before she was placed supine with LUD. Fortunately, this patient's BP remained stable. She was discharged on POD 6 on an augmented antihypertensive regimen.

Discussion: SMO parturients are at increased risk for supine hypotensive syndrome (SHS), defined as the onset of hypotension with supine positioning due to compression of IVC by gravid uterus(1). Symptoms can be exacerbated by quick onset of neuraxial anesthesia. If symptoms develop, FHT may necessitate stat delivery, as seen in the first case.

SMO presents challenges with NIBP cuffs due to the size and conical shape of the upper arm leading to difficulties obtaining accurate measurements. In these situations, invasive BP monitoring may be appropriate(2).

Hypertensive disorders in pregnancy occur in 10% of parturients with 1-2% at risk of hypertensive crisis. Initial management of hypertensive emergencies includes rapid reduction to a goal of SBP 140-150 and DBP 90-100 with IV labetalol, hydralazine, and CCB(3). Even in urgent circumstances, maternal stabilization should occur before delivery(4).

Our cases of SMO show that a slowly dosed epidural in the sitting position until onset of a surgical level may minimize hemodynamic swings, SHS, and risk of stat CS with general anesthesia in high risk patients with potential difficult airways.

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2. Local Reg Anesth. 2016 Aug;9:45-57
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Abstract #: F-94

Intraoperative Noninvasive Cardiac Output Monitoring In a Parturient with Severe Aortic Stenosis Undergoing Cesarean Delivery With Epidural Anesthesia

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Background: Aortic stenosis(AS) in pregnancy presents a significantly high risk for cardiovascular collapse during peripartum. Both general and neuraxial anesthesia have been successfully used for cesarean delivery (CD) in these patients.^{1,2} In 2011, Fanning et al reported a case using noninvasive cardiac output monitoring (NICOM) during general anesthesia for CD in a severe AS(sAS) patient³, but little is known with neuraxial anesthesia. Thus, we report a case of a sAS parturient undergoing CD with epidural anesthesia while NICOM was utilized for hemodynamic monitoring.

Case Introduction: A 37-year-old G7P0 at 28 weeks, with sAS and moderate AR (area surface 0.94 cm², mean gradient 41.6mmHg), was scheduled for an elective CD due to worsening cardiac symptoms. NICOM pads were placed in addition to standard ASA (American Society of Anesthesiologists) monitors. A lumbar epidural catheter (with intentional dura puncture technique using a 25G Whitacre) followed by a radial arterial catheter were placed smoothly. After a negative test dose, epidural block was reached to T4 level by slow incremental doses of 2% lidocaine with sodium bicarb. After delivery of the infant, adequate uterine tone was achieved with oxytocin and the surgery was completed uneventfully. During the entire case, hemodynamics including blood pressure (BP) and heart rate (HR) as well as NICOM cardiac data were closely monitored and recorded.

Results: Initial 8ml of epidural bolus achieved T10 level block while patient's cardiac output(CO), stroke volume(SV), stroke volume variation(SVV), and total peripheral resistance(TPR) were normal. Additional 3ml of 2% lidocaine raised block level to T6 and she became hypotensive requiring the initiation of phenylephrine infusion (CO, SV, SVV, and TPR changed to 4.3 Lpm, 60.3 ml/beat, 12% and 780 dyn·s·cm⁻⁵). Hemodynamics remained stable with phenylephrine (3.6±0.2 Lpm, 52.8±2.7 ml/beat, 14.3±2.1% and 1300 dyn·s·cm⁻⁵) until the delivery of the fetus, which was associated with an increased CO, SV, and lower SVV to 4.0±0.2 Lpm, 62.3±3.0 ml/beat, and 12.2±1.6%. At the end of case, her CO and SV were low-normal at 3.3±0.2 Lpm and 52.6±2.5 ml/beat with stable BP and TPR. Throughout the surgery, hypotension was treated using intravenous fluids and vasopressors guided by NICOM. She remained asymptomatic and stable postoperatively.

Conclusion: By offering real-time, objective cardiac data, NICOM may guide an optimized hemodynamic management during CD with neuraxial anesthesia in a high-risk cardiac parturient.

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2. Ghosh, S. et al, Anesthetic management for CD in a patient with sAS and severe obesity. *Obes Surg* **21**, 264-266, 2011
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Abstract #: F-95

Chronic headache and chronic backache following unintentional dural puncture at delivery room. A comparative study.

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Introduction: Unintentional dural puncture (UDP) and postdural puncture headache (PDPH) occur during the course of epidural catheter placement for labor analgesia with a reported incidence of 1%-5%. 80%-86% of these patients might develop PDPH. Few studies have evaluated the long-term complications of UDP. We investigated the incidence of chronic headache and chronic backache in parturients who experienced UDP.

Methods: In a case control retrospective design, we have 4 groups:

1. Parturients who gave birth to a normal birth and did not receive epidural anesthesia (**Control group**).
2. Parturients who gave birth to a normal birth with epidural anesthesia without an UDP (**Epidural group**).
3. Parturients who gave birth to a normal birth with epidural anesthesia and had an UDP, these women were treated conservatively (**PDPH group**).
4. Parturients who had a normal birth with epidural anesthesia and had an UDP and were treated with an epidural blood patch following PDPH (**EBP group**).

Data were collected over 24 month's period. A match was made between the teams in terms of age, weight and delivery number. Patients were recruited by telephone and 2 validated questionnaires were administered assessing headache and back pain symptoms 12 to 24 months after delivery.

Results: To date, we have collected 27 patients to EBP group, 24 patients to PDPH group, 48 patients to epidural group and 58 patients to control group. Mean age was 30.6 (18-44) and average birth number was 3.6 (1-14).

The proportion of patients with chronic headache among the EBP group was 33.3% compared to 12.5% in the PDPH group ($p = 0.01$), among the epidural and the control groups no patient suffer from chronic headache ($p = 0.0001$, $p = 0.0003$). Of patients suffered from chronic headache, there was no difference in pain intensity ($p = 0.78$) and disability level ($p = 0.65$) between groups.

The proportion of patients with chronic backache among the EBP group was 29.6% compared to 16.7% among patients in PDPH group ($p = 0.46$), in the epidural group the rate of chronic backache was 10% compared to 3.4% In control ($p = 0.65$). Of the patients with chronic backache, the intensity of pain among control group patients was lowest ($p = 0.01$). There is no difference in the level of disability ($p=0.65$).

Responding to questions about satisfaction with the obstetric anesthesia unit rated 0 to 10, among patients in epidural group satisfaction rate was 8.81 versus 5 in patients in PDPH group ($p=0.0001$) and 4 among EBP group patients ($p=0.0001$).

Conclusion: Patients with UDP during childbirth are more likely to develop chronic headache. We found a higher rate of chronic backache in patients with UDP but without statistical significance. Satisfaction among women with UDP during labor is significantly lower. The pathophysiology underlying these symptoms is not known. So far we have only preliminary results and more data is needed. We are currently continuing the data collection for this research.

Abstract #: F-96

Anaphylaxis to Cefazolin in the Second Trimester

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Introduction: Anaphylactic reactions during pregnancy are uncommon & can trigger maternal hypotension. These hemodynamic changes increase both maternal & fetal morbidity & mortality as emergent cesarean delivery is often necessary due to worsening fetal status. Only a handful of case reports describe perioperative & intraoperative management of anaphylaxis in pregnancy.

Case: A 37-year-old otherwise healthy, G4P3 at 19 weeks with MCDA twins complicated by twin-twin transfusion syndrome (TTTS) who presented for fetoscopic laser photocoagulation of pathological placental anastomoses. A combined spinal-epidural was performed with intrathecal fentanyl 15mcg & hyperbaric bupivacaine 7.5mg. A cefazolin 2g infusion was then initiated. Five minutes into the infusion, the patient experienced itching & hives with subsequent dyspnea, facial edema & wheezing. Intravenous diphenhydramine 50mg, dexamethasone 10mg & epinephrine 10mcg were given followed by an infusion of epinephrine 0.5mcg/min. Heart rate remained at baseline of 120 beats per minute, blood pressure was 105-125/50-60 mmHg & oxygen saturation remained 98-100% on room air. Ultrasound assessment of fetal heart rates were adequate but the donor fetal heart was noted to be hypercontractile with an irregular rhythm during the first 10 minutes of recognition of the anaphylactic response & initiation of epinephrine. Vital signs were observed for 40 minutes after the antibiotic was dosed & she remained stable on the epinephrine infusion. As the laser procedure was urgent, the decision was made to proceed with the procedure. The procedure was uneventful with the hives resolving by the end of the case. Post-operatively, epinephrine was down-titrated & then discontinued. The patient was observed overnight before being discharged home in stable condition.

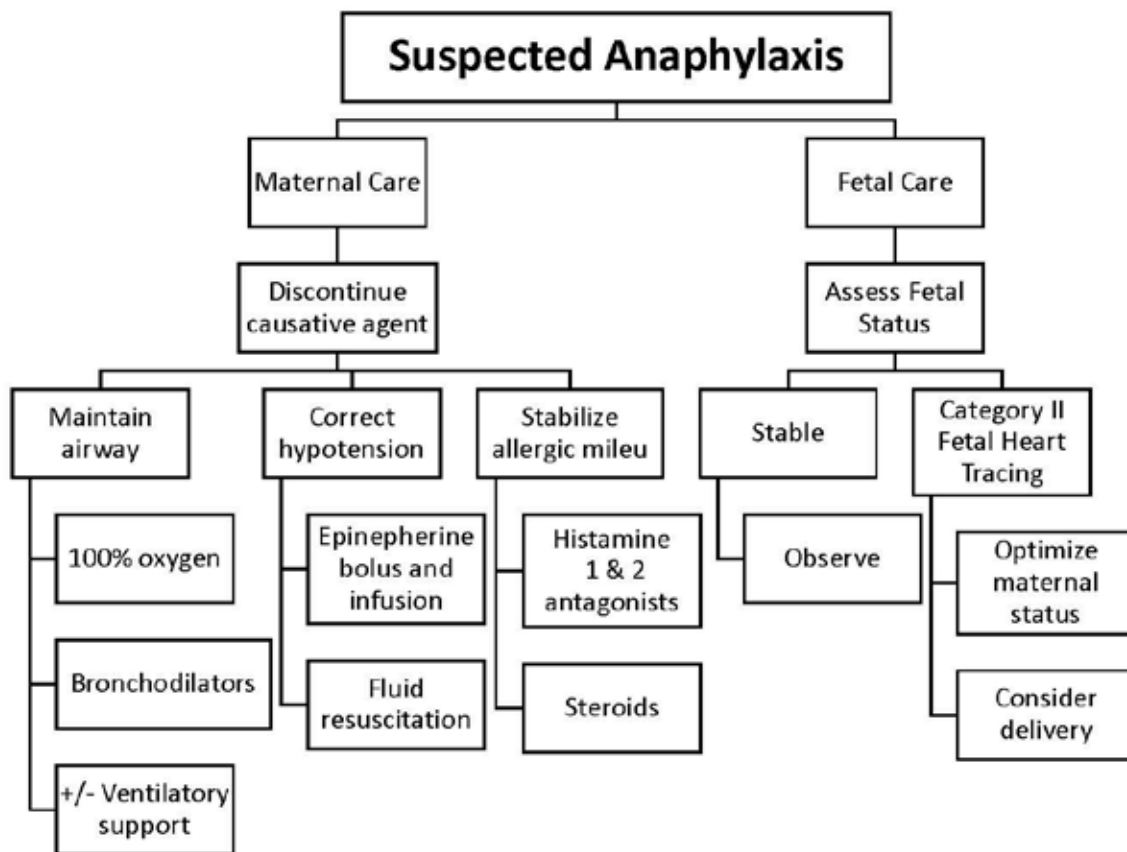
Discussion: Anaphylaxis during pregnancy jeopardizes the life of the mother & fetus, as profound hypotension can result in maternal & fetal hypoperfusion & premature delivery that can be emergent. This is the first reported case of maternal anaphylaxis occurring in the setting of laser photocoagulation for TTTS & the third reported cases of anaphylaxis during the second trimester of pregnancy with good maternal & fetal outcomes.^{1,2} Compared to the general perioperative population, antibiotics are the most common cause of anaphylaxis during pregnancy.³

Management of anaphylaxis in pregnant women should be similar to that of non-pregnant women with a few additional caveats (Figure 1).⁴ Our emphasis on treating with epinephrine, maintaining maternal blood pressure & preventing maternal hypotension likely assisted in our good fetal outcome. Although uncommon, when anaphylaxis occurs during pregnancy prompt recognition & treatment is required to prevent maternal & fetal morbidity.

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3. *Int J Obstet Anesth* 2008;**17**:350-7.
4. *World Allergy Organ J* 2011;**4**:13-37.

Figure 1: Steps in responding to anaphylaxis in pregnant patients at viable gestational ages



Abstract #: F-97

Sociodemographic factors associated with request for labor epidural analgesia in a tertiary obstetric hospital in Vietnam

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Background: Labor epidural pain relief has become prevalent in developed countries (1) but remains underutilized in developing countries such as Vietnam. Low epidural utilization in developing countries may serve as a marker of health care access disparity. Here we examine the sociodemographic factors associated with the utilization of labor epidural analgesia at a large obstetrics and gynecology hospital in Vietnam.

Methods: This was a cross-sectional study of women who underwent vaginal delivery in September 2018 at a large obstetrics and gynecology hospital in Hanoi, Vietnam. After IRB approval, utilization of epidural analgesia during labor was determined. Demographic variables collected included maternal age (grouped by age less than 18 years, 18-34 years, 35-45 years and >45 years); place of residence (urban or rural); ethnicity (Kinh, the largest ethnic group in Vietnam, or an alternate ethnic minority); education levels (primary; secondary; high school; graduate school); occupation; health insurance; health knowledge (high or low); and income (high or low). Data were collected in a standardized way by co-investigators by in-person interview 24 hours after delivery. Univariate and multivariate regression models were applied to evaluate the association between patient demographic and socioeconomic factors and utilization of labor epidural analgesia.

Results: A total of 417 women had vaginal deliveries during the study period. 207 women (49.6%) utilized epidural analgesia for pain relief during labor and 210 (50.4%) did not. Sociodemographic and obstetric characteristics are shown in the Table. Parturients more likely to utilize labor epidurals were older than 35 years of age (OR 2.84, 95% CI 1.11-8.17), multiparous (OR 2.8 95% CI 1.85-4.25), from an urban area, with higher income (OR 6.47, 95% CI 2.59-19.23), and with higher level of education. A higher percentage of women who requested epidural pain relief had health insurance coverage. Consistent with this finding, a greater number of women who went without epidural pain relief expressed concern about the expense of the epidural (48.1 vs 8.7%, respectively). Women who requested epidural pain relief had greater concern about labor pain in general (89.4 vs. 52.9%, respectively).

Conclusions: Factors related to a parturient's request for epidural analgesia during labor at our tertiary obstetric hospital included age greater than 35 years, multiparity, and high income and education levels. Increasing the rate of labor epidural analgesia may enhance maternal safety through avoidance of general anesthesia and associated aspiration risk (2). By defining demographics of women who declined epidural analgesia, our findings can help to focus and maximize educational outreach to women about the benefits of epidural analgesia.

References:

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Abstract #: F-97
Table. Sociodemographic and obstetric patient characteristics

Characteristics		Epidural (N=207)		No epidural (N=210)		P value
		n	%	n	%	
Age (years)	< 18	1	0.5	4	1.9	0.02
	18 - 35	199	96.1	187	89.0	
	36 - 45	7	3.4	19	9.0	
Parity	nulliparous	129	62.3	78	37.1	<0.01
	multiparous	78	37.7	132	62.9	
Education	primary	11	5.3	37	17.6	<0.01
	secondary	18	8.7	54	25.7	
	high school	35	16.9	44	21.0	
	graduate	143	69.1	75	35.7	
Ethnicity	minorities	11	5.3	20	9.5	0.101
	Kinh	196	96.7	190	90.5	
Residence	urban	178	86.0	130	61.9	<0.01
	rural	29	14.0	80	38.1	
Income	low	6	2.9	34	16.2	<0.01
	high	201	97.1	176	83.8	
Occupation	homemaker	43	20.8	13	6.2	<0.01
	farmer	3	1.4	47	22.4	
	worker	17	8.2	82	39.0	
	white-collar workers	144	69.6	68	32.4	

Abstract #: F-98

Peripartum Peripheral Nerve Injuries and Anesthetic Practice: A Retrospective Nested Case-Control Study

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Introduction: Childbirth is the most common reason for hospital admission in the United States. Approximately 40,000 women experience lower extremity nerve injuries after childbirth (1). The incidence of injury is 0.1-1%, and is largely attributed to nerve compression or stretch injuries. Previous studies have evaluated maternal and labor characteristics associated with nerve injury. The objective of this study was to investigate anesthetic factors associated with peripartum peripheral nerve injuries.

Methods: In this single center, retrospective nested case-control study, all deliveries from 2006-2016 were queried. Nerve injuries were matched 3:1 with controls who delivered the same date and by the same mode of delivery. Nerve injuries were identified by an ICD code for nerve injury, physical medicine & rehabilitation consult, physical therapy consult or an anesthesia complication note. Nerve injuries were verified by chart review. Anesthetic factors extracted included the total volume of local anesthetic infused for labor analgesia, change in mean arterial pressure (MAP), and paresthesias during neuraxial placement.

Results: Of the 127,000 deliveries, 377 women experienced new confirmed nerve injuries (incidence 0.3%). Among patients who utilized neuraxial labor analgesia, the total volume of bupivacaine 0.0625%-fentanyl 2mcg/mL infused was higher for patients who experienced a nerve injury versus controls (140mL vs. 92mL, $P < 0.0001$). The median percentage change in MAP was larger in patients who experienced nerve injuries versus controls (25.0% vs. 15.5%, $P < 0.0001$). The incidence of paresthesias was 14.9% among women with nerve injuries versus 6.5% in matched controls ($P < 0.00001$).

Discussion: The incidence of peripheral nerve injuries in our study was 0.3%, which was lower than previous studies; however, the incidence of nerve injuries has been shown to be lower in retrospective versus prospective studies. All three anesthetic factors investigated (total volume of bupivacaine, greater decreases in MAP, and paresthesias) were associated with postpartum lower extremity nerve injuries. It is possible that women who experienced nerve injuries had denser blocks which masked nociceptive warning signs of nerve compression. Larger decreases in MAP may cause an increased incidence of nerve injury due to decreased blood supply and poor nerve perfusion. These findings identify potential targets for further investigation and potentially intervention within anesthetic practice to decrease the incidence of peripartum peripheral nerve injury.

References:

1. Wong CA, et al. Incidence of postpartum lumbosacral spine and lower extremity nerve injuries. *Obstet Gynecol* 2003;101:279-88

Abstract #: F-98

	Nerve Injury Detected N=377	No Nerve injury Detected N=1146	P
Median total Bupivacaine 0.0625%- Fentanyl 2mcg/mL infused	140 mL (IQR: 94-204 mL)	92mL (IQR: 55-143 mL)	< 0.0001
Median Baseline MAP	91.3 (IQR: 84.7 – 97.7)	90 (IQR: 83.3 – 97)	0.20
Median Minimum MAP	71.7 (IQR: 65.3 – 77.3)	75.0 (IQR: 68.7 – 81.7)	<0.0001
Median % Change in MAP	25% (IQR: 16.4% – 34.2%)	15.5% (IQR: 7.8% - 22.9%)	<0.0001
Total % Paresthesia during placement	14.9%	6.3%	<0.00001

Abstract #: F-99

Anesthetic and surgical outcomes for placenta accreta cesarean delivery in the hybrid versus the labor ward operating room: Retrospective cohort study

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Background and Goal of Study: Prophylactic balloon occlusion (PBO) may reduce hemorrhage during cesarean delivery for suspected placenta accreta spectrum (PAS). We report planned use of a hybrid operating room (hOR) using POB prior to cesarean delivery compared with management in the labor ward operating room (lwOR).

Materials and Methods: Retrospective study (IRB approved) identified all PAS (01/01/2016 and 31/12/2018) from hOR and lwOR. The primary outcome was estimated blood loss (EBL). Anesthesia mode was at the anesthesiologist's discretion (neuraxial or neuraxial+general anesthesia). Maternal, obstetric and perioperative characteristics are reported using descriptive statistics. EBL was compared (hOR vs. lwOR) using Mann-Whitney U test and anesthesia mode compared using Chi-square.

Results and Discussion: Twenty-four women were identified, hOR=10 and lwOR=14. All hOR cases had ≥ 1 PAS ultrasound characteristic and 4 cases had surgically confirmed PAS. All lwOR cases had surgical confirmation of PAS and 6 had ultrasound characteristics. Median (IQR) EBL was 900(500-1125)mL vs. 1100(1000-1625)ml, hOR vs. lwOR respectively, $p=0.048$. Nine hOR cases underwent spinal anesthesia (for balloon insertion) followed by general anesthesia; one underwent the entire procedure under combined spinal epidural. In lwOR, 6 cases had general anesthesia, 7 had spinal and one had spinal followed by general anesthesia. The rate of general anesthesia was significantly higher for women in lwOR, $p = 0.014$. Total number packed cells transfused 11 vs. 23 for hOR and lwOR respectively with mean(SD) of 1.1(1.7) vs. 1.5(2.1), respectively; $p=0.06$. Mean(SD) cryoprecipitate transfusion was also lower in hOR compared to lwOR: 1(3.2) vs. 2.7(4.6). No platelets or fresh frozen plasma were transfused in hOR compared to a total of 33 units transfused in lwOR. Length of surgery differed; 102 (67) minutes vs. 54 (30) minutes, hOR vs. lwOR respectively, $p=0.026$. Complications from the PBO included one thrombus requiring thrombectomy and two cases of self-limiting groin hematomas.

Conclusion(s): EBL was significantly higher among women undergoing cesarean for PAS in the lwOR. Our data suggest that planned use of hOR is potentially beneficial for women with suspected PAS undergoing delivery, with a greater likelihood of undergoing the procedure under neuraxial anesthesia.

Table: Labour ward OR VS. Hybrid OR

Mean (SD)	lwOR (n=14)	hOR (n=10)
Age (years)	39 (4)	35 (4)
Gestation (weeks)	35 (3)	36 (1)
Length of surgery (minutes)	54 (30)	102 (67)
Birth weight (grams)	2660 (602)	2464 (281)
EBL (ml)	1493 (950)	880 (405)
Hospital LOS (days)	8 (6)	9 (6)
Red packed cells	2 (2)	1 (2)
FFP	1 (2)	0 (0)
Platelets	1 (3)	0 (0)
Cryoprecipitate	1 (3)	3 (5)
Crystalloids (ml)	3178 (1776)	2933 (1760)

Key: OR – Operating Room, SD – standard deviation, EBL – estimated blood loss, LOS – length of stay, FFP – fresh frozen plasma, ml - milliliter

Abstract #: T10-01

Nalbuphine for management of intrathecal morphine-induced hypothermia: A Case Report

Presenting Author: Kyra Bernstein

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Co-Authors: Ruth Landau

Background: Neuraxial morphine is universally recommended in Enhanced Recovery After Cesarean protocols.¹ Common side effects include nausea and vomiting, pruritus, respiratory depression and sedation.² Hypothermia occurs with neuraxial local anesthetic alone due to vasodilation and radiant heat loss, but neuraxial opioids can exacerbate this effect.³ Description of an intrathecal morphine-induced hypothermia (IMIH) syndrome with doses of morphine between 50-250mcg involves a maternal core temperature of less than 35°C, subjective warmth, profuse sweating, nausea, vomiting, and pruritus.⁴⁻⁵ Prior treatment modalities have included naloxone (between 80-400mcg) and lorazepam, though the mechanism of action for successful reversal with benzodiazepines remains unclear.

Case-report: We report a case of IMIH in a primigravid 50yo 70.3kg woman with an IVF pregnancy and preeclampsia undergoing cesarean delivery with spinal anesthesia (hyperbaric bupivacaine 0.75% 12mg, fentanyl 15mcg, morphine 150mcg, clonidine 30mcg). Active warming with an underbody warming blanket (3M™ Bair Hugger™) was maintained throughout the procedure. In the PACU, refractory vomiting, profuse sweating, and an initially unmeasurable temperature were noted (Figure). After active warming, and despite returning sensory motor function, the first measured temperature 5h after spinal dosing was 34.1°C. Hypothermia and all symptoms resolved with 5mg IV nalbuphine. To our knowledge, this is the first case describing the use of nalbuphine to treat IMIH. Nalbuphine has a long track record of safety and efficacy in parturients and is a practical and attractive treatment option for management of this rare but ominous syndrome.

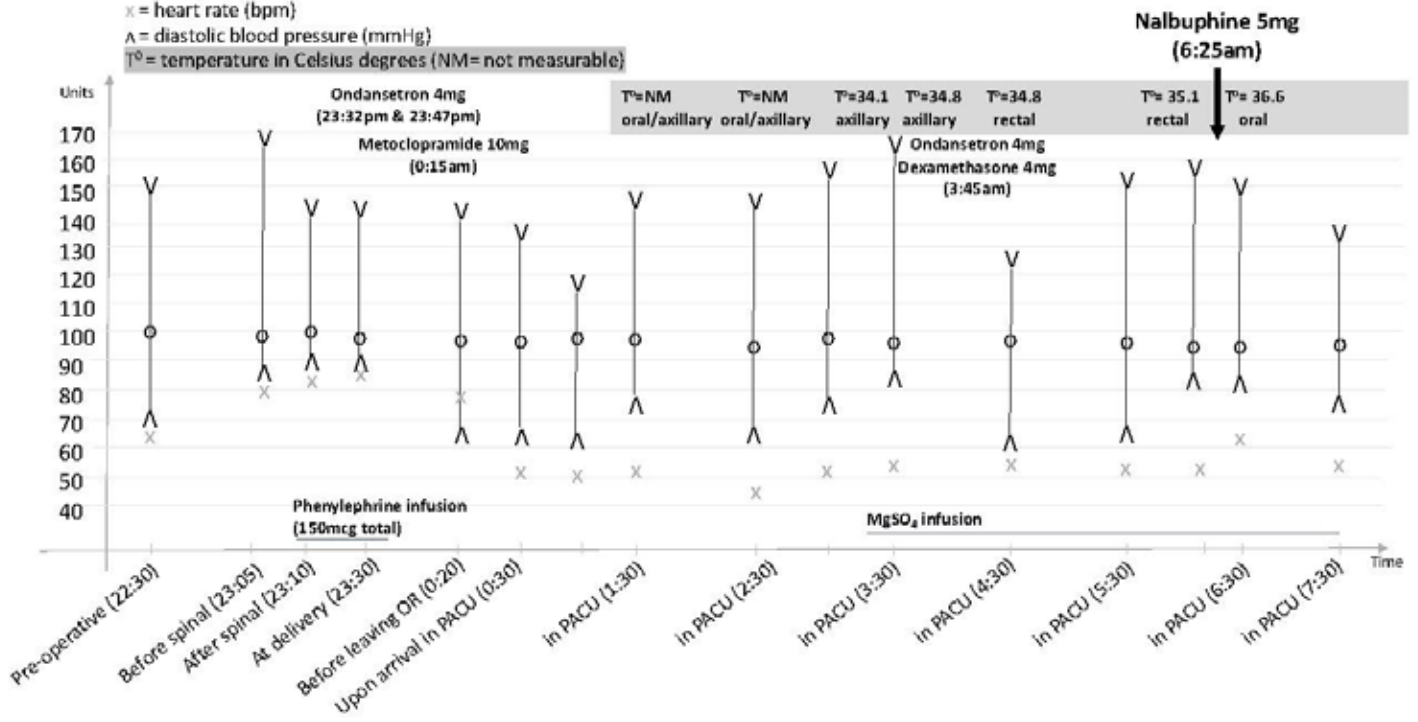
Conclusion: This case emphasizes the importance of temperature monitoring protocols, both in the operating room and in the PACU, and for early identification and management of IMIH with nalbuphine. Future studies should evaluate the effect of nalbuphine on postpartum temperature regulation and identify the optimal dose to reverse IMIH.

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3. *Anaesthesia* 2006;61:29-31.
4. *Reg Anesth Pain Med* 2003;28:140-3.
5. *Int J Obstet Anesth* 2005;14:279-83.

Abstract #: T10-01

v = systolic blood pressure (mmHg)
 o = oxygen saturation (%) at room air
 x = heart rate (bpm)
 Δ = diastolic blood pressure (mmHg)
 T° = temperature in Celsius degrees (NM= not measurable)



Abstract #: T10-02

Severe Pre-Eclampsia Complicated by Pleural Effusions and Pericardial Effusion: A Case Report

Presenting Author: Juliet Nash, MD

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Introduction: Asymptomatic pericardial effusion is seen in up to 40% of pregnant women with pre-eclampsia (PEC) with severe features.¹ We present a case and management of a parturient with PEC with severe features complicated by pericardial effusion with bilateral pleural effusions undergoing urgent, cesarean delivery (CD).

Case Report: A 31 yo G1 at 27w6d was transferred for management of PEC with severe features based on severe hypertension (MAP ranged from 109 to 141) and pulmonary edema. Chest radiograph showed pulmonary edema, bilateral pleural effusions and an enlarged cardiac silhouette. She was treated with IV hydralazine and PO nifedipine, IV magnesium, betamethasone and furosemide for 12 hours. Prior to CD a maternal transthoracic echo (TTE) was ordered to rule out cardiomyopathy, which revealed moderate pericardial effusion and mildly depressed LV function (LVEF of 45-50%). Per cardiology consult, pericardiocentesis was not indicated. The risk of a sympathectomy with neuraxial anesthesia was weighed against the risk of positive pressure ventilation under general anesthesia. A pre-operative arterial line was obtained and a combined spinal epidural was placed with a low spinal anesthetic dose to minimize reduction in systemic vascular resistance and bradycardia. A T10 anesthetic level was achieved, but when positioning supine, the patient became dyspneic and the fetal heart rate declined to the 60 beats per minute. Rapid sequence induction was performed and the trachea was intubated. Incision was made with delivery of the infant (APGARS 1, 7). Persistent maternal hypotension (MAP 50 mmHg) prompted the team to obtain central venous access for fluid resuscitation, and administration of norepinephrine, epinephrine and vasopressin infusions; 100% FiO₂ was required to maintain a SpO₂ >90%. Cardiac anesthesia was called to conduct a TEE to evaluate for cardiac tamponade and/or signs of pulmonary or amniotic fluid embolism. TEE revealed a significant pleural effusion, estimated >1L of fluid, and a large pericardial effusion with RA collapse. No RV dilation or systolic dysfunction was noted thus ruling out pulmonary and amniotic fluid embolism. She was transported to the CVICU intubated and diuresed 1.7 liters overnight. The patient was weaned off all vasoactive agents, extubated, and was discharged home on post-operative day 3.

Discussion: Pericardial and pleural effusions secondary to severe PEC are rare, yet life-threatening complications of PEC with severe features. This case highlights competing management strategies for pulmonary edema and pleural effusions in the setting of cardiac tamponade in a patient with PEC with severe features. A multidisciplinary care team should be established in order to optimize the patient and develop a comprehensive delivery and postpartum plan.

References:

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Figure 1. Transesophageal echocardiography: Trans-gastric mid-papillary view with pericardial effusion, predominantly in the inferior to the LV and RV. LV, left ventricle; RV, right ventricle.

Abstract #: T10-03

Multidisciplinary Management of a Pregnant Patient with Metastatic Pancreatic Adenocarcinoma

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Although rarely diagnosed in the reproductive years, pancreatic cancer (PC) remains one of the top five leading causes of cancer-related deaths for women in the United States. Little is known about disease progression in pregnancy, however, potential contributors include the presence of estrogen and progesterone receptors on PC cells and pregnancy induced immunosuppression. Management is highly dependent on the resectability of the mass and life expectancy.^{1,2}

A 43 y.o G5P3 at 32 weeks gestation with metastatic pancreatic adenocarcinoma and 3 previous cesarean deliveries (CD) was admitted following a syncopal episode. Laboratory evaluation reveal anemia and anion gap metabolic acidosis secondary to starvation ketosis. Imaging was remarkable for a negative chest computerized tomography and a magnetic resonance imaging that revealed progression of disease (Fig 1). After fluid resuscitation, the patient's acid base status improved and fetal status was reassuring. Multidisciplinary planning recommended control of pain, deep vein thrombosis prophylaxis, nutrition support, and hemoglobin optimization prior to CD that was scheduled for 36 weeks gestation.

Pain control was provided with fentanyl 75 mcg patch every 72 h, PO morphine immediate release 15 or 30 mg, and IV morphine 2mg as needed. Her admission was complicated by an episode of confusion attributed to narcotics and prolonged hospital stay. At 36 weeks gestation, the patient underwent CD via midline vertical incision under combined spinal-epidural anesthesia. Spinal dosed with 12mg of hyperbaric bupivacaine, 20 mcg fentanyl, 200 mcg morphine, 0.25 mcg/kg clonidine. Delivery of a female infant was uneventful with Apgars 8 and 9 at 1 and 5 min., respectively, without evidence of neonatal abstinence syndrome. Adequate postpartum pain control was achieved via multimodal analgesia with bilateral transversus abdominis plane blocks (20cc bupivacaine 0.25% and 133mg liposomal bupivacaine each side), acetaminophen, and ketorolac with continuation of her baseline pain regimen. Although the surgery was complicated by preoperative anemia, ascites, and hemorrhage requiring transfusion, she recovered well and was discharged on postoperative day 4. She commence palliative chemotherapy which she is currently continuing 9 months postpartum.

A multidisciplinary approach involving Maternal Fetal Medicine, Gastroenterology, Oncology, Palliative Care, and Anesthesiology is essential to provide individualized, patient-centered care. As surgical intervention does not improve survival with metastatic disease and mortality of PC is high, focus was placed on the patient's desire for pain management, optimization for CD scheduled at 36 weeks for fetal benefit, and palliative chemotherapy in the peripartum period.^{1,2}

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Abstract #: T10-04

Undiagnosed Primary Hyperparathyroidism in Pregnancy- a case report

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Co-Authors: Craig Palmer - University of Arizona College of Medicine

Case report: A 40-yr-old primigravida, at 28 weeks EGA, with an intrauterine twin pregnancy from IVF, was admitted complaining of nausea and vomiting. Lab tests showed leucocytosis, electrolyte imbalance, elevated serum amylase and LDH, and hypoproteinemia. An initial diagnosis of preeclampsia was made. Antihypertensive therapy and anticoagulation (enoxaparinum 0.2ml) was started. When her condition deteriorated, a decision to transfer to higher level hospital was made, and she was transferred to our facility. On admission to our hospital, she was somnolent, and unable to answer on our questions. PE revealed edema on her face, hands and legs; hypertension (170/100) and tachycardia. A urinary catheter was placed but no urine was present.

The patient responded to gross stimuli, but verbal communication was very poor. The admitting obstetrician diagnosed uterine hypertonicity, and immediate cesarean delivery was planned. Because of the previous anticoagulant therapy shortly before transfer, general anesthesia was performed. Two viable infants were delivered 35 minutes after admission: a male, weight 1150g /37cm high (Apgars 2/4/6 at 1/5/10min) and second male 1250g /36cm (Apgars 2/3/5). Each received a single surfactant dose and were subsequently transferred to the neonatal intensive care unit. The patient was extubated and transferred to the intensive care unit where she received antihypertensive therapy (urapidil infusion - an α_1 -adrenoceptor antagonist), Mg⁺⁺, two antibiotics (elevated procalcitonin indicated possible sepsis), diuretics, and anticoagulation, but she remained unresponsive almost 24 hours later. By the 2nd postoperative day, her condition had improved slightly - she became more responsive, with a decreased amylase level, but increased creatinine required dialysis. Concern for sepsis remained. Further investigation revealed an elevated serum Ca⁺⁺ (2.6mmol/l, range 1.15-1.29mmol/l), and an elevated parathyroid hormone level (834.0 pg/ml- normal range 10-65 pg/ml). With further dialysis and zoledronic acid therapy, serum Ca⁺⁺ normalized, and ultrasound examination revealed a mass near the left lower lobe of the thyroid gland. Approximately one month following CS she was discharged home. Two months after delivery, the patient had a partial parathyroidectomy performed, and recover was uneventful. She was discharged home five days after this procedure in a good condition. Both infants were eventually discharged home in a good condition (first baby 3 months after delivery, and the second, 2 months after).

Hyperparathyroidism is much more common in women than men, and is relatively uncommon in both genders until the 6 decade of life, when incidence increases significantly (1). In this case, both preeclampsia and hyperparathyroidism likely contributed to the patient's clinical presentation (nausea, vomiting, confusion).

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Abstract #: T10-05

Starvation Ketoacidosis in a Near-Term Parturient

Presenting Author: Jessica Rock, MD

Presenting Author's Institution: Medical College of Wisconsin

Co-Authors: Zachary Biehl, MD - Medical College of Wisconsin

Introduction: Severe maternal acidosis leading to fetal harm is ascribed to many etiologies in pregnancy. We report a rare case of acute starvation ketoacidosis in a parturient.

Case Report: A 30-year-old G3P2002 at 36 weeks gestation with no significant past medical history presented after four days of nausea, vomiting, and poor oral intake. Additional symptoms included tachycardia, tachypnea, borderline hypertension, and hypoxia requiring four liters nasal cannula. Fetal heart rate (FHR) demonstrated a category two tracing. Concern was initially for pre-eclampsia given the increased blood pressure and elevation in urine protein and creatinine. Urgent delivery was discussed between teams and delayed in lieu of broadened workup. After intravenous fluid resuscitation, oxygen requirements and FHR showed some improvement. Etiologies such as pulmonary embolism, pulmonary edema, acute fatty liver of pregnancy, pancreatitis, coagulopathy, infection, and drug ingestion were all ruled out during workup, but the patient was found to have a large anion gap. During the workup, dyspnea worsened, oxygen requirements increased, and the fetal tracing developed late decelerations. After discussion by OB, internal medicine, and anesthesia, bicarbonate and a dextrose-containing infusion were administered for a significant anion gap metabolic acidosis and increased serum ketones. Patient and fetal clinical status improved. Supplementation of electrolytes was required as anion gap and pH began normalizing. A final diagnosis of starvation ketoacidosis secondary to prolonged vomiting and poor oral intake was made. At this point, the multidisciplinary team deemed it safe to induce labor for treatment of pre-eclampsia (thought to be the cause of the GI symptoms). Soon after induction, the patient requested an epidural for labor analgesia and went on to an unremarkable spontaneous vaginal delivery.

Discussion: Metabolic acidosis during pregnancy may result in fetal acidosis and hypoxemia leading to an adverse outcome. Pregnancy causes an increased tendency towards ketogenesis due to relative insulin deficiency and resistance, respiratory alkalosis, and renal excretion of bicarbonate. The ketogenic response is further accelerated during periods of stress, such as illness/vomiting. In a pregnant patient with poor oral intake, starvation ketoacidosis should be considered early in a presentation with a large anion gap. As maternal acidosis will cause fetal intolerance of labor, delivery should be delayed until correction of maternal pH, unless maternal or fetal status requires immediate delivery.

Conclusion: Starvation ketoacidosis can present quickly and severely in the pregnant patient. Early recognition and treatment are critical for favorable fetal outcome.

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Abstract #: T10-06

A multidisciplinary approach to a pregnant patient with Pentology of Fallot and VACTERL

Presenting Author: Seth Fischer

Presenting Author's Institution: UCSD

Co-Authors: Anne E. Shapiro - UCSD

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A 30-year-old G3P0202 with PMHx significant for pentalogy of fallot s/p corrective surgery, VACTERL syndrome complicated by severe scoliosis with persistent severe restrictive lung disease, TE fistula s/p repair with G-tube dependence complicated by chronic malnutrition, and PHTN, pulmonic valve regurgitation and severe RV dilation, presented for c-section.

This patient's 2 prior pregnancies delivered pre-term via c-section secondary to maternal respiratory decompensation and acute malnutrition. They were done under general anesthesia, as scoliosis and Harrington rods precluded neuraxial.

A multidisciplinary approach was crucial to her safe delivery. She underwent a scheduled c-section at 37 weeks. Adequate IV access and an A-line were placed. Anesthesia was induced with minimal cardiovascular changes and TEE was done by a cardiac anesthesiologist. Six minutes after induction the infant was delivered. In spite of pitocin she continued to bleed, requiring methergine, TXA, and a Bakri balloon. She was transported to the ICU, extubated, for further monitoring. The Bakri was removed post-op day 1 and she was discharged home post-op day 2.

Myriad considerations need to be addressed within the growing population of patients with congenital heart defects that are surviving to reproductive age. This case highlights how patients can be delivered safely with an interdisciplinary approach.

Pregnant patients with both pentalogy of Fallot and VACTERL are exceedingly rare in obstetric anesthesia literature. Pentalogy is a rare form of tetralogy of Fallot (2:100,000 live births) which encompasses the four defects in tetralogy of Fallot - RV hypertrophy, VSD, overriding aorta, pulmonic valve stenosis - with the addition of an ASD. In this patient, the physiology of pregnancy, specifically the increased cardiac output, threatened to overwhelm her already taxed RV. Her VACTERL syndrome, also rare, further complicated her care (i.e. severe scoliosis complicated by restrictive lung disease and G-tube dependence). A multidisciplinary approach that included the expert input of obstetricians, obstetric and cardiac anesthesiologists, cardiologists, pulmonologists and intensivists, along with extensive planning, allowed for an uncomplicated c-section and delivery.

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Partana P, Tan JKH, Tan JL, *et al*

Multiple pregnancy in a primigravida with uncorrected Pentalogy of Fallot

Case Reports 2017;2017:bcr2016216809.

Abstract #: T10-07

Considerations for the Transgender Parturient

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Co-Authors: Elizabeth Lange, MD - Northwestern University, Feinberg School of Medicine
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Introduction: Transgender individuals represent a sexual and gender minority population whose gender identity differs from their sex assigned at birth. Despite efforts by medical and social activists, transgender patients encounter barriers to adequate and gender-appropriate healthcare, resources, and support. Transgender parturients face improper pronoun use, insensitive treatment, and denial of medical care¹. As some transgender men may desire childbirth, physicians must strive to become familiar with and respectful of the unique considerations for this patient population in the peripartum setting.

Case: Our patient is a 38-year-old G1P0 transgender man with no significant past medical history. In transitioning from female-to-male, he underwent gender-affirming hormonal therapy, which was discontinued prior to conception via in vitro fertilization. Before our patient arrived for induction of labor, we coordinated a multidisciplinary meeting to educate healthcare staff about appropriate gender identity language and information and provide a safe place to ask questions.

He presented at 39 3/7 weeks of gestation for induction with cervical ripening balloon and oxytocin due to polyhydramnios. A combined spinal-epidural was performed for labor analgesia. A healthy infant was born via spontaneous vaginal delivery, which was complicated by postpartum hemorrhage due to retained placenta and lower uterine segment atony. The patient received oxytocin, misoprostol, methylergonovine, and carboprost, and a Bakri balloon was placed; he remained hemodynamically stable with a final EBL of 1400 mL. He was discharged home on postpartum day three in stable condition.

Discussion: Labor and delivery has traditionally been viewed as a female process. As a result, transgender men often face increased difficulty with gender sensitivity and identity in the peripartum period. These challenges are emphasized by survey respondents in Light et al. such as “people don’t assume that someone who looks like me could be pregnant.”¹

Standard of care should encourage patients to disclose their preferred name, preferred pronouns, gender identity, and sex assigned at birth. It is also important to empower transgender parturients and their partners as they affirm their parental role identities (e.g. “dad,” “mom,” “carrier,” “gestational parent”). This would help ensure that individuals are addressed in the manner in which they desire. Another consideration includes asking individuals if they prefer the term “breastfeeding” or “chestfeeding” as a gender-neutral alternative. Our case demonstrates that multidisciplinary meetings may help avoid assumptions and stereotypes during the peripartum period, affording healthcare providers the opportunity to greatly improve the experience of transgender parturients.

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Abstract #: T10-08

Hemorrhagic Stroke in a Laboring Parturient Following Unintentional Placement of an Intrathecal Catheter

Presenting Author: Immaculate Fernandes, MD

Presenting Author's Institution: University of Tennessee Graduate School of Medicine - Knoxville, Tennessee

Co-Authors: Carrie Polin, MD - University of Tennessee Graduate School of Medicine

Introduction: The estimated incidence of stroke in pregnancy is around 30 cases per 100,000 deliveries [1]. Reversible cerebral vasoconstriction syndrome (RCVS) is the most common cause of cerebrovascular events associated with pregnancy; however, there is a lack of guidelines for anesthetic management of peripartum stroke [2]. We present the management of acute stroke in an actively laboring parturient.

Case: A 27-year-old G1P0 African American female with past medical history of asthma, obesity, and reflux presented for induction of labor at 37.1 weeks. The patient requested an epidural for labor analgesia. The catheter was placed at the L3-4 interspace using a loss of resistance technique. Initial aspiration of the catheter was negative for blood or cerebrospinal fluid. A 3mL test dose of 1.5% lidocaine with epinephrine indicated intrathecal placement of the catheter as the patient developed loss of sensation to pinprick to the T4 level, inability to move her lower extremities, and hypotension treated with phenylephrine. No further medications were administered through the intrathecal catheter. An hour following the test dose, the patient became nauseous and vomited. She then had sudden onset of left arm and left leg weakness accompanied by a headache. Imaging of her head revealed a subarachnoid hemorrhage (SAH). Since the patient was actively contracting, a Cesarean section was performed using general endotracheal anesthesia. Postoperatively, she was transferred to the intensive care unit for management of her SAH. Cerebral angiography confirmed RCVS with vasospasm in multiple vessels. The patient was discharged home two weeks later with persistent yet improving left sided neurological deficits.

Discussion: Stroke in pregnancy can lead to significant morbidity and mortality. Management is focused on maintenance of cerebral perfusion and treatment of the underlying etiology. For our case, Cesarean section was performed under general endotracheal anesthesia for rapidity of delivery and ability to tightly control blood pressure and cerebral perfusion. Angiography revealed that the patient's SAH was secondary to RCVS. The pathogenesis of RCVS is poorly understood; however, vasoactive drugs are known to trigger RCVS [3]. Consequently, it is possible that the epinephrine in the neuraxial test dose or the phenylephrine used to treat her hypotension exacerbated the RCVS.

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Abstract #: T10-09

Veno-Arterial ECMO rescue from massive Pulmonary Embolus maintains viable pregnancy

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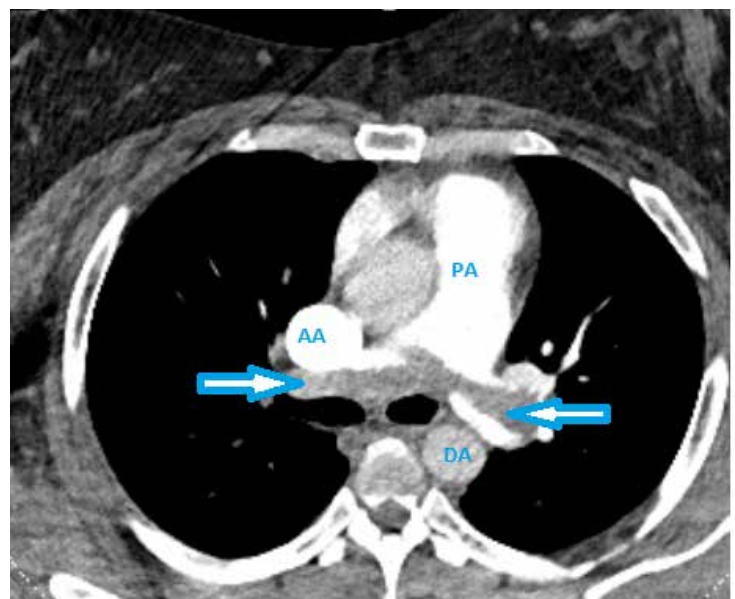
Susan Sankova, MD - University of Maryland Medical Center

A 44-year-old G5P1122 (full-term VBAC) at 23 weeks' estimated gestational age (EGA) initially presented to an outside hospital with abdominal pain/vomiting. Past medical history was notable for heterozygous Factor V Leiden mutation and a distant history of Roux-en-Y gastric bypass. BMI= 44. Ultrasound confirmed a live breech, FHR=150. The patient was resuscitated from mild lactic acidosis (lactate level= 3 mmol/L) with intravenous infusion of crystalloid solutions. Abdominal pelvic CT revealed a jejeuno-jejunal intussusception. She remained hemodynamically stable and transferred to our facility.

On arrival, FHR=160s without deceleration. Not previously anticoagulated, she was injected with enoxaparin, general anesthesia induced and 45cm of small bowel resected. Her intra- and immediate post-operative course was uneventful. Over the course of post-operative day (POD) 1-2, she was injected with two doses of betamethasone (12 mg); daily enoxaparin (40 mg) was continued; and, she began ambulating. While standing on POD 5, the patient complained of acute onset of chest pain; her HR=113 bpm; BP=74/51 mmHg; with room air SpO₂=88%. The attending anesthesiologist performed point-of-care TTE revealing right ventricular (RV) strain and severe tricuspid regurgitation (TR). Subsequent CT angiography revealed a pulmonary saddle embolus extending bilaterally into the lobar segments. A cardiothoracic surgeon was consulted and the patient transported to the ICU. On Vapotherm, the right femoral artery and left femoral vein were immediately cannulated for VA-ECMO with initial blood flow = 3 LPM, RPM 3125, sweep FiO₂=100% and sweep flow=2 LPM. Maternal systemic BP was supported with intermittent infusion of epinephrine and anticoagulation achieved with intravenous heparin to keep aPTT= 60-80s. Throughout ECMO, EFM revealed FHR 140s with moderate variability and no contractions.

On POD 10, TTE demonstrated improvement in RV function, mild RV dilation and TR. She was weaned off VA-ECMO, decannulated, and transferred back to the L&D unit, now on twice-daily subcutaneous injection of enoxaparin (90mg) to maintain anti-Xa level of 0.8 to 1.2 IU/mL. On POD 20, with almost complete resolution of RV dysfunction with minimal TR, the patient was discharged home, continuing on twice-daily enoxaparin. Follow-up lower extremity venous duplex revealed no evidence of DVT. Investigation of intermittent bleeding from the left femoral cannulation site revealed arterio-venous fistula with pseudoaneurysm.

She had follow-up with intermittent fetal and post-surgical assessment. At 31 weeks' EGA, while at home, she reported two hours of uterine cramping followed by a spontaneous vaginal delivery. EMS responded, finding an apneic and pulseless neonate. The patient was transported to an outside hospital for an otherwise uncomplicated postpartum stay.



Abstract #: T10-10

Evidence of mother-to-newborn infection with COVID-19

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Vertical and perinatal mother-to-newborn transmission of COVID-19 has not yet been confirmed,^{1,2} although there are reports of COVID-19 infections in newborns.³⁻⁷ Here, we report three mothers with COVID-19 and the outcomes of their newborns in Henan province, China. All three mothers did not have significant past medical histories but had confirmed COVID-19, who underwent Cesarean deliveries. In all three cases, the obstetricians, anesthesiologist, neonatologist and nurses wore full personal protection equipment (PPE) and the COVID-19 disinfection policy was fully executed. Notably, only obstetricians touched both the mothers and newborns during the time of Cesarean delivery, handing the newborns off to neonatologists from the operating tables. The resuscitation tables for newborns were about 3 meters away from the head of the mothers in the operating rooms.

The first patient was a 28-year-old nulliparous woman at 37 weeks' gestation. The mother had a Cesarean delivery under general anesthesia. The newborn was taken from the operating room before extubation of the mother. For the remainder of his hospitalization, the newborn was in the patient's inpatient room, but was placed in a temperature-controlled isolate, which was 3 meters away from the mother's head. The newborn was cared for by a nurse who was not in physical contact with the mother or other visitors after the delivery. Visitors wore masks in the mother's room but were not allowed to be in contact with the newborn. The mother wore a face mask all the time after the surgery. The medical staff wore the same level of PPE in the inpatient room as they did in the operating room. The newborn was discharged home 11 hours after birth and tested positive for COVID-19 on postnatal (P) day 6. The second mother was a 30-year-old pregnant (G3P2) woman at 30.5 weeks gestation, who had a Cesarean delivery under spinal anesthesia. The newborn tested negative for COVID-19 on P3. The third case was a 29-year-old pregnant woman at 36 weeks' gestation who had a Cesarean delivery under spinal anesthesia. The newborn had a fever (P3), lung rales and abnormal lab results. A chest CT scan of the newborn was performed on P6 that demonstrated findings suggestive of COVID-19.

It is not known whether the transmission of COVID-19 to the newborn in case 1 occurred in utero, in the operating room, recovery room or community while being cared by his grandmother (wearing a mask), or whether the route of transmission was via airborne droplets, personal contact, or blood. Interestingly, the newborn in case 3 who tested negative for COVID-19 had clinical symptoms and classical chest CT findings consistent with COVID-19, although other acute lung diseases could also cause the CT findings.

While there is a common belief that general anesthesia, associated with more aerosol generation during intubation, may increase the risk of transmission of SARS-CoV-2, our case series included a case of potential transmission under regional anesthesia. The limited case number in this series precludes our definitively knowing the effects of anesthesia techniques on COVID-19 maternal-to-newborn transmission. Therefore, it is not yet known whether general versus regional anesthesia for Cesarean deliveries can lead to different outcomes.

Nevertheless, this report highlights the risk of mother-to-newborn transmission of SARS-CoV-2 and suggests that more systematic investigations are warranted to determine if vertical transmission is possible.

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Abstract #: ES1-01

Neuraxial Labor Analgesia Success Rates in Women with a BMI \geq 50: A Single-Center Retrospective Study

Presenting Author: David E. Arnolds, MD, PhD

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Co-Authors: Barbara Scavone

Background: Early neuraxial labor analgesia is recommended for obese parturients to ensure that a functioning neuraxial catheter is available should emergent cesarean delivery become necessary.¹ The failure rate of neuraxial analgesia varies widely depending on the anesthetic technique and population, and the failure rate of neuraxial analgesia in the super-obese (BMI > 50 kg/m²) is unknown. The goal of our study was to determine the failure rate of neuraxial labor analgesia in women with BMI > 50 kg/m².

Methods: We retrospectively reviewed the anesthetic records of women with BMI > 50 kg/m² who delivered at our institution with neuraxial labor analgesia between January 1, 2012 and August 20, 2018. The primary outcome was the incidence of catheter failure among initial catheters placed for labor analgesia. Failure was defined as replacement of a neuraxial catheter, a note indicating a replacement was recommended, or administration of a second neuraxial or general anesthetic for cesarean delivery. We also assessed the failure rate of replacement catheters, analyzed failure rate by anesthetic technique, stratified failure as analgesic (occurred during labor analgesia) or anesthetic (occurred during cesarean delivery), and recorded times to delivery or catheter failure.

Results: We identified 233 women with a median BMI of 53 (IQR 51-57) kg/m² who received neuraxial labor analgesia. Among initial catheters placed for labor analgesia 32 failed, for a failure rate of 14% (95% CI 10-19%). Of 28 replacement catheters placed for labor analgesia 2 failed, for a replaced catheter failure rate of 7% (95% CI 2-23%). 78 patients delivered by cesarean; the catheter *in situ* for labor analgesia provided adequate surgical anesthesia for 74 patients and 4 patients required a *de novo* neuraxial anesthetic; no patients required general anesthesia (failure rate at cesarean delivery 5% (95% CI 2-12%). Anesthetic outcomes by catheter technique are shown in the table. Initial epidural catheters placed after dural puncture (a combined group consisting of CSE and DPE techniques) had a lower failure rate than epidural catheters placed without dural puncture (10% vs. 29%; $p < 0.05$, Chi-square test). Notable reasons for failure included catheter migration (8/32; 25%) and early failure to achieve a dermatomal level (4/32; 12.5%, all of which were catheters inserted after attempted CSE with failure to obtain CSF with the spinal needle). The median anesthesia start to delivery and start to failure times were 11.1 (IQR 5.1-19.4) and 9.1 (IQR 4.8-15.5) hrs, respectively.

Discussion: Neuraxial labor analgesia has a high success rate even in the super-morbidly obese population. Within the limitations of the retrospective design, our study supports the increased reliability of epidural catheters placed after dural puncture (CSE or DPE) relative to those placed without preceding dural puncture.²

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Abstract #: ES1-01

	Initial Catheter for Labor Analgesia (n=233)				
	Overall n=233	Combined spinal epidural n=144	Dural puncture epidural n=9	Epidural n=63	Intrathecal n=17
Failed catheter	32 (14% [10-19%])	13 (9% [5-15%])	1 (11% [2-43%])	18 (29% [19-41%])	0 (0% [0-18%])
Analgesic *	28 (12% [8-17%])	11 (7.6% [4%-13%])	1 (11% [2-43%])	16 (25% [16-37%])	0 (0% [0-18%])
Cesarean Deliveries**	69	39	2	21	7
Anesthetic ***	4 (6% [2%-13%])	2 (5% [1-17%])	0 (0% [0-66%])	2 (9.5% [2.7-29%])	0 (0% [0-35%])
	Replacement Catheter for Labor Analgesia (n=28)				
	Overall n=28	Combined spinal epidural n=12	Dural puncture epidural n=3	Epidural n=10	Intrathecal n=3
Failed catheter	2 (7% [2-23%])	0 (0% [0-24%])	0 (0% [0-56%])	2 (20% [6-51%])	0 (0% [0-56%])
Analgesic *	2 (7% [2-23%])	0 (0% [0-24%])	0 (0% [0-56%])	2 (20% [6-51%])	0 (0% [0-56%])
Cesarean Deliveries**	9	3	2	4	0
Anesthetic **	0 (0% [0-35%])	0 (0% [0-56%])	0 (0% [0-66%])	0 (0% [0-49%])	N/A

*Failed during labor analgesia

** Attempted in the absence of/prior to catheter replacement

***Failed for cesarean delivery

Data presented as n (% [95%CI])

Abstract #: ES1-02

Study on hemodynamics of labor analgesia in parturients with hypertensive disorder of pregnancy by Lidco-rapid monitoring system

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Co-Authors: XU MINGJUN - Beijing Obstetrics and Gynecology Hospital

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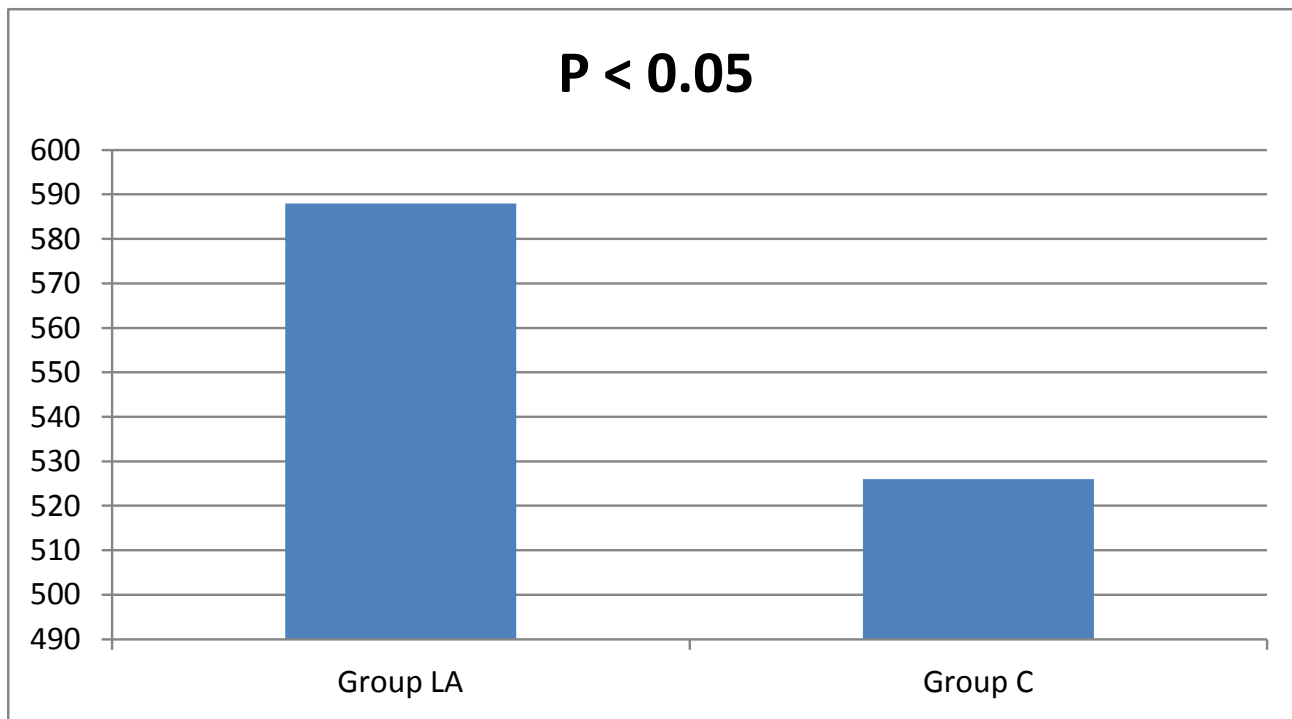
Objective To observe the hemodynamic changes and delivery outcome of parturients with Hypertensive disorder of pregnancy after labor analgesia by lidco rapid monitoring system.

Method 132 parturients (Group LA), aged 22-35 years, weight 55-85 kg, ASA II or III, were selected. All the parturients were primipara, singleton, diagnosed as hypertensive disorder of pregnancy, 25 of them diagnosed as preeclampsia. 126 parturients (Group C) who did not perform labor analgesia due to obstetric factors, anesthesia taboo or refusal of intraspinal anesthesia were collected in the same period. They were primipara and singleton. They were diagnosed as hypertensive disorder during pregnancy, 21 of them were diagnosed as preeclampsia. All parturients were monitored by lidco rapid system. In Group LA, continuous epidural analgesia was performed after regular contraction of uterus, and the analgesia pump was continuously applied until the end of the first labor process. Firstly, 5ml of ropivacaine 2 mg / ml was given, after 5 minutes, the mixture of ropivacaine 1 mg / ml and sufentanil 1 ug / ml was used for 10-15 ml, until VAS < 5. The epidural analgesia pump was connected 30 minutes after injection, and when VAS > 5, the analgesia pump was pressed. Map, VAS score, CO and SVR were recorded before analgesia (T_0), 10 minutes (T_1), 30 minutes (T_2), 60 minutes (T_3) and after analgesia (T_4); The time of first and second stages labor were recorded; the cases of oxytocin, antihypertensive therapy, eclampsia and postpartum hemorrhage were recorded; the mode of delivery (natural delivery, forceps delivery, cesarean section) was recorded; the newborn's weight, Apgar score of 1, 5 and 10 minutes after birth were recorded; The blood gas analysis of umbilical artery was recorded.

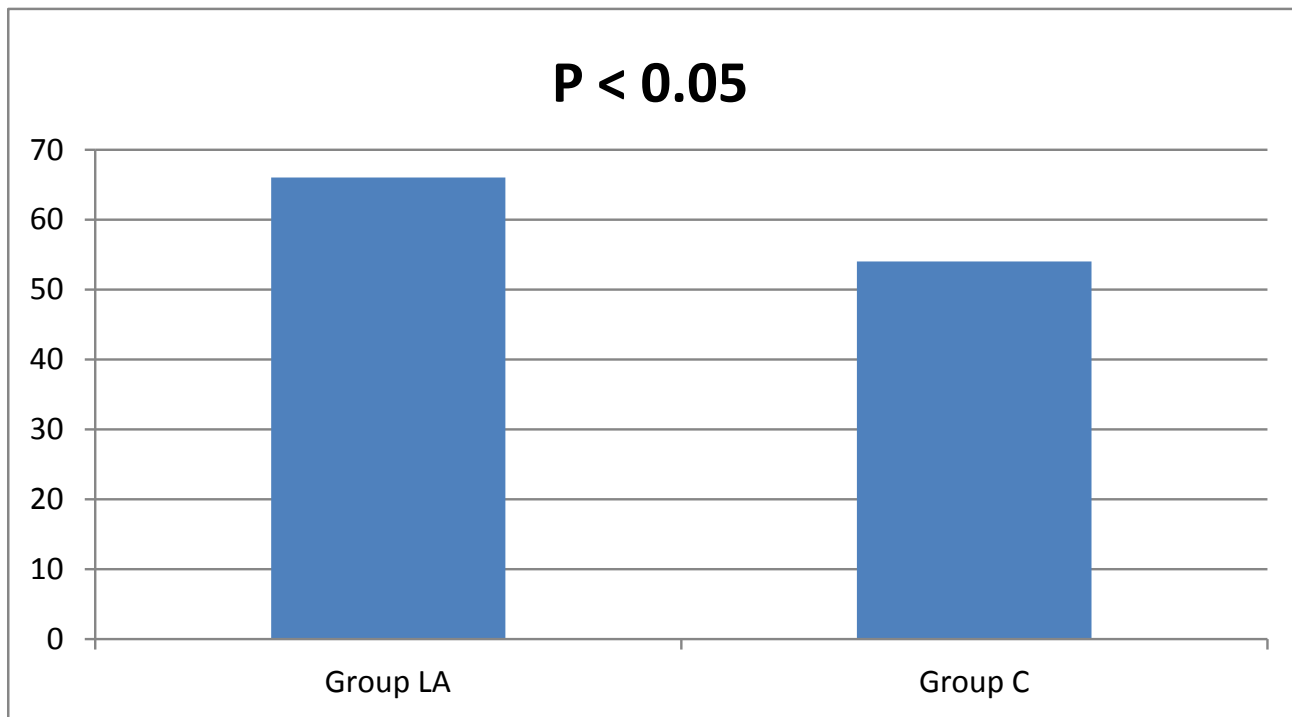
Result The time of the first and the second stages labor in Group LA was longer than that in Group C ($P < 0.05$); the MAP and VAS in Group LA at T_1 time point were lower than those in Group C ($P < 0.05$); the MAP, VAS and SVR at T_2, T_3, T_4 time point were lower than those in Group C ($P < 0.05$); the CO at T_2, T_3, T_4 time point in Group LA was higher than those in Group C ($P < 0.05$); the utilization rate of oxytocin in Group LA was higher than that in Group C ($P < 0.05$); the utilization rate of antihypertensive treatment in Group LA was lower than that in Group C; the rate of forceps delivery in Group LA was lower than that in Group C ($P < 0.05$); there was no significant difference in cesarean section rate between the two groups; there was no significant difference between the two groups in Apgar scores at 1, 5 and 10 minutes after birth ($P > 0.05$).

Conclusion Labor analgesia has no obvious effect on the final delivery mode, it can reduce the fluctuation of circulatory system during labor and improve the fetal oxygen supply. For the parturients with hypertensive disorder of pregnancy, it is suggested that labor analgesia should be carried out in the early stage of labor.

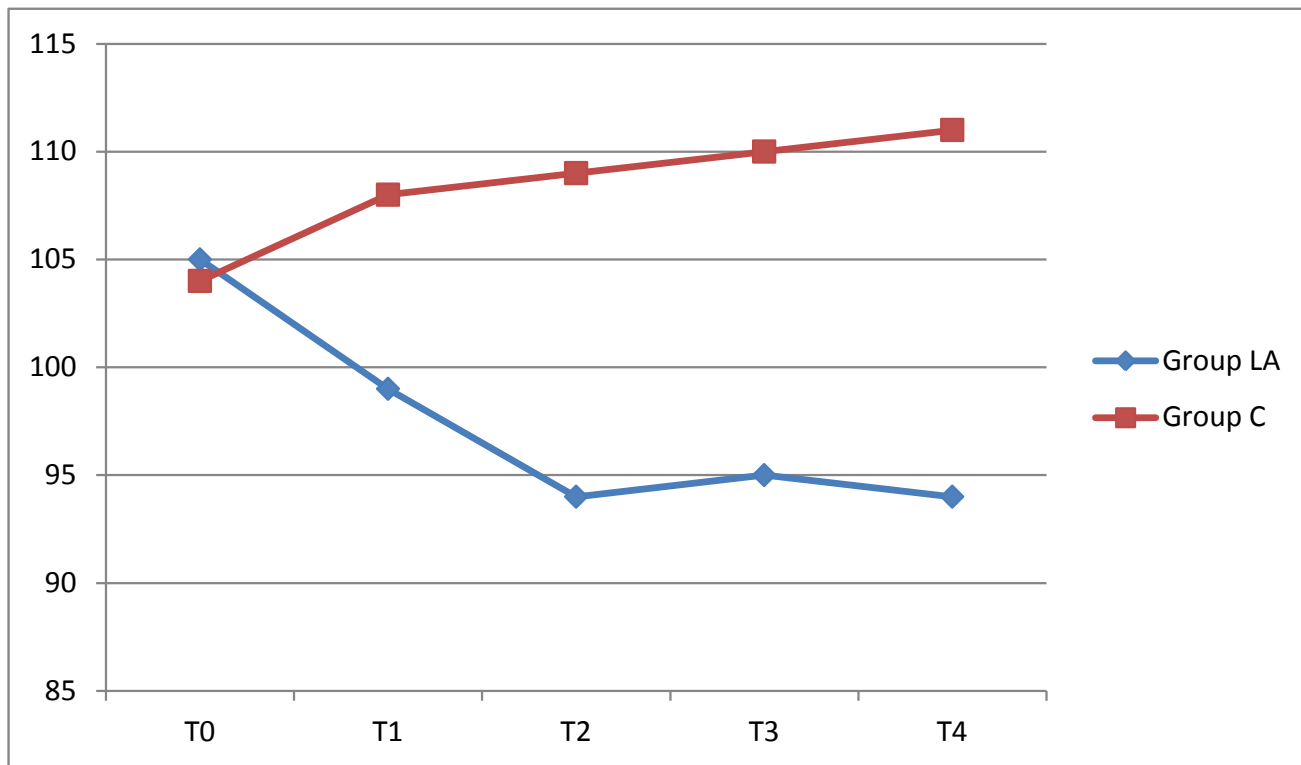
The Time of First Stage Labor(min)



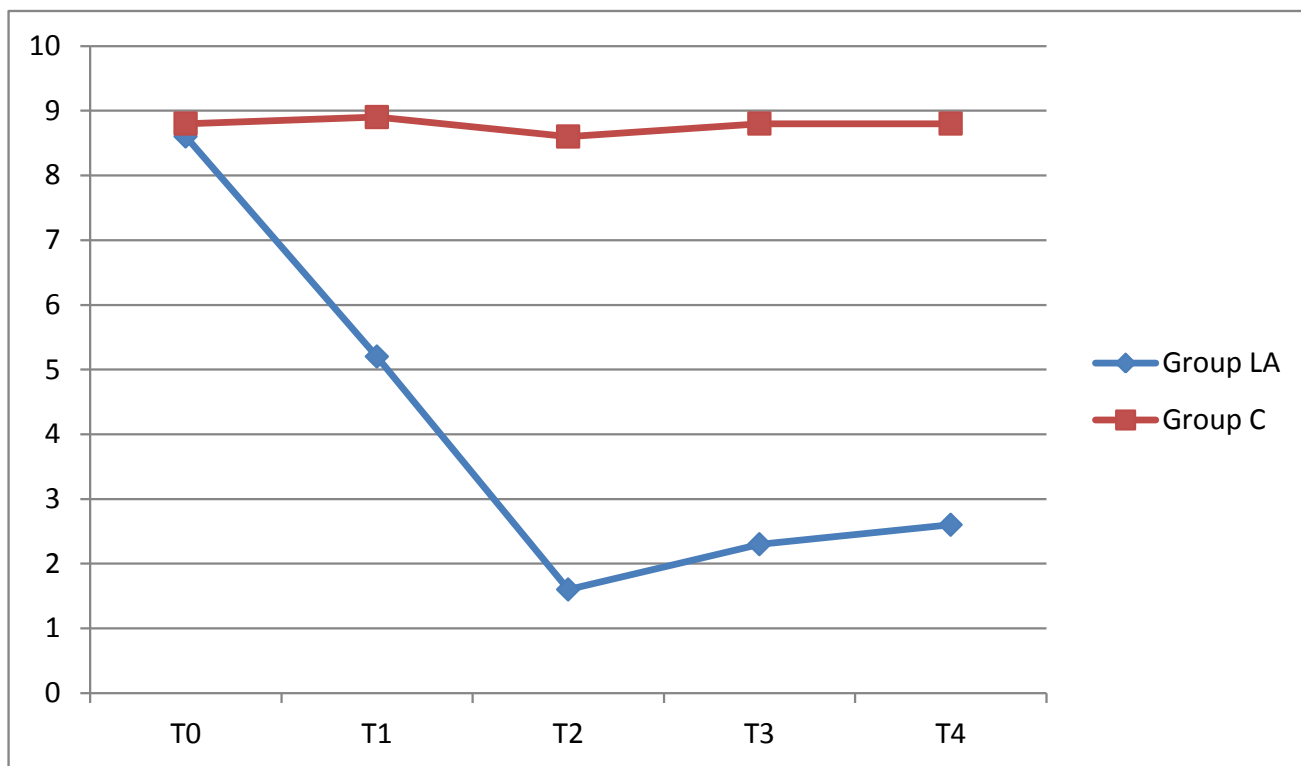
The Time of Second Stage Labor(min)



Comparison of MAP(mmHg) between two groups of parturients at different time points

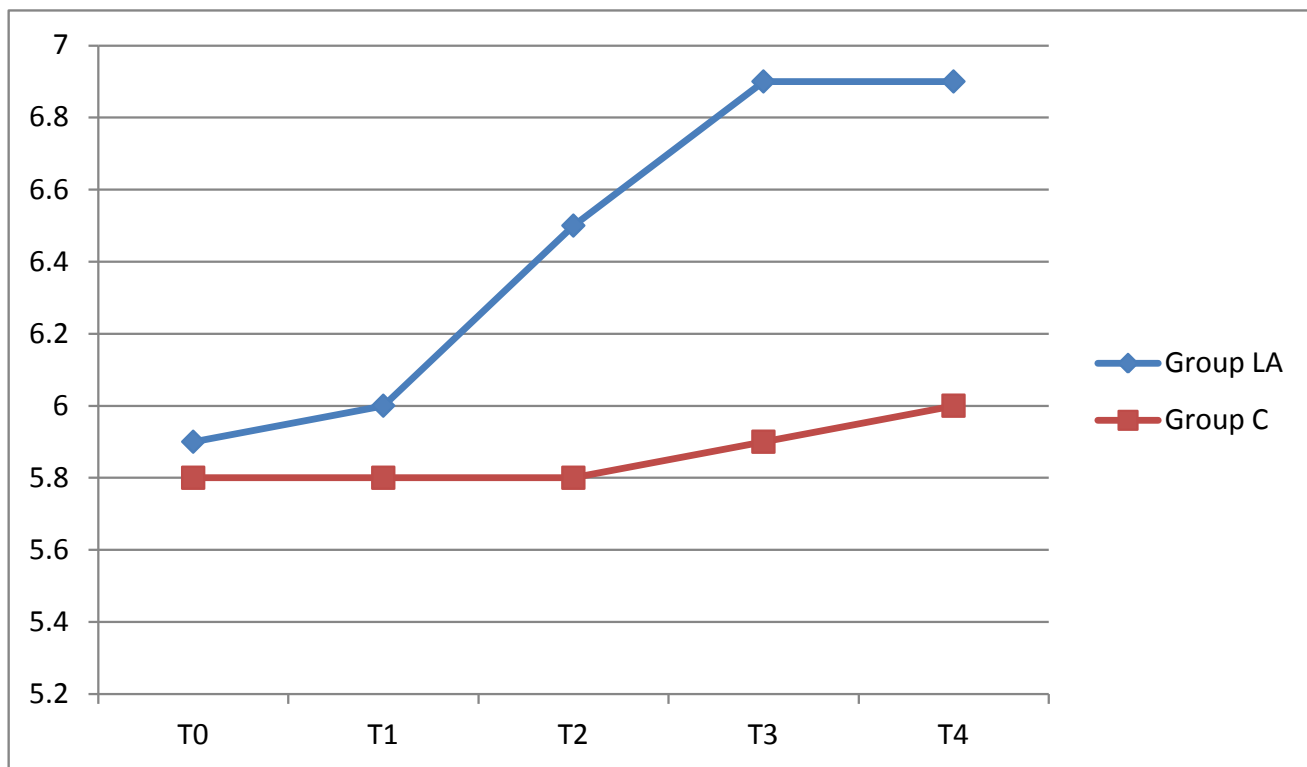


Comparison of VAS between two groups of parturients at different time points

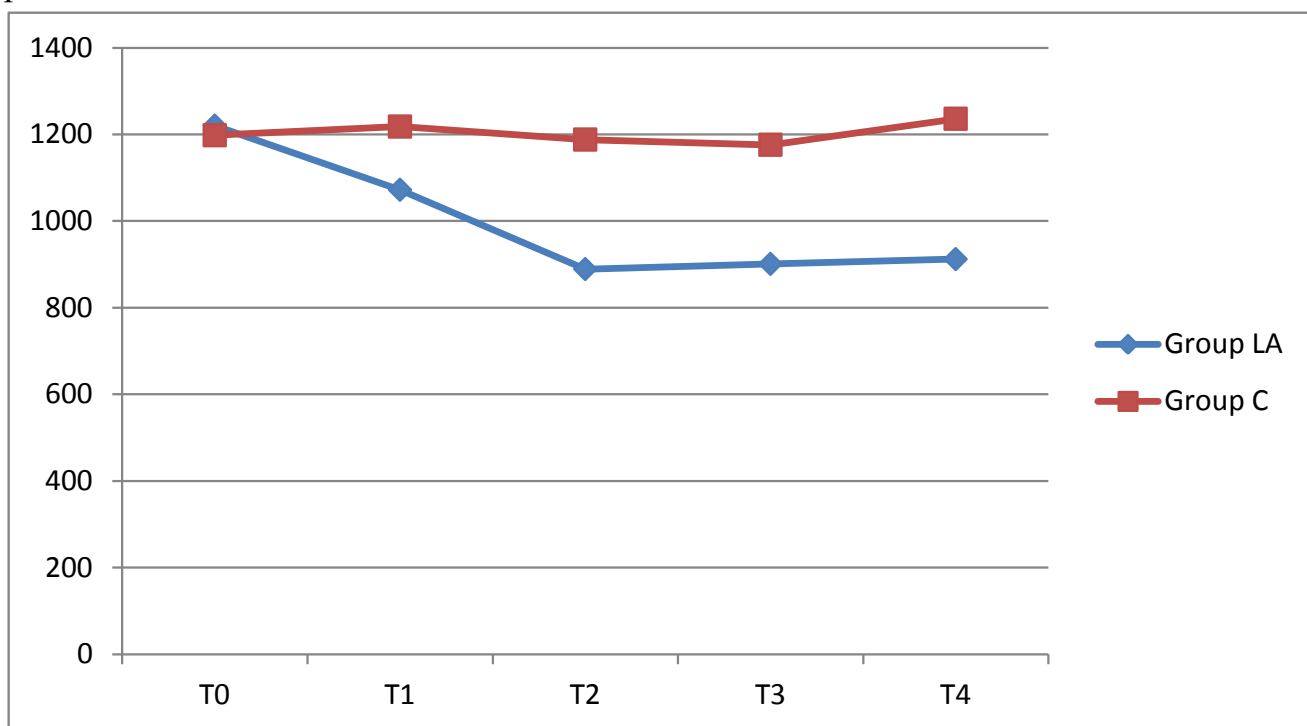


Abstract #: ES1-02

Comparison of CO(L/min) between two groups of parturients at different time points

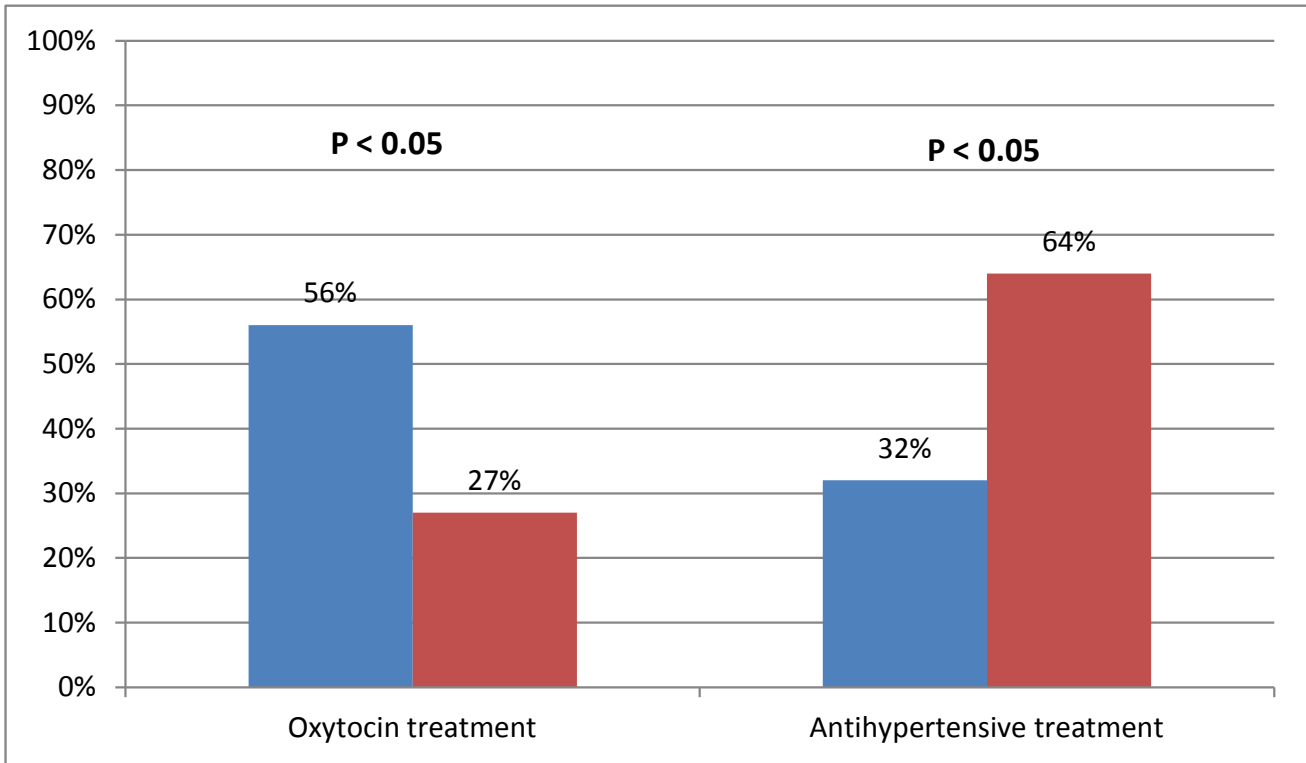


Comparison of SVR(dyn • s/cm³) between two groups of parturients at different time points

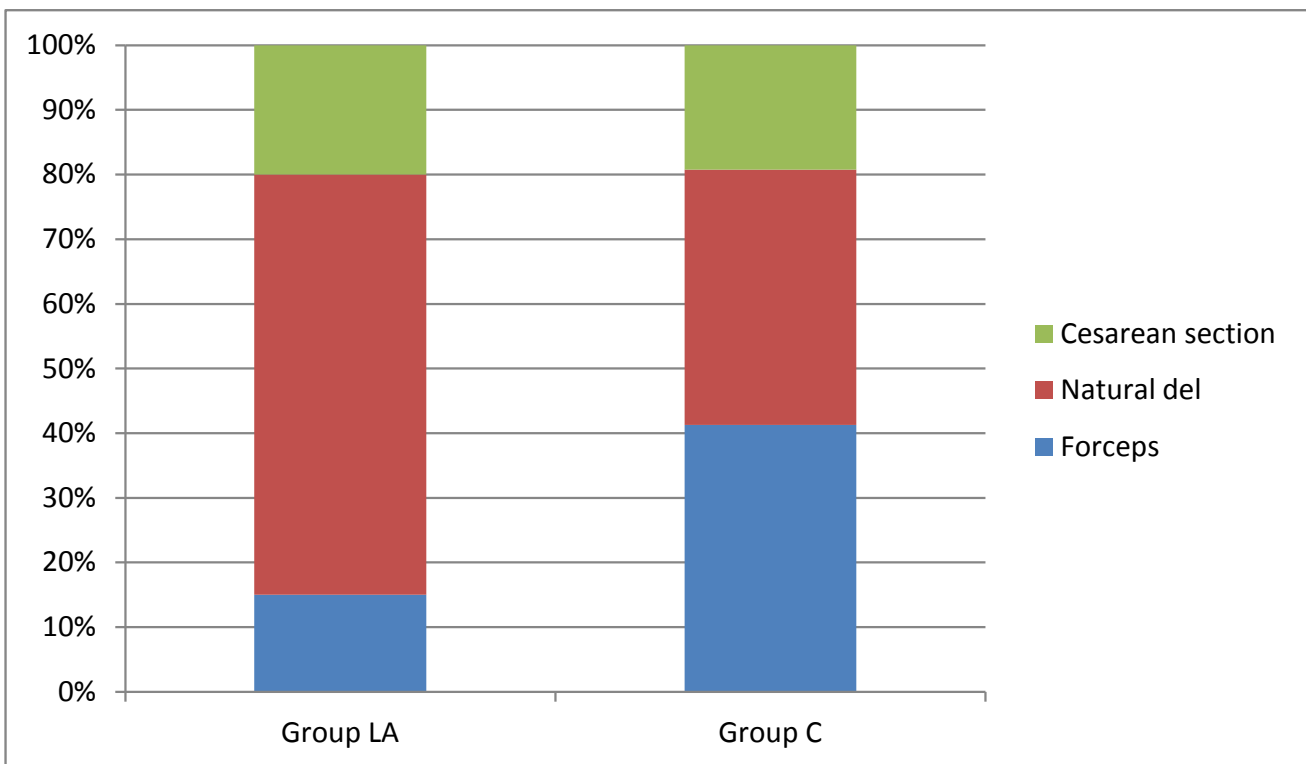


Abstract #: ES1-02

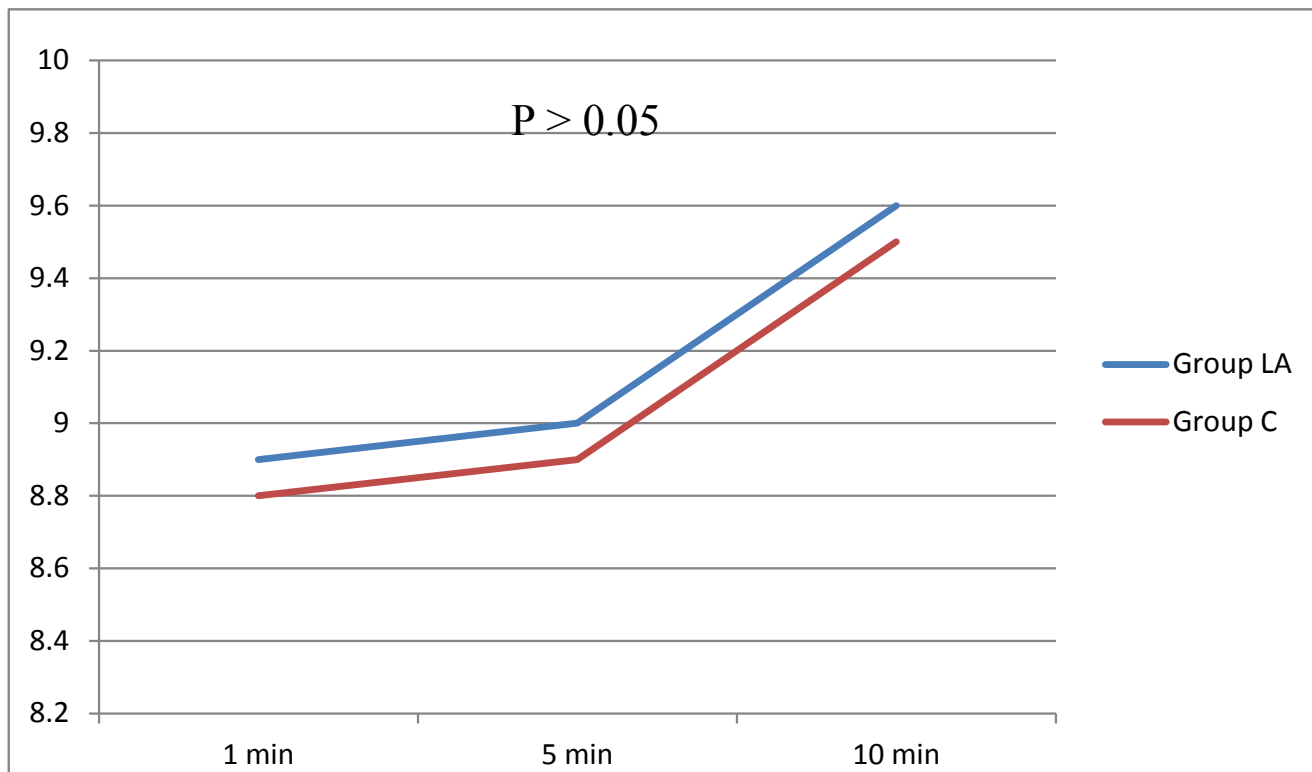
Comparison of Oxytocin and Antihypertensive Treatment Between Two Groups of Parturients



Statistical analysis of ratios for natural delivery, forceps assistant delivery and cesarean section in two groups



Comparison of Apgar Scores between the two groups at 1, 5 and 10 minutes after birth



Abstract #: ES1-03

Prospective study of pain and analgesia during labor and delivery between 16 weeks and 22 6/7 weeks estimated gestational age

Presenting Author: Chad T. Dean, M.D.

Presenting Author's Institution: University of Chicago Medicine - CHICAGO, Illinois

Co-Authors: Barbara M. Scavone, M.D. - University of Chicago Medicine

Introduction: Labor and delivery at a preivable gestational age is a difficult experience for many women. It is widely recognized that significant pain occurs during term labor and delivery and that many women benefit from analgesia (1) and the general consensus exists that neuraxial analgesia affords the most efficacious pain control (2). However, sparse data exist regarding pain and efficacy of analgesic options at very early gestational ages, making counselling patients difficult. We recently published retrospective data that demonstrated most women require analgesia during these deliveries and suggested neuraxial analgesia may provide better pain control than intravenous analgesia (3); however, analgesic regimens were not standardized and our study lacked reliable numerical pain score data. We undertook this prospective study to further characterize pain and analgesia during preivable delivery, hypothesizing: (1) Parturients at 16 to 22 6/7 wk EGA experience significant pain during labor and delivery; and (2) neuraxial analgesia provides more effective pain control than systemic opioid analgesia in this setting.

Methods: In this IRB-approved study patients undergoing induction of labor between 16 and 22 6/7 wk EGA were offered either systemic or neuraxial analgesia, according to standardized regimens. Demographic, obstetric, and analgesic outcome data were obtained. Pain scores were recorded by the patient hourly until delivery and area under the pain-time curve was calculated. The primary outcome was nadir pain score after analgesic intervention. Those who chose neuraxial analgesia were compared to those who chose systemic opioid analgesia with U-test, chi-squared or Fisher's exact test as appropriate.

Results: A total of 29 patients met inclusion criteria; 20 chose systemic analgesia; 9 chose neuraxial analgesia. No patients < 19 wk EGA requested neuraxial, while 9/19 (47%) of those \geq 19 wk EGA did ($P = 0.01$). See table for demographic and outcome variables. Patients who chose neuraxial analgesia were older and had higher EGA (but not neonatal weight) than those who chose systemic analgesia. Neuraxial analgesia was associated with lower nadir pain scores and greater change in pain score post analgesic intervention than systemic analgesia.

Conclusion: Our data confirm that significant pain occurs with preivable labor and delivery (3, 4, 5). Neuraxial analgesia appears to be superior to systemic analgesia especially at more advanced EGA; specifically \geq 19 wk. Anesthesiologists and obstetricians should routinely discuss neuraxial analgesia with patients in this population.

References:

1. Jones: *Cochrane Database Syst Rev* 2012;3:CD009234
2. Anim-Somuah: *Cochrane Database Syst Rev* 2011;12:CD000331
3. Hamer: *Obstet Gynecol* 2016; 127:1161
4. Hamoda: *BJOG* 2004;111:996
5. Jackson: *Contraception* 2011;83:116

Abstract #: ES1-03
Table

	All (n=29)	Neuraxial (n=9)	Systemic (n=20)	P
Demographics				
Age (yr)	29 (23-32)	31 (30-36)	28 (22-30)	0.004
BMI (kg/m ²)	29.2 (26.1-34.6)	27.6 (26.2-32.6)	29.5 (25.5-35.4)	0.41
Nulliparity	11 (38)	2 (22)	9 (45)	0.41
EGA (wks)	19 (18-21)	21 (19-21)	19 (17-21)	0.03
Neonatal wt (g)	182 (113-330)	237 (172-330)	152 (110-285)	0.23
Induction duration (h:m)	7:44 (4:45-10:53)	6:02 (5:00-11:06)	8:00 (4:34-10:24)	0.48
Pain Scores				
Peak pain (pre)	8 (5-8)	6 (3-8)	7 (5-8)	0.84
Nadir pain (post)	3 (0-6)	0 (0-0)	5 (2-7)	<0.0001
Change pain score	2 (0-5)	6 (3-8)	2 (-1-3)	0.0015
% Change pain score		100 (100-100)	31 (3-60)	<0.0001

Data expressed as median (IQR) or n (%)

Abstract #: ES1-04

Racial disparities in regional neuraxial anesthesia placement in laboring patients

Presenting Author: Michael Holbert, MD

Presenting Author's Institution: TriHealth

Co-Authors: Megan Thomas, MD - TriHealth

Introduction: Racial and ethnic disparities have been described in the use of regional neuraxial anesthesia for laboring women, with under-represented groups exhibiting lower rates of regional neuraxial anesthesia during labor along with higher rates of general anesthesia during cesarean delivery. The goal of this study was to evaluate self-reported race and ethnicity and correlations with labor characteristics related to the intrapartum placement of regional neuraxial anesthesia.

Materials and Methods: This is an IRB approved retrospective study of deliveries at a tertiary healthcare system over four years from January 1, 2016 to December 31, 2019. Participants were limited to term, singleton pregnancies resulting in a vaginal delivery that received regional neuraxial anesthesia. Self-reported race and ethnicity; including Caucasian, African-American, Hispanic and Asian, were examined to determine correlations with pain scores and cervical dilation immediate prior to placement. ANOVA and Tukey's multiple comparisons were utilized for statistical analysis. In addition, multiple regression models were developed that included parity, maternal obesity, induction status, time from admission to regional neuraxial anesthesia placement, along with pain score and cervical dilation at admission, to evaluate confounders.

Results: There were 15898 vaginal deliveries that received regional neuraxial anesthesia. When evaluating for self-reported maternal race and ethnicity, there were significant differences in the cervical dilation prior to placement, with significant intergroup differences between Caucasian and all other groups; African-Americans ($p < .0001$), Hispanics ($p < .0001$), and Asians ($p < .0001$). In addition, there were significant differences between African-Americans and Hispanics ($p = 0.02$). Further, there were significant differences in pain scores prior to placement, with significant intergroup differences between Caucasians and both African-Americans ($p = .007$) and Hispanics ($p < .0001$). Additionally, a difference was seen between African-Americans and both Hispanics ($p < .0001$) and Asians ($p = .001$).

Conclusion: This study further demonstrated racial and ethnic differences in the intrapartum use of regional neuraxial anesthesia. However, it is unclear the contribution of patient, caregiver, and systemic factors on this disparity. Additional research is needed to identify specific factors which play a role in the racial differences seen.

Abstract #: ES1-05

Can analgesia nociception index (ANI) identify patients at risk for maternal hypotension following combined spinal and epidural for labor analgesia? - a prospective pilot case study -

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Co-Authors: William Dan, B.S. - Department of anesthesiology, Columbia university college of physicians and surgeons

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Objective: Combined spinal and epidural (CSE) analgesia can induce sympathectomy that results in sudden maternal hypotension. Heart-rate variability (HRV) reflects autonomic nervous system function, and new analytical methods offer more refined information on cardiovascular dynamics than traditional linear analysis of HRV. In addition, the analgesia nociception index (ANI) represents a novel HRV analytical derivative that can be obtained in real time. No previous studies have used nonlinear analytical HRV to predict the risk of cardiovascular instability associated with standard neuraxial blockade for labor analgesia. This study investigated the changes in ANI to identify parturients in early labor at the greatest risk of developing cardiovascular instability (hypotension) following CSE analgesia.

Methods: The institutional review board approved this study (no. B18-182), which included 30 healthy, normotensive, matched American Society of Anesthesiologists physical status Class 1 or 2 parturients. All participants gave informed consent. Maternal baseline ANI were digitally recorded for 15 min before receiving standardized CSE analgesia (bupivacaine (2.0 mg) and fentanyl (10 mcg)). ANI monitoring continued for a minimum of 30 min after intrathecal administration of spinal medications. Patient characteristics included in the analysis were age, gestational age, height, weight, visual analog scale (VAS), cervical dilation at the time of the labor analgesia request. Automated blood pressure, heart rate, oxygen saturation, and fetal heart-rate tracings were recorded as standard of care. The primary endpoint was hypotension defined as a $\geq 15\%$ decrease in mean arterial pressure after CSE analgesia. For analyses participants were divided into two groups, those who became hypotension following CSE or not, and we compared area under curve (AUC) of ANI before CSE. Results were reported as means \pm SD and differences in mean values were analyzed by unpaired t-tests. P-values of < 0.05 were considered statistically significant.

Results: Table 1 shows the patient characteristics. The groups did not significantly differ in age, gestational age, height, weight, visual analog scale (VAS), cervical dilation at the time of the labor analgesia request (Table 1). Significant reductions in blood pressure occurred in 12/30 women (40 %) and the frequency of hypotension following CSE was greater in women with a low ANI than in those with a high index ($P < 0.01$, Figure 1).

Conclusions: ANI (HRV derivative) accurately predicts maternal hypotension following CSE for labor analgesia.

Table 1. Patient characteristics

	Hypotension (n=12)	Normotension (n=18)	p value
Age (year)	35.8 ± 3.68	34.2 ± 3.68	0.26
Gestational age (weeks)	38.4 ± 0.49	38.2 ± 0.69	0.3
Primipara	5 (41.7)	8 (44.4)	0.71
ASA-PS			
I	10 (83.3)	15 (83.3)	
II	2 (16.7)	3 (16.7)	
Height (cm)	160.5 ± 2.72	159.3 ± 4.17	0.38
Weight (kg)	65.8 ± 4.78	62.23 ± 7.02	0.14
pre VAS (mm)	58.5 ± 13.8	59.1 ± 15.0	0.91
cervix dilatation (cm)	4[3-5]	4[3-6]	0.64

Values are expressed as the mean ± standard deviation, n (%) or median [range].

Figure 1 AUC pre CSEA

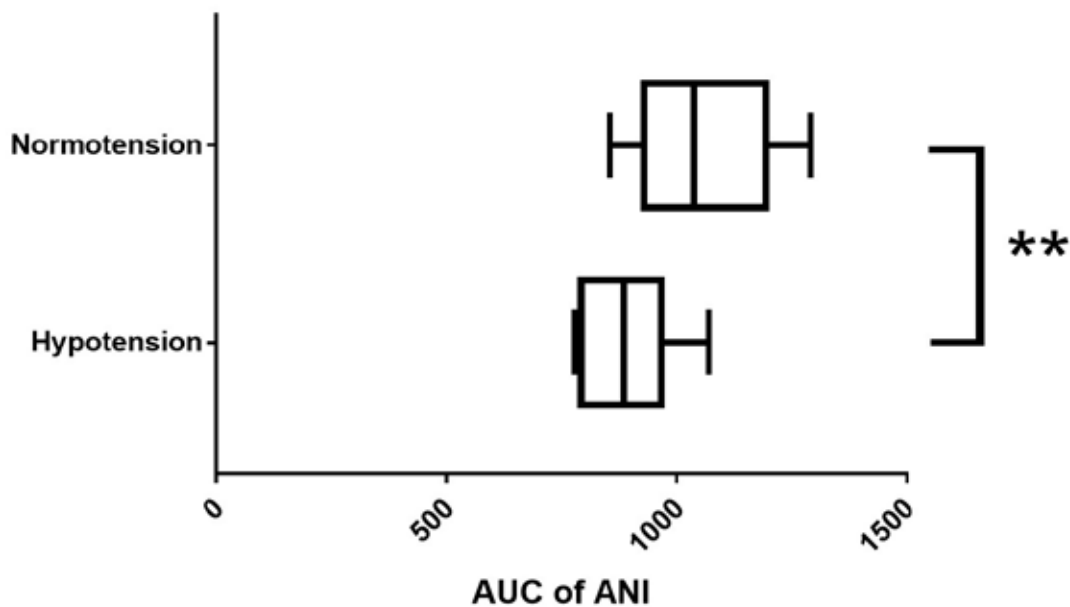


Figure.1 Baseline ANI (non-linear Heart rate variability analytics) can predict which parturients are at greatest risk for developing cardiovascular instability (hypotension) following combined spinal and epidural analgesia for labor.

Compiled results of area under curve (AUC) for non-linear HRV analytics (ANI: Analgesia Nociception Index) prior to combined spinal and epidural analgesia (CSEA). Hypotension as defined by a decrease in mean arterial pressure (MAP) after CSEA by 15% or more. The frequency of hypotension after CSE administration was greater in women with a low ANI than in those with a high index (**p<0.01).

Abstract #: ES1-06

Evaluation of the Obstetric Quality-of-Recovery score (ObsQoR-11) following vaginal delivery of patients who received neuraxial anesthesia

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Presenting Author's Institution: Brigham and Women's Hospital - Boston, Massachusetts

Co-Authors: Michaela Farber

Kara G. Fields, MS - Brigham and Women's Hospital, Harvard Medical School

Mario I. Lumbreras-Marquez, MBBS, MMSc - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham and Women's Hospital

Introduction: Metrics to capture quality of recovery after vaginal delivery (VD) are not clearly defined, and tools that capture anesthesia-related patient factors are of clinical relevance for obstetric (OB) anesthesiologists. Recently, use of a modified OB Quality-of-Recovery score (ObsQoR-11), a validated tool for patients undergoing elective and emergent cesarean delivery [1,2] was reported for patients after spontaneous and assisted VD [3]. Additional evaluation of the ObsQoR specifically for patients who had neuraxial analgesia for their VD is warranted. Here we report use of the ObsQoR-11 for patients after VD who received labor epidural pain relief and OB anesthesia care.

Methods: ObsQoR-11 was administered to women who had VD with neuraxial analgesia from Nov 1, 2019 through Jan 16, 2020, Sun-Thurs, 7AM to 5PM. This design enabled survey collection to be standardized at 24±2 hours from time of VD. The original ObsQoR-11 was utilized, including rating on 11 post-delivery metrics (0=most negative, 10=most positive) and a post-delivery global health score (NRS; 0=worst imaginable health state, 100=best imaginable health state) [1]. For ObsQoR-11 validation, correlation with the NRS and comparison of ObsQoR-11 scores to good vs. poor NRS (NRS ≥70 = good, NRS < 70 = poor) was performed. Reliability was tested for internal consistency with Cronbach's alpha, inter-item correlation tests, and split-half reliability. Demographic and clinical characteristics were tested for correlation to the ObsQoR-11. Correlations were calculated with the Spearman rank correlation coefficient (r).

Results: 108 patients were recruited. ObsQoR-11 scores at 24h correlated strongly with NRS (Table); The median ObsQoR-11 scores for women with good vs. poor NRS ratings was 99.5 [89-105] vs. 78 [73-86], respectively (p< 0.001). Internal consistency was strong at 0.81, and inter-item correlations were good for most items (R = 0.28). Split-half reliability with Spearman Brown adjustment was 0.86, suggesting near equal contribution from all items. Higher ObsQoR-11 scores correlated with higher postpartum hematocrit and spontaneous rather than assisted VD (Table); lower ObsQoR scores correlated with longer 2nd stage of labor, emergent delivery, lacerations or episiotomy, and inadvertent dural puncture (Table).

Discussion: The ObsQoR-11 is a valid tool for OB anesthesiologists to assess recovery after VD with neuraxial analgesia. The ObsQoR-11 demonstrated adequate convergent validity, discriminant and content validity, and reliability for this population. ObsQoR in patients after VD with neuraxial analgesia correlates with relevant clinical outcomes. Further utilization of the ObsQoR-11 score to evaluate impact of clinical interventions are warranted.

References:

1. Ciechanowicz S et al. Br J Anaesth 2019; 122(1): 69-78
2. Ciechanowicz S et al. Int J Obstet Anesth 2019; 39: 51-9
3. Nishimura et al. 2019. Poster presentation F3B-94, SOAP

Table

ObsQoR-11	Correlation to global health NRS score Spearman r (95% CI)	P-value
Total average score	0.72 (0.617, 0.801)	<0.001
Clinical characteristic	Correlation to ObsQoR-11 score Spearman r (95% CI)	P-value
LOS	0.03 (-0.160, 0.216)	0.761
Parity	0.14 (-0.049, 0.320)	0.145
Gestational age, weeks	-0.04 (-0.225, 0.150)	0.689
Gestation type (single vs. multiple)	-0.17 (-0.349, 0.017)	0.074
Age	-0.15 (-0.327, 0.041)	0.125
Body mass index	0.13 (-0.061, 0.309)	0.184
Previous cesarean delivery	-0.13 (-0.307, 0.064)	0.192
Duration of second stage of labor	-0.34 (-0.495, -0.158)	<0.001
Blood loss (mL)	-0.21 (-0.382, -0.019)	0.031
Predelivery hematocrit, %	0.07 (-0.122, 0.253)	0.484
Postdelivery hematocrit, %	0.42 (0.060, 0.688)	0.025
Mode of anesthesia	0.01 (-0.181, 0.195)	0.943
Delivery type (SVD vs. assisted)	0.28 (0.101, 0.447)	0.003
Induction of labor	0.12 (-0.073, 0.298)	0.227
Augmentation	-0.13 (-0.311, 0.059)	0.175
Urgent situation during delivery	-0.29 (-0.449, -0.103)	0.003
Perineal laceration or episiotomy	-0.25 (-0.420, -0.067)	0.008
Epidural replacement	-0.13 (-0.312, 0.058)	0.174
Epidural top-ups	-0.04 (-0.223, 0.153)	0.708
Inadvertent dural punctures	-0.24 (-0.409, -0.054)	0.012
Intrathecal catheter	-0.07 (-0.257, 0.117)	0.452
Hypotension	-0.12 (-0.300, 0.071)	0.221
Vasopressor use	-0.15 (-0.329, 0.039)	0.119

Abstract #: ES1-07

Standardization of Epidural Top-ups for Breakthrough Labor Pain Results in Faster Replacements

Presenting Author: Binh Tran, M.D.

Presenting Author's Institution: Vanderbilt University Medical Center - Nashville, Tennessee

Co-Authors: Jeanette Bauchat, MD - Vanderbilt University Medical Center

Holly Ende, MD - Vanderbilt University Medical Center

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Mallika Thampy, M.D. - USAP

Introduction: Neuraxial techniques are the most effective form of pain control in labor, but breakthrough pain requiring provider administered medication (top-up) is needed 6-25% of the time.¹ Frequent or ineffective top-ups may be a sign of a non-functional epidural catheter and if not recognized, delays in replacement may necessitate general anesthesia (GA) for cesarean delivery (CD)² or result in low patient satisfaction.³ There are no standard guidelines for breakthrough pain management with epidural analgesia.⁴ We conducted a quality initiative to standardize top-ups utilizing a newly created algorithm and evaluated its effects on timing of replacement of non-functional epidural catheters.

Methods: All charts of women receiving more than one neuraxial procedure in labor were reviewed for 6 months pre-algorithm (PRE) November 2017 – April 2018 and during the same time period post-algorithm (POST) November 2018 – April 2019. Epidural block failures within 30 minutes of initiation were excluded. The primary outcome was median time to epidural catheter replacement, defined as time from first top-up to time to neuraxial replacement or induction of general anesthesia. Top-up was defined as any analgesic medication given through the epidural catheter ≥ 1 hour after the initiation of epidural analgesia. Secondary outcomes included rates of epidural replacements occurring < 60 min and < 30 min from first top-up.

Results: Total neuraxial replacement rates were PRE 74/1289 (5.74%) and POST 76/1327 (5.73%). Median time to replacement and rates of epidural replacement occurring within 60min of first top-up were not different between groups; however, rates of epidural replacements occurring within 30min of first top-up increased in the POST period (Table). Rates of GA due to neuraxial catheter failure were not different PRE and POST (24% vs. 18%, difference -6%, 95% CI -17 to 29, P=0.56).

Conclusions: Implementation of a top-up algorithm for management of breakthrough pain during labor did not increase replacement rates or reduce median time to replacement; however, a greater number of catheters were replaced within 30min of patient request for top-up. Standardization of practice may allow providers to respond decisively to patient reports of pain and recognize suboptimal response to epidural medication administration in order to shorten the amount of time that patients experience inadequate pain control.

References:

1. Hon Sen Tana et al. *Curr Opin Anesthesiol* 2019;32:307–14
2. Mcquaid et al. *Clin Obstet Gynaecol* 2018;61(2):372-86
3. Yurashevich M et al. *Anaesthesia* 2019;74(9):1112-20.
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Abstract #: ES1-07
Table: Outcomes Pre and Post Top-up Algorithm Implementation

	PRE (n=68)	POST (n=72)	<i>P</i>
Time to epidural replacement (min)	120 [53,400]	130 [45,262]	0.64
Rates of epidural replacement <60min	19 (0.28)	21 (0.29)	0.86
Rates of epidural replacement <30min	2 (0.03)	11 (0.15)	0.01
Patient Satisfaction (0 to 10)	10 [8,10]	10 [8,10]	0.93

Abbreviations: BMI=body mass index, CD=cesarean delivery

Data presented as median[IQR] or n(%)

Abstract #: ES1-08

A randomized controlled comparison of epidural analgesia onset time and adverse reactions during labor with different dose combinations of bupivacaine and sufentanil

Presenting Author: Tingting Wang

Presenting Author's Institution: Obstetrics & Gynecology Hospital, Fudan University

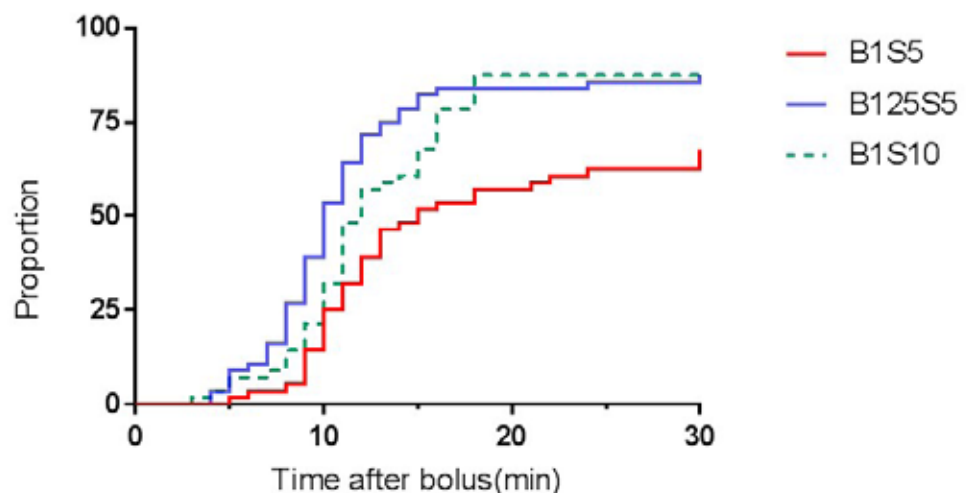
Co-Authors: shaoqiang Huang - Obstetrics & Gynecology Hospital, Fudan University

BACKGROUND: Local anaesthetics with opioid analgesics are common combinations of epidural analgesia during labour. In order to accelerate the analgesia onset time, anesthesiologist often increase the dosage of opioids or increase the concentration of the anesthetic, but the extent of the acceleration is uncertain and it may lead to a series of adverse reactions. In this randomized controlled study, we compared the effects of three commonly used combination doses on the onset time and adverse reactions.

METHODS: One hundred of sixty-eight pregnant women were randomly assigned to 3 groups: the B1S5group received 0.1% bupivacaine + 5 µg sufentanil in 15 ml; the B125S5 group received 0.125% bupivacaine + 5 µg sufentanil in 15 ml; and the B1S10 group received 0.1% bupivacaine + 10 µg sufentanil in 15 ml. The primary outcome was the analgesic onset time, defined as the time from the start of the injection to the time when the NPRS (numeric pain rating scale) score was reduced to at least half of the original score. The secondary outcomes were mode of delivery, patient satisfaction scores, maternal and neonatal side effects (pruritus, hypotension, sedation, motor block and decreased fetal heart rate, fever, breast feeding).

RESULTS: Median (IQR [range]) time to achieve effective analgesia in the B125S5 groups was significantly faster than those in the B1S5 group (10 (11-14 [4-30]) min vs. 15 (17-20 [5-30]) min, $p < 0.001$). No statistically significant difference in the analgesia onset time between B1S10 and B125S5 groups (10 (11-14 [4-30]) min vs. 12 (13-15 [3-30]) min, $p = 0.202$). Pruritus, hypotension, motor block, maternal satisfaction, delivery mode, decreased fetal heart rate, total bupivacaine dose and breastfeeding scores were not significantly different among the three groups. However, there were statistically significant differences among the three groups in degree of sedation, maternal fever, and total sufentanil dosage. Specifically, the number of mild sleepiness in group B1S10 was significantly higher than that in group B1S5 (22 vs 10, $p = 0.014$) and group B125S5 (22 vs 11, $p = 0.016$). The number of fever in B1S10 group was significantly higher than that in B1S5 group (12 vs 2, $p = 0.010$) and B125S5 group (12 vs 3, $p = 0.012$). The total amount of sufentanil administered was significantly higher in the B1S10 group than in the B125S5 group (30.0 ± 9.7 µg vs. 20.9 ± 10.4 µg, $p < 0.0001$)

CONCLUSIONS: As the initial dose of epidural analgesia, compared with bupivacaine 0.1% with 5 µg of sufentanil in 15 ml, the same volume of bupivacaine 0.125% with 5 µg of sufentanil can achieve faster analgesia within 30 min and less side effects (fever and sedation). Future studies should consider defining a more complete dose-response relationship for epidural analgesia and the association with side effects, particularly the effect of sufentanil on sedation and fever.



Abstract #: ES1-09

Determination of half effective dose and 90% effective dose of epidural hydromorphone for labor analgesia in the latent phase using modified Dixon's up-and-down sequential allocation method

Presenting Author: Shiqin Xu

Presenting Author's Institution: Women's Hospital of Nanjing Medical University

Co-Authors: Caijuan Li - Women's Hospital of Nanjing Medical University

Mao Mao - Women's Hospital of Nanjing Medical University

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Susu Zhang - Women's Hospital of Nanjing Medical University

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Background: Increasing evidence indicates that epidural analgesia in the early stages of labor does not increase cesarean delivery and extend the duration of labor. However, some obstetric care providers are always concerned that epidural use of local anesthetics in the latent phase of labor may affect contractions. Opioids alone may be an option for the early stages of pain control. We conducted this study to determine the half effective dose (ED_{50}) and 90% effective dose (ED_{90}) of epidural hydromorphone for labor analgesia in the latent phase.

Method: Twenty-eight term, singleton, nulliparous parturients aged 25-45 with BMI 19-29 kg/m² were enrolled. The cervical dilatation of all parturients was less than 3cm when they requested epidural analgesia. After an epidural catheter was placed, a 10 ml hydromorphone was then administered. The dose of hydromorphone was determined by the sequential method (Figure 1). The initial dose of hydromorphone was 0.4 mg, and the adjacent drug dose ratio was 1:1.2. If patients reported VAS \leq 3, the subsequent treatment was decreased, while the next dose was increased when patients reported VAS \geq 3. Parturients' demographical data and characteristics data such as VAS scores during contractions, and adverse reactions during labor were recorded.

Results: The ED_{50} and ED_{90} of hydromorphone was 0.237 mg (95% CI 0.206 ~ 0.271mg) and 0.479 mg (95% CI 0.320 ~ 0.717mg) respectively. Only one patient experienced pruritus during the observation time. No other complications were noted.

Discussion: The latest guidelines for labor analgesia indicates that maternal requests are a sufficient indication for pain relief. A study showed that opioids were safe and effective in neuraxial labor analgesia for term, singleton parturients, whose cervical dilation was less than 4 cm. And it did not increase the cesarean delivery rate and affect the labor duration. In this study, we confirmed the ED_{50} and ED_{90} of epidural hydromorphone for labor analgesia in the latent phase. Early epidural administration of hydromorphone may be an appropriate choice in the management of latent phase labor pain and improve maternal satisfaction. Further studies are required to explore this.

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Practice Guidelines for Obstetric Anesthesia, 2016

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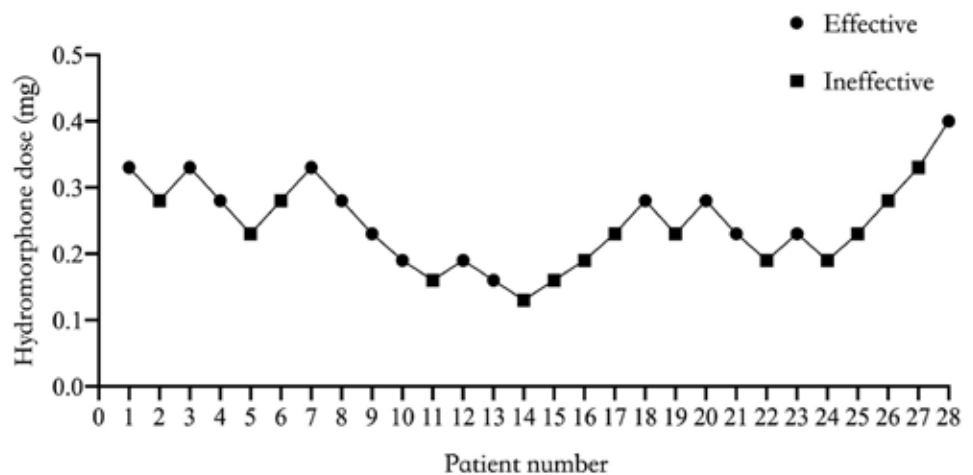


Figure 1 Hydromorphone dose sequential diagram

Abstract #: ES2-01**PIEB for labor analgesia during first stage of labor: A sequential allocation trial to determine the optimum interval between boluses of 2.5ml of bupivacaine 0.25% plus fentanyl 8 mcg/ml**

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Background: Despite increasing use of Programmed Intermittent Epidural Bolus (PIEB) for labor analgesia, the ideal regimen has yet to be determined. Two previous studies using the same dose of local anesthetic in different concentrations [10 mL of bupivacaine 0.0625% (1) or 5 mL of bupivacaine 0.125% (2)] have determined very similar outcomes, including ideal PIEB time intervals, sensory and motor block. In both studies, the upper sensory block level was unnecessarily high in many women, suggesting an opportunity for optimization of the technique. This study was designed to establish the PIEB time interval of 2.5 mL boluses of bupivacaine 0.25% with fentanyl 8 mcg/mL to produce effective analgesia in 90 percent of women (EI90) during first stage of labor without the use of top-ups (PCEA or manual).

Methods: This study was approved by our institutional REB and written informed consent was obtained from all participants. We conducted a double-blind sequential allocation trial using a biased coin up-and-down design to determine the EI90. Inclusion criteria: ASA II or III nulliparous women; gestational age \geq 37 weeks; singleton fetus; first stage of labor; regular contractions; cervical dilatation 2-5cm; VNRS for pain at epidural request $>$ 5 (VNRS 0-10). All women received a loading dose of 15 mL of bupivacaine 0.125% with fentanyl 50 mcg. The first PIEB for each patient was delivered 1 hour after the loading dose. The subsequent PIEB boluses of 2.5ml of 0.25% bupivacaine plus fentanyl 8 mcg/ml were delivered at varying intervals - 60, 50, 40, and 30 minutes – according to the up-and-down sequential allocation design. The interval for the first patient was 60 minutes. The primary outcome was the adequate response of the patient to the PIEB regimen, defined as no request for supplemental analgesia (PCEA or clinician administered bolus) until completion of first stage of labor or until 6 hours following initiation of PIEB, whichever occurred first. Secondary outcomes were the upper sensory block level to ice, motor block (Bromage 0-3), and hypotension.

Results: Twenty women were included in the data analysis. We used the Isotonic regression with extrapolation approach to estimate the EI90. The estimated EI90 was 20 minutes. We combined women in two groups, those assigned to 30 minutes (16 women) and those assigned to $>$ 30 minutes (4 women), to look at the secondary outcomes. Women in the 30-min group showed a trend of a higher upper sensory block to ice (up to T5). Three women in the 30-min group developed motor block Bromage 1. One woman in the 30-min group developed hypotension.

Conclusion: The estimated EI90 for 2.5 mL of bupivacaine 0.25% with fentanyl 8 mcg/mL is 20 minutes. These results indicate that there is no advantage in using this regimen as compared to those reported in the literature (1,2) using the same dose of bupivacaine in concentrations of 0.0625% and 0.125%.

References:

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Abstract #: ES2-02

Post-epidural Pain Documentation for Labor Analgesia Encounters: a Single Center Quality Improvement Initiative

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Introduction: Neuraxial analgesia is considered to be the “gold standard” to manage pain during labor and delivery. In our institution epidural is the most common technique used. Timely patient follow-up after catheter placement is imperative to ensure proper catheter function and patient comfort.

Methods: We retrospectively reviewed the electronic medical records of all labor epidural analgesia encounters at our institution from January 1 to March 31, 2019. Data extracted from each record included demographics and obstetrical information. Any documentation about post-epidural pain control entered by nurses, obstetricians, or anesthesiologists was reviewed. The documentation was then examined using categorical outcome tests and logistical regression analysis.

Results: A total of 1033 labor epidural analgesia encounters during the study period were identified. Of these, anesthesia providers documented information about post-epidural pain control in 13.8% of encounters. Nurses provided documentation of pain control in 88.3% of cases, and obstetricians in 76.9% of cases. Epidural catheters placed by attendings were more likely to include documentation from the anesthesia team regarding post-epidural pain control than catheters placed by residents or CRNAs under attending supervision (OR 1.71; CI: 1.1-2.6, $p=0.012$). In contrast, success or failure of epidural analgesia (i.e. unilateral block, non-working epidurals) were not more likely to include a note from the a member of the anesthesiology team ($p=0.30$; OR 0.71; CI: 0.38-1.41).

Conclusions: While our practice includes routine, prompt follow-up with patients after epidural catheter placement, a review of documentation at our center revealed that we do not routinely document this follow-up. This presents an opportunity for quality improvement, by helping to ensure that every patient receives follow-up, and that different anesthesia providers have an accurate record by which to judge analgesia efficacy.

Abstract #: ES2-03

Post-partum headaches treated with blockade of the pterygopalatine fossa

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Introduction: The pterygopalatine fossa contains nerve fibers providing sensory innervation to the dura and parasympathetic vasomotor fibers responsible for vasodilation of dural and brain parenchymal vessels. Blockade of these fibers can be effective in treating multiple headache (HA) types. We describe five cases where pterygopalatine ganglion (PPG) block was used to treat peripartum headaches presumed to be postdural puncture headache (PDPH) based on symptomatology. Percutaneous PPG block technique has been described previously [Boezaart et al].

Case 1: A parturient had spinal anesthetic with a 25g Whitacre needle for C-section. An epidural blood patch (EBP) was performed 5 days later without improvement. Four hours after EBP, bilateral PPG and greater occipital nerve (GON) blocks resulted in HA resolution.

Case 2: A parturient with migraine history had inadvertent dural puncture during labor epidural placement. An EBP performed 2 days after PDPH provided temporary relief. The patient underwent bilateral PPG, which was repeated with GON 2 days later. Pain scores improved from 8/10 to 4/10 after repeat PPG and GON blocks.

Case 3: A patient had inadvertent dural puncture with 18 gauge Tuohy. An EBP was performed 1 day after PDPH with partial improvement in pain scores (10/10 to 5/10). Due to a persisting HA, bilateral PPG were performed without improvement. A repeat EBP resolved her HA.

Case 4: A parturient scheduled for external cephalic version had inadvertent dural puncture with 18g Weiss needle during attempted combined spinal epidural. 3 days after onset of her HA, bilateral PPG were performed with resolution of HA. No EBP was performed.

Case 5: A parturient with a migraine history received an uneventful labor epidural. An EBP was performed 4 days later for presumed PDPH which resulted in temporary improvement in pain scores (8/10 to 4/10). Magnetic resonance venography was performed to further elucidate headache etiology and was negative. Bilateral PPG were performed 2 days later with complete resolution of symptoms.

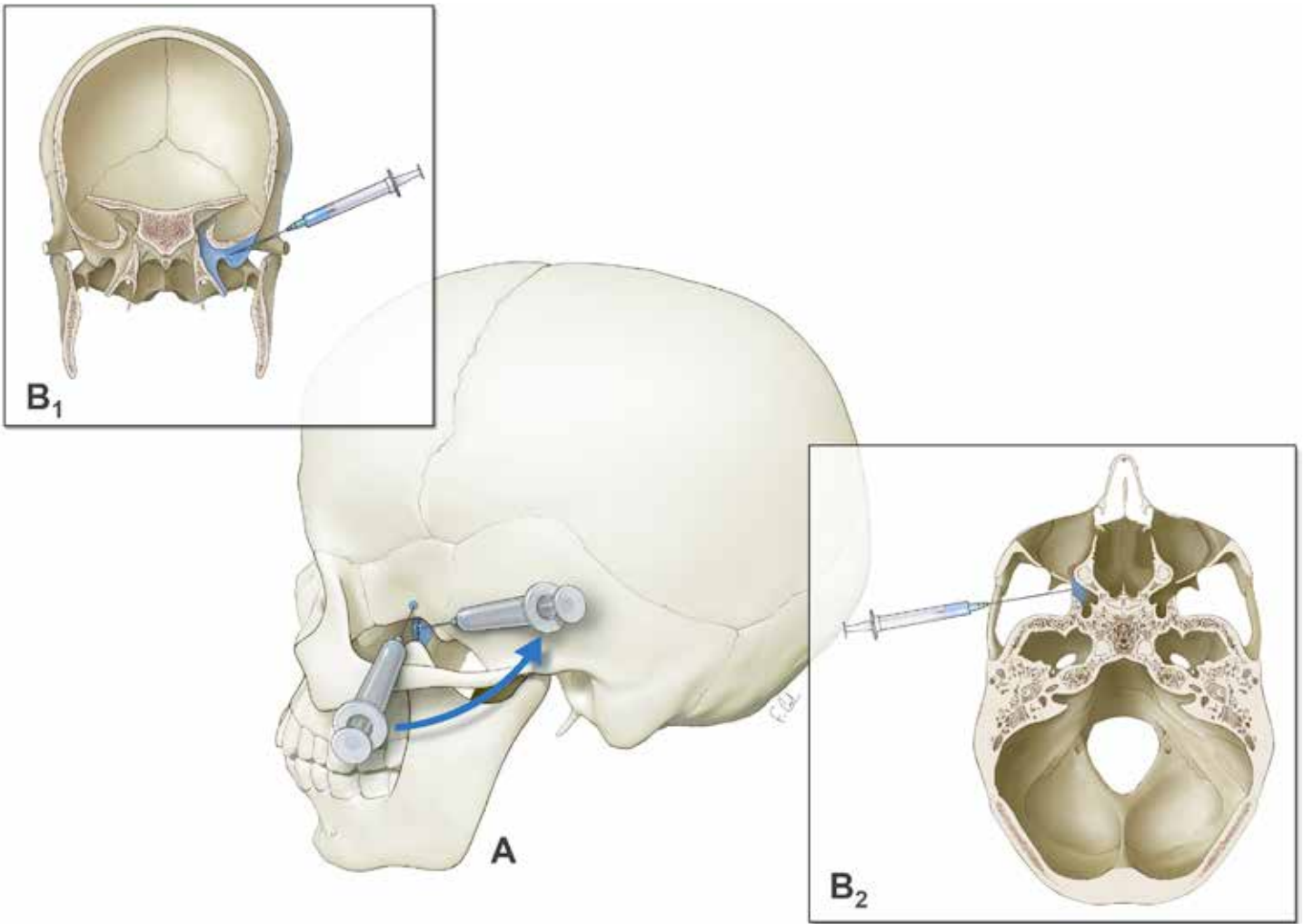
Discussion: Postpartum HA often have presentations that are far from clear. Numerous benign and morbid conditions manifest as postpartum HA. It is important to rule out morbid conditions, such as pre-eclampsia or intracranial processes, before entertaining benign conditions such as PDPH, migraines, and tension HA. PPG blocks may assist with both diagnosis and symptomatic relief of atypical presentations of postpartum HA.

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Russell R, Laxton C, Lucas DN, Niewiarowski J, Scrutton M, Stocks G. Treatment of obstetric post-dural puncture headache. Part 1: conservative and pharmacological management. *Int J Obstet Anesth.* 2019 May;38:93-103. doi: 10.1016/j.ijoa.2018.12.006. Epub 2018 Dec 21.

Boezaart AP, Smith CR, Reyneke JP. Pterygopalatine Ganglion Block: for effective treatment of Migraine, Cluster Headache, Postdural Puncture Headache & Postoperative Pain. Gainesville, FL: RAEducation.com LLC Publications; 2018.

Abstract #: ES2-03



Abstract #: ES2-04

Incidence of intracranial hypotension signs and cerebral venous thrombosis on brain MRI in women suffering from post-dural puncture headache - A retrospective observational evaluation

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Background: Post-dural puncture headache (PDPH) is a known complication of epidural labor analgesia. However, little is known about radiographic findings in these patients. Aim of this study was to evaluate imaging characteristics of women suffering from PDPH, as well as to analyze risk factors for cerebral venous and sinus thrombosis in these patients.

Patients and methods: In this single center analysis, between 2012 and 2017, all women presenting with the clinical signs of PDPH after having an epidural catheter for labor analgesia had received a cranial and, partially, a spinal Magnetic Resonance Imaging (MRI). Cranial MRIs (cMRI) were qualitatively evaluated regarding signs of cranial hypotension (e.g. subdural hygroma/ hematoma, sagging of the brain, uncal herniation, downward displacement of the tonsils, dural enhancement and distension of the dural sinus). If present, maximum extent of the subdural hygroma/hematoma was measured and the sagging index (anteriorposterior/ bipenduncular diameter of the mesencephalon) determined. Presence and localization of a sinus or cortical venous thrombosis as well as secondary signs of cerebral venous and sinus thrombosis were evaluated. Spinal MRIs (sMRI) were evaluated regarding presence and maximal extent of epidural fluid collections as well as presence of epidural venous distension. Clinical characteristics, coagulation parameters such as prothrombin time, activated partial thromboplastin time and platelet count, as well as hemoglobin and hematocrit were noted. Patient age, laboratory parameters as well as sagging index and extent of maximal hygroma and epidural fluid collections are given as median and interquartile ranges (IQR) for patients with/ without cerebral venous and sinus thrombosis, respectively. Fisher's exact tests or Wilcoxon rank-sum tests were used to determine group differences between patients with/ without cerebral venous and sinus thrombosis. Probability values $p < 0.05$ were considered statistically significant.

Results: Forty-four patients presenting with clinical signs of PDPH were included. All patients had received a cMRI, 34 patients also had a sMRI. Median age of the patients was 33 years (range 22-40 years). Cerebral venous and sinus thrombosis was present in 5 patients (11%). One or more imaging signs of cranial hypotension were found in 29 patients (66%). sMRI showed epidural fluid collections in 29 of 34 (85%) and venous distension in 24 of 34 (71%) patients. In patients with cerebral venous and sinus thrombosis, sagging of the brain was more often ($p=0.03$), extent of subdural hygroma was larger ($p=0.04$), and platelet count was higher ($p=0.01$) compared to those patients without (see table).

Conclusions: Patients with PDPH have an elevated risk to develop cerebral venous and sinus thrombosis. MRI signs such as sagging of the brain or large subdural hygroma, as well as high platelet count could pose a risk factor for developing cerebral venous and sinus thrombosis.

Abstract #: ES2-04
Table: Imaging characteristics and laboratory findings for all patients with PDPH

	All patients (n=44)	Patients with CVST (n=5)	Patients without CVST (n=39)	p-value
Age (median/IQR)	33/ 7.5	29/ 11.5	33/ 7	0.06
days EDA-MRI (n(av.)) median/ IQR	(43) 3/ 5	(5) 12/ 6	(38) 3/ 4.25	<0.001*
Laboratory parameters				
PT (%) (median/ IQR)	108/ 14.75	112/ 14.5	107/ 15	0.80
INR (median/ IQR)	1/ 0.1	0.9/ 0.15	1/ 0.1	0.88
aPTT.(s) (median/ IQR)	26/ 3	25/ 2	26/ 3	0.16
hemoglobin (g/dl) (median/ IQR)	12.25/ 1.35	12/ 1.75	12.3/ 1.2	0.38
hematocrit (%) (median/ IQR)	25.6/ 3.85	35.8/ 4.3	36.6/ 3.9	0.94
thrombocytes (td/ μ l)(median/ IQR)	225.5/ 42,25	295/ 121	215/ 93	0.01*
cranial MRI				
any sign of hypotension [#] (n/ %)	29/ 66%	4/ 80%	25/ 64%	0.64
hygroma (n/ %)	17/ 39%	4/ 80%	13/ 33%	0.06
max.hygroma in mm (median/IQR)	0/ 2	4/ 5	0/ 2	0.04*
sagging (n/ %)	8/ 18%	3/ 60%	5/ 13%	0.03*
sagging index (median/ IQR)	0.89/ 0.08	0.9/ 0.2	0.89/ 0.08	0.56
uncal herniation (n/ %)	6/ 14%	3/ 60%	3/ 8%	
tonsillar herniation (n/ %)	7/ 16%	2/ 40%	5/ 13%	
dural enhancement (n(av)/ n/ %)	(13) 7/ 54%	(2) 1/ 50%	(11) 6/ 55%	
spinal MRI				
lum. EFC (n(av)/n/ %)	(34) 29/ 85%	(4) 3/ 75%	(30) 26/ 87%	0.48
th. EFC (n(av)/n/ %)	(21) 16/ 76%	(2) 1/ 50%	(19) 15/ 79%	
cerv. EFC (n(av)/n/ %)	(17) 10/ 59%	(2) 0/ 0%	(15) 10/ 67%	
max. EFC in mm (median/ IQR)	(34) 5/ 5	(4) 1.5/ 5.25	(39) 5/ 5	0.21
distension of EV (n(av)/n/ %)	(34) 24/71%	(4) 1/ 25%	(30) 23/ 77%	
C1/C2-sign (n(av)/n/ %)	(17) 9/53%	(2) 0/0%	(15) 9/ 60%	

CVST: cerebral venous and sinus thrombosis, n: number, IQR: interquartile range, EDA: epidural analgesia, MRI: magnetic resonance imaging, av.: available, PT: prothrombin time, INR: international normalized ratio, PTT: activated partial thromboplastin time, s: seconds, g/dl: gram/deciliter, td/ μ l: thousands/ microliter, mm: millimeter, EFC=epidural fluid collection, lum.: lumbar, th.: thoracical, cerv.: cervical, EV=epidural veins.

[#] one or more of the signs mentioned below in the "cranial MRI"-section; * p<0.05

Abstract #: ES2-05

Combined Spinal Epidural versus Epidural Labor Analgesia for Postpartum Depression Symptoms (COPE Trial): Pilot Randomized Control Trial

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Introduction: Epidural labor analgesia (EDA) is suggested to mitigate risk for postpartum depression (PPD). However, the extent to which the choice to use analgesia, vs. analgesia itself, exerts this effect is unclear. Assessing a relative “dose-response” relationship between high- and low- pain relief and PPD symptoms, is achievable by comparing different labor analgesia techniques on the outcome, PPD symptoms. Accordingly, this pilot trial compared epidural labor analgesia by combined spinal epidural (CSE) vs. EDA for their impact on PPD symptoms 6 weeks postpartum.

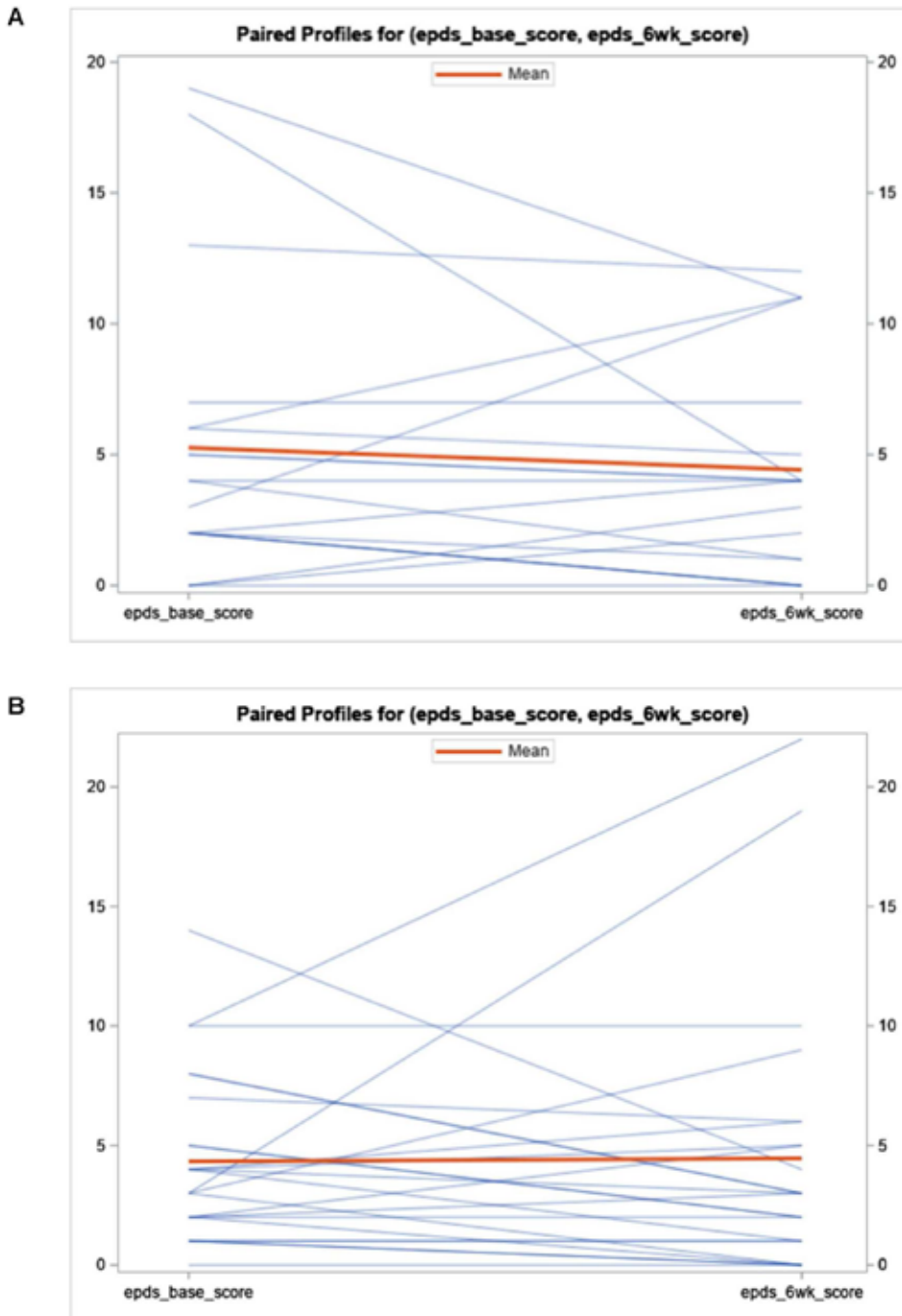
Methods: In a prospective randomized control design, primiparous women planning to use EDA were enrolled at term gestation. At baseline, they completed demographic and depression (Edinburgh Postnatal Depression Scale, EPDS) surveys. On hospitalization, women completed hourly assessments of labor pain intensity and labor pain unpleasantness, pain management satisfaction and expectations. Upon requesting EDA, they were randomized 1:1 to initiation by EDA or CSE. Subjects and nurses were blinded to group assignment. Obstetric variables were collected. EPDS was collected at 6 weeks postpartum. The primary outcome (6-week postpartum EPDS score) was compared between groups using the independent Student t-test. Changes in EPDS scores from baseline to 6 weeks postpartum were assessed within each group visually as well as with the paired Student t-test. Labor pain burden was calculated as area under the curve (AUC) for subjects completing all measures, using the trapezoid rule.

Results: Of 68 subjects, 25 received CSE; 30 had EDA. There was no group crossover. Demographic and obstetric traits were similar between groups. Labor pain relief was more effective in CSE than EDA groups (mean labor pain intensity burden (AUC), EDA 585.4 ± 537.2 vs. CSE 305 ± 271.3 , $P = 0.0498$); mean labor pain unpleasantness burden (AUC), EDA 638.4 ± 589.0 vs. CSE 316.6 ± 285.4 , $P = 0.039$). There was no significant difference in 6-week EPDS scores between groups (CSE 4.42 ± 4.11 v EDA 4.46 ± 5.66 , $P=0.98$). For CSE, an overall downward trend in change of EPDS score from baseline to 6 weeks was observed (EPDS baseline 5.08 ± 5.11 , 6-weeks 4.42 ± 4.11 , $P=0.43$) (**Figure A**). In contrast, for EDA, a mild uptrend was seen (EPDS baseline 4.33 ± 3.49 , 6 weeks 4.46 ± 5.66 , $P=0.91$) (**Figure B**). Pain management satisfaction and expectations were not different.

Conclusion: Although CSE was significantly more effective than EDA for lowering labor pain burden, no difference in 6-week depression scores were seen in this pilot trial. However, trends were observed for depression score improvements from baseline to 6-weeks with CSE. These data suggest there may be individual differences in benefit from enhanced labor analgesia strategies. A larger trial is needed to definitively answer questions about individualized labor analgesia, and the impact of acute labor pain and analgesia quality, on clinically relevant postpartum outcomes including PPD.

Abstract #: ES2-05

Figure. Changes in baseline EPDS score to six-week EPDS score per subject, by CSE and EDA groups. (A) In the CSE group, an overall trend (orange line) for improvement in six-week EPDS scores is seen. Two subjects demonstrated significant improvements in baseline to six-week EPDS scores over the study period. (B) In the EDA group, an overall trend (orange line) for six-week EPDS scores is overall unchanged or slightly worse. Two subjects demonstrated significant changes in baseline to six-week EPDS scores over the study period. These data suggest that there may exist some individuals who benefit more from enhanced labor analgesia by CSE, compared to the majority of other subjects.



Abstract #: ES2-06

A systematic review and network meta-analysis of spinal needles and PDPH rates and other common complications.

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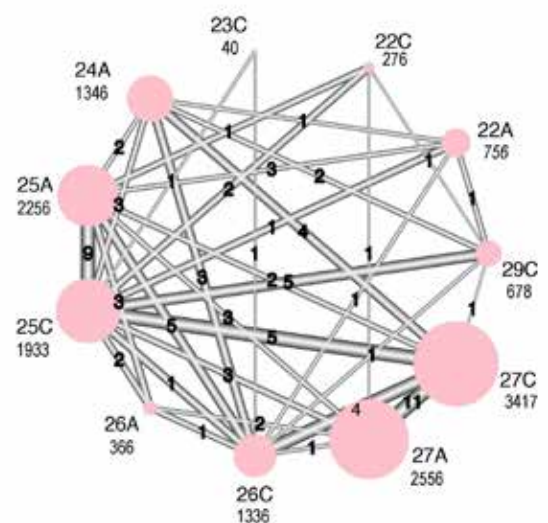
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Background: Post-dural puncture headache (PDPH) is one of the most undesirable complications of spinal anesthesia. Several meta-analyses show that a smaller spinal needle gauge and the use of atraumatic/non-cutting needles result in a lower incidence of PDPH. However, such studies dichotomize the spinal needles into either an arbitrary collection of "large" vs. "small" gauge needles irrespective of needle tip design, or as cutting vs. atraumatic needle tip design irrespective of needle gauge. To address this shortcoming, we utilized network meta-analysis (NMA) techniques to treat needles as individual entities. This approach allowed needles of different gauges to be treated as independent nodes such that needles of different tip design were not grouped together (i.e. data from 25 gauge cutting needles was not grouped with data from 25 gauge atraumatic needles, nor was it grouped with data from 26 gauge cutting needles).

Methods: Pubmed, Embase, and Cochrane databases were queried for studies that featured PDPH and spinal anesthesia. Randomized controlled trials were included in which the incidence of PDPH was compared between two or more groups of patients receiving a spinal anesthetic with different spinal needles. Secondary endpoints were non-PDPH headache, backache, and spinal failure. Articles were scored using the first five indices of the Cochrane "Risk of Bias" guidelines. Bayesian NMA was performed with R "gemtc" package and with a meta-regression for the covariate of obstetric vs non-obstetric patient population.

Results: Of 1723 distinct abstracts reviewed, 94 were selected for full manuscript review. Of these, 59 studies representing 14,961 subjects who received spinal anesthesia via one of 11 distinct needle types were included (Figure 1). NMA of the collective patient pool demonstrated a clear superiority of the smallest two atraumatic needles (26 and 27 gauge). All atraumatic needles were ranked better than all cutting needles with a lower incidence of PDPH, with the exception of the 29 gauge cutting needle which was ranked between the 27 gauge and 25 gauge atraumatic needles. Meta-regression for obstetric vs non-obstetric patients demonstrated small changes in rank likelihood, but no significant differences in the overall rank order. Additionally, the 26 gauge atraumatic needle outperformed the 27 gauge atraumatic needle, contrary to the dogma that smaller needles result in less PDPH. Our analysis shows fewer attempts with the 26 gauge needle, which suggests that the use of 26 gauge needle permits easier recognition of intrathecal access with presumably fewer unrecognized dural punctures and less PDPH.

Conclusions: Results from our NMA support the use of 26 gauge atraumatic needles to decrease the incidence of PDPH during spinal anesthesia. If an assortment of atraumatic spinal needle sizes are available, our results support the use of the smallest possible needle size.



Abstract #: ES2-07

Programmed Intermittent Epidural Bolus for Labor Analgesia: an RCT Comparing Bolus Delivery Speeds of 125 mL/h versus 250 mL/h

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Background: Programmed intermittent epidural bolus (PIEB) provides better analgesia for labor pain than continuous epidural infusion (1). The PIEB technique seems to be associated with high sensory block to ice in many women (2-4). While this finding is not associated with important side effects, it suggests that the technique could be optimized. Previous studies have shown that higher speeds of bolus delivery generate higher pressures in the epidural space (5), however one study failed to correlate bolus delivery speeds to quality of labor analgesia or complications (6). We hypothesized that a PIEB technique programmed to deliver boluses at 125 mL/h would produce lower sensory levels than at 250 mL/h.

Method: This was a double-blind RCT conducted with institutional REB approval and written informed consent of all participants. We recruited term nulliparous laboring ASA II-III women with singleton pregnancies during first stage of labor. Epidural catheter was inserted at L3/4 interspace as determined by ultrasound. All women received a loading dose of 15 mL of 0.125% bupivacaine with 50 mcg fentanyl and achieved VNRS ≤ 1 (0-10) for pain at 20 minutes. PIEB was used for maintenance with 0.0625% bupivacaine with fentanyl 2 mcg/mL with the following settings: PIEB bolus 10 mL Q 40 minutes; PCEA 5 mL; lockout 10 min; hourly max 30 mL. Manual top ups were administered if required. Women were randomized to receive the PIEB regimen at two different delivery speeds: Group 250 (G250): 250 mL/h; Group 125 (G125): 125 mL/h. In-charge nurses assessed pain scores, sensory block to ice and motor block (Bromage 0-3) hourly. The study was terminated six hours after epidural initiation or when women were fully dilated, whichever came first. Primary outcome was the upper sensory block to ice.

Results: Data from 81 women were analyzed. Patient demographics and outcomes are depicted in

Table 1. Highest sensory block level and incidence of women presenting at least one sensory block assessment $\geq T6$ were not different between groups. The incidence of women presenting sensory block $\geq T6$ in more than 25% of the assessments was significantly lower in the G125. Overall incidence of hypotension was significantly lower in G125. Quality of analgesia and local anesthetic consumption was similar in both groups.

Discussion: We could not demonstrate a significant difference in our primary outcome, which was the incidence of any sensory block $\geq T6$. However, Group 125 was associated with less episodes of sensory block $\geq T6$ and also with lower overall incidence of hypotension. These differences, although subtle, may be clinically relevant. Given that there is no difference in quality of analgesia, in keeping with a previous study (6), the use of a PIEB regimen with boluses delivered at 125 mL/h may be advantageous.

References:

1. Sci Rep 2019; 9: 2583; 2) A&A 2017; 124: 537-41; 3) Anaesthesia 2018; 73: 459-65; 4) CJA 2019; 66: 1075-81; 5) RAPM 1998; 23: 14-9; 6) Anesthesiology 2018; 128: 745-53

Abstract #: ES2-07
Table 1. Demographics, sensory and motor block levels, supplementary analgesia, local anesthetic consumption & hypotension

	250 mL/h N=39	125 mL/h N=42	p-value
Demographics			
Age (yrs), mean (SD)	33.4 (3.4)	33.3 (4.0)	
Height (cm), mean (SD)	165.9 (7.7)	165.6 (6.5)	
Weight (kg), mean (SD)	78.8 (17.7)	78.0 (11.4)	
BMI (kg/m ²), mean (SD)	28.6 (5.9)	28.4 (3.1)	
Gestational age (weeks), mean (SD)	39.4 (1.1)	39.4 (1.3)	
Outcomes			
Highest sensory block, median (IQR)	T5 (T7, T5)	T6 (T7, T5)	0.39
At least one sensory block assessment ≥ T6, n(%)	29 (74.4)	26 (61.9)	0.23
At least 25% of sensory block assessments ≥ T6, n(%)	24 (61.5)	12 (28.6)	0.003
Number of sensory block assessments ≥ T6, median (IQR)	4 (0, 8)	2 (0, 6)	0.03
Any motor block, n(%)	2 (5.1)	3 (7.1)	0.71
PCEA/top-up administered, n(%)	16 (41.0)	20 (47.6)	0.55
Number of PCEA boluses administered, median (IQR)	1.5 (1, 2.5)	2 (1, 4.5)	0.47
Hourly bupivacaine consumption (mg/h), median (IQR)	8.33 (8.33, 9.38)	8.85 (8.33, 10.0)	0.14
Overall incidence of hypotension, n(%)	15 (38.5)	5 (11.9)	0.006
Hypotension requiring treatment, n(%)	3 (7.7)	0 (0)	0.11

Notes: the reported p-values were based on the comparisons between two groups using Chi-square test for binary outcomes and Wilcoxon Rank Sum test for continuous/ordinary variables.

Abstract #: ES2-08

Inadvertent Dural Puncture: Racial/Ethnic- and Language-Related Disparities in Parturients

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Background: Obstetric racial and ethnic disparities afflict non-white women; causes range from provider characteristics to systemic inadequacies.^{1,2} While disparities in obstetric morbidity and mortality are well-documented¹, less is known regarding anesthetic complications. Some racial/ethnic groups have lower labor epidural analgesia use² and perhaps higher failure rates. We hypothesized that language barriers and non-white race would be linked to higher rates of inadvertent dural puncture (IDP) during labor epidural procedures.

Methods: With IRB approval, deliveries at MGH and BWH (April 1, 2016 - Dec 1, 2017) were identified using the Research Patient Data Registry. IDP cases were identified by ICD-9/ ICD-10 codes for postdural puncture headache and epidural blood patch (EBP), and from complication clusters confirmed by chart review. Data collected included age, race, language preference, body mass index (BMI), gravidity, parity, length of stay, and readmissions/revisits. A pilot study at MGH investigated preferred language ("English" vs "non-English") and race ("white" vs "non-white") and IDP incidence.³ This follow-up study of a much larger patient cohort across two institutions included a secondary analysis of revisits/readmissions with propensity score matching [2:1 on institution, age, race, language preference, mode of delivery, body mass index (BMI), and parity] and assessed EBP procedures by descriptive statistics. Primary results are presented as multivariable adjusted odds ratios with 95% confidence intervals, and p value < 0.05 as statistically significant.

Results: For 16,626 total deliveries, IDP was present in 145 cases (~1%). 53% of parturients were "white" and 92% reported "English" as primary preferred language. We performed a complete case analysis, using $N=8,760$ total cases with complete data for which the model was conducted. After controlling for age and BMI, there was a statistically significant increased odds of IDP in "non-white"/"non-English" parturients compared with white/"English" parturients [aOR = 2.55 (95% CI 1.25 to 4.92), $p = 0.007$].

In secondary analyses, 49.3% of cases of parturients with IDP had a revisit/readmission within 2 weeks of discharge compared to 26.9% of matched controls ($\chi^2 (1) = 10.1$, $p < .001$). 63% of "white" parturients versus 36% of "non-white" parturients underwent EBP.

Discussion: Across two institutions, odds of IDP were significantly increased for "non-white"/"non-English" (preferred language) parturients. Language barriers may interfere with intraprocedure coordination and procedures may be done during more advanced labor. IDP was also linked with more revisits/readmissions and fewer EBP, possibly impacting postpartum recovery. Future prospective study is needed to validate these findings in larger, more diverse settings.

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Abstract #: ES2-09

Optic Nerve Sheath Diameter in Patients with Intracranial Hypotension Before and After Epidural Blood Patch

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Background: Intracranial pressure is transmitted into the perineural subarachnoid space, resulting in a dilation or contraction of the optic nerve sheath. Ocular ultrasound can be used to non-invasively estimate intracranial pressure by measuring optic nerve sheath diameter (ONSD) (1). We hypothesized that ONSD would increase after epidural blood patch (EBP) in patients with post-dural puncture headache (PDPH) due to low cerebral spinal fluid (CSF) pressure.

Methods: IRB approval was obtained prior to enrolling patients. Healthy ASA II postpartum parturients who received neuraxial anesthesia for labor or cesarean delivery and developed PDPH based on clinical assessment were prospectively enrolled. Bilateral ONSD measurements were taken in the sitting and supine positions immediately before and one hour after completion of an epidural blood patch. ONSD measurements were compared using Wilcoxin Signed-rank test.

Results: At time of interim analysis, nine patients had completed the study. Data reported as median (IQR). During a symptomatic headache, ONSD was stable in the lying and sitting positions (lying: 0.49 cm (0.47-0.55 cm) vs. sitting: 0.50 cm (0.47-0.52 cm); $p=0.95$). After successful resolution of the headache, the ONSD remained unchanged from the pre-EBP value ($p=0.99$), and there was again no difference with position change (lying: 0.50 cm (0.47-0.52 cm) vs. sitting: 0.51 cm (0.47-0.52 cm); $p=0.87$).

Conclusions: In postpartum patients with PDPH, the ONSD was unchanged moving from supine to sitting position, either before or after EBP. After EBP and headache resolution, the ONSD was unchanged compared to the pre-EBP values. Thus, resolution of the headache immediately after EBP may not be associated with an increase in CSF pressure. Alternatively, ultrasound measurement of ONSD may not be sensitive enough to detect a small, but clinically significant, change in pressure.

References:

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Abstract #: ES3-01

Use of Virtual Checklists for Improving Aseptic Technique During Neuraxial Anesthesia Simulation

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Introduction: Traditional training of neuraxial anesthesia focuses on technical mastery. While adherence to strict aseptic technique is important, it often remains poor even with experience.¹ Thus, we investigated a novel method of teaching sterile practice for lumbar epidurals through the use of a virtual checklist in wearable technology.

Methods: Following IRB approval, Anesthesiologists (PGY2-5, attending) volunteered to place lumbar epidurals on a simulation mannequin in two sessions. These epidural insertions were observed and scored for aseptic technique by 2 investigators using a task-specific, 15-item, 30-point checklist.² In the first session, participants placed a baseline epidural (T1), followed by an instructional video on proper sterile technique and second placement (T2). Then, participants used the Streye technology (Google Glass) to place a final epidural (T3) with a virtual checklist in their field of vision. Participants returned in 4-6 weeks to repeat the initial epidural insertion (T4) followed by Streye checklist usage (T5). Scores were analyzed via repeated measures ANOVA, P < 0.05. Analysis of baseline scores and performance improvement among individuals with different experience levels (< 30, 30-90, >90 epidurals performed) used ANOVA, P < 0.05.

Results: Anesthesiology residents, fellows and attendings were included (N=20), with 6, 5 and 9 having < 30, 30-90, and >90 prior neuraxial block experience, respectively. The primary outcome of improvement in sterile performance occurred between T1-T5, P < 0.00001 (Table). Use of a virtual checklist significantly improved performance, both after viewing the instructional video, T3 (4.75±2.5 P < 0.001) and after 4-6 weeks, T5 (3.71±1.4, P < 0.001). Performance decreased significantly after the 4-6 week gap (-3.45±1.4, P < 0.001) and perfect sterility scores occurred only with the use of a checklist. There were no significant differences in sterile technique scores at baseline or for improvements in scoring based on the degree of prior neuraxial experience.

Conclusion: Use of a virtual checklist via wearable technology significantly improves sterility performance in simulated epidural placements beyond standardized video based instruction and for all experience levels. While instructional videos help improve sterility scores at all experience levels, the use of a real-time checklist further improves sterility performance scores and is needed to achieve perfect scores. While an 'acceptable' sterility performance score has not yet been established, the standard of anesthesia practice assumes complete sterility. Thus, all levels of practitioners should utilize visual field checklists to improve the sterility of neuraxial administration.

References:

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Table Performance scores, range 0-30, P<.0001 Repeated Measures ANOVA

	T1	T2	T3	T4	T5
mean±std dev	21.6±2.8	24.9±2.5	29.6±0.6	26.1±1.5	29.8±0.5
Perfect score, %	0	0	60%	0	90%
≥90% (27), %	0	15	100	35	100
≥80% (24), %	30	75	100	95	100
≥70% (21), %	55	90	100	100	100

Abstract #: ES3-02

Comparison of ButterflyiQ and Sonosite for Neuraxial Ultrasound: A Cross-sectional, Randomized, Blinded Study

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Ultrasound technology is frequently used to obtain point-of-care information at the bedside. The images obtained are used to either guide procedure (i.e., central line placement, epidural needle guidance) or to make a diagnosis (i.e., abnormal placentation, presence of pneumothorax). Given its purpose, the ideal ultrasound machine should be portable, lightweight, and within an acceptable price range. Recently, the Butterfly iQ company created an ultrasound that is portable and less expensive than the more traditional ultrasound machine and as of October 2017 is FDA-approved. It allows the physician to obtain images for diagnostic and procedural guidance using a single probe. This cross-sectional, blinded, and randomized observational study aims to compare the images acquired by a handheld ultrasound machine (Butterfly iQ, BU) and our current mobile ultrasound system (Sonosite M-turbo US, SU). With IRB approval, a single interspace was identified by one sonographer with both the BU and the SU. The images are obtained and transferred to a computer, where they are cropped and masked to leave only gray-scale images without additional information, randomized in pairs using a PowerPoint slide. (Figure 1) Three other experienced sonographers rated 30 spine images. Evaluators looked for resolution, detail, and total image quality. Resolution is defined as the sharpness and crispness of the image and a lack of haziness/blurriness. Details defined as clarity of bone/tissue outlines and ease with which boundaries of structures are seen. Total image quality is defined as an overall assessment encompassing contrast of solid and fluid-filled structures (i.e., tissue vs. bone) and absence of noise. Each of these three qualities is rated using a ten-point Likert scale. A paired t-test is conducted between the images. There was a significant difference between the two devices when looking at the continuous Likert scale amongst resolution (BU=6.59±1.69, SU=5.97±2.04, p-value < 0.001), detail (BU=6.75±1.82, SU=5.98±1.93, p-value < 0.001), and total image quality (BU=6.72±1.67, SU=5.87±2.11, p-value < 0.001), with the evaluators favoring the BU. Statistical significance remained even when we divided the scale into three groups: poor, good, and excellent. The higher scoring seen in the BU can be due to the nature of the technology being easily digitalized. At the same time, the SU images had to be exported from the machine and then imported into the computer, which could have distorted the image quality. Nonetheless, we can say that the BU is at the very least comparable to the SU while enabling increased portability and real-time smartphone-based image review due to the integrated circuit design.

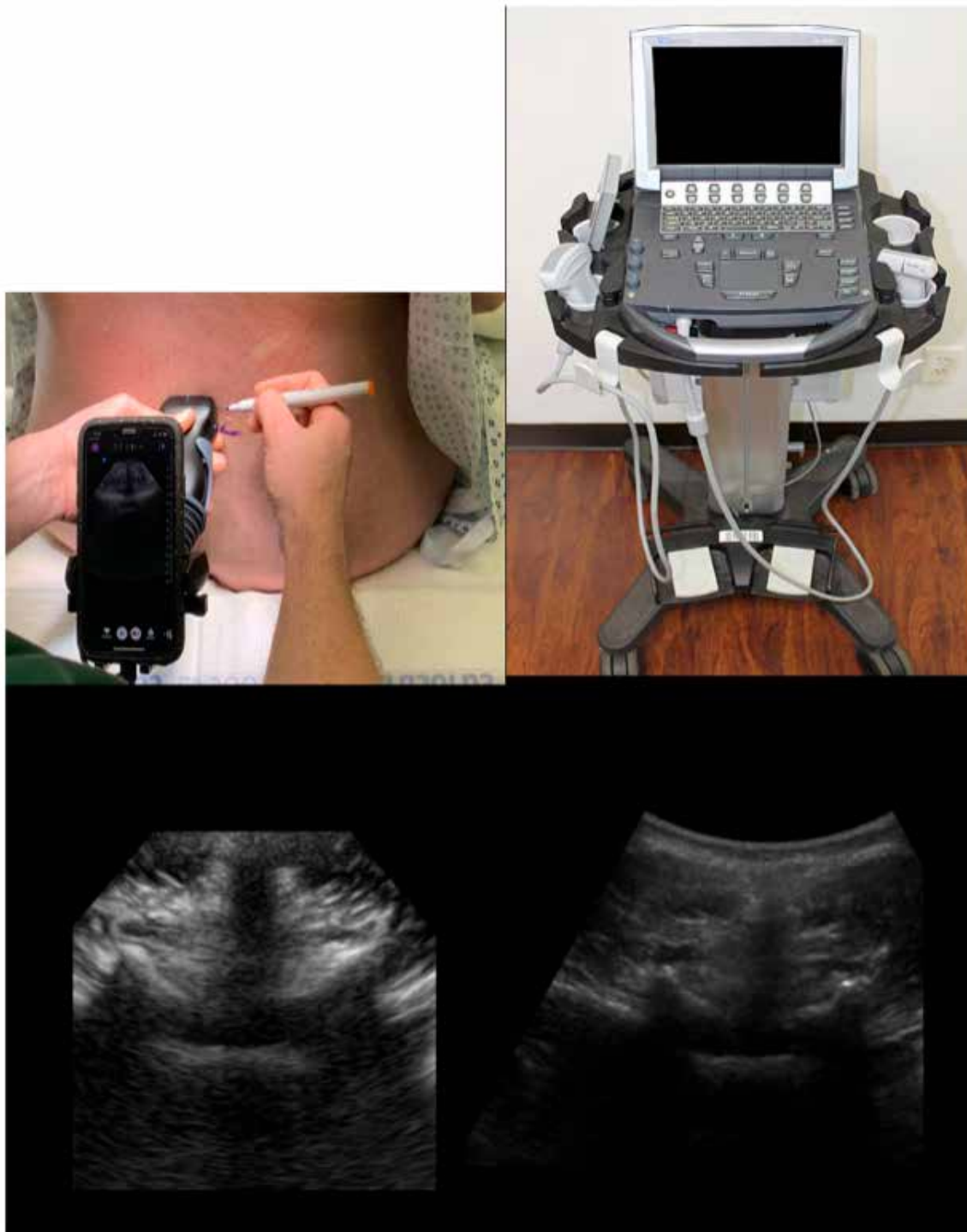
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Abstract #: ES3-02

Figure 1. Spine anatomy captured by Butterfly (L) and Sonosite (R).



Abstract #: ES3-03

Is Failure to Aspirate Spinal Fluid Before Injection Associated with Failed Spinal for Cesarean Section?

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Most descriptions of spinal technique in textbooks advise that after flow of CSF is observed, the syringe is attached to the needle hub, "*aspiration of CSF is then performed and....the local anesthetic solution is injected.*"¹ On occasion, despite free flow of CSF, aspiration is not possible. Failure to aspirate CSF during spinal anesthesia may indicate malposition or obstruction of the needle affecting the spread of the anesthetic and success of the block. Aspiration of CSF is not essential to the success of labor analgesia using the CSE technique.² For cesarean section (C/S) which requires a much higher level and denser block, the implications of inability to aspirate CSF are not known. This study aims to determine whether the inability to aspirate CSF predicts failure when performing spinal anesthesia for C/S.

Methods: Data was collected on patients in whom CSF could not be aspirated during spinal anesthesia for C/S. Spinals were performed in the sitting position using hyperbaric bupivacaine 0.75%, 12mg, morphine 0.15mg, fentanyl 10mcg. After free flow was observed through the 25g Pencan needle, aspiration of CSF was attempted. If aspiration was not possible, the syringe was detached and free flow again confirmed prior to injection. If there was no resumption of flow, the needle was rotated to reestablish flow. Once supine, the patient's block level was checked at 5 and 10 minutes. If the level was inadequate, the head-down position was used to help raise it. A level below T6 at 15 minutes or the need for conversion to general anesthesia prior to delivery is considered a block failure.

Results: Failure to aspirate CSF pre-injection was observed in 55 patients. In all patients, flow was reestablished when syringe was removed or following slight needle rotation. Fifty three patients (96.4%) developed an adequate block. One patient did not develop any block, while another developed a T10 level. In each, a second spinal was successful.

Discussion: Failure rate in the absence of aspiration was 3.6%. Reported spinal anesthesia failure rates in the literature range from 2.7-17%² with most studies at the low end of this range. The rate in our study was not significantly different from our own overall spinal failure rate of 2.2% (5/218 spinals). It is often assumed that inability to aspirate CSF indicates dislodgement of the spinal needle. However the ease with which flow was reestablished without needle advancement or withdrawal suggests obstruction of the side hole by either dura, a nerve root or trabeculae in the subarachnoid space, resulting from negative aspiration pressure.

Conclusion: When free CSF flow is obtained but aspiration of CSF fails, the clinician may nevertheless proceed with the anesthetic injection (provided there is still free flow) rather than attempting to reposition the needle. Aspiration is not an essential component of proper spinal technique for C/S.

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1. Cousins, Neural Blockade, 4th ed. p.229
2. Anesth;2009 111:165-72

Abstract #: ES3-04

Suspected anaphylactic reactions during obstetric anesthesia: analysis of three private maternities database

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Introduction: allergic / anaphylactic reactions (AR) in obstetrics are rare, but the similarity among clinical features of anaphylaxis, acute obstetric morbidities and complications of anesthesia can difficult the diagnosis of anaphylaxis in obstetric anesthesia.¹ The aim of this retrospective study was to verify in three private maternity hospitals, the incidence of AR in obstetric patients, the clinical signs/symptoms, possible triggers and management of the AR.

Methods: In this IRB-approved retrospective study, we analyzed the medical records of pregnant women undergoing cesarean section, with reactions described as “allergic or anaphylactic” from January 2015 to December 2019. Data including age, BMI, gestational age, parity, comorbidities, history of allergy, type of anesthesia, clinical features of AR, time between the use of the agent and the onset of AR, possible triggers and treatment of AR were collected. The suspected anaphylaxis was classified according the severity of the reactions (modified Ring and Messmer four-step grading scale²) into four groups: Grade I (skin or mucosal signs) to Grade IV (circulatory and/or respiratory arrest). Percentage, mean, standard deviation (SD), median and IQR were used to descriptive variables.

Results: During 2015-2019, there were 94 AR notifications in 125,931 cesarean sections. The mean and SD of age and MCI were 34.7 ± 6.5 y; 29.3 ± 2.2 kg.m⁻²; median and IQR of gestational age and parity were 38 [35-39] wks; 0 [0-2].

Comorbidities: 12.8% hypertension, 15% obesity, 10.6% women had a history of previous allergic reactions to foods and NSAID, and no patient had previous anaphylactic reaction. All patients underwent standard spinal anesthesia (0.5% bupivacaine, morphine and fentanyl). The suspected AR were: 68.0% Grade I (n = 64); 27.7% Grade II (n = 26) ; 4.3% Grade III (n = 4) and no patients Grade IV. The onset of AR was recorded in 74.5% of the medical records and 78.6% occurred within the first 5 min after the start of drug administration, 17.1% between 5 and 10 min and 4.3% after 20 minutes. The presumed anaphylactic triggers identified were: 70.3% cefazolin; 18.7% oxytocin/ketoprofen 11.0%; ketoprofen/dipyrone. Treatment: 85.1% corticoid; 89.7% diphenhydramine; 44.7% metaraminol; 14.9% epinephrine. Conclusions: the AR in obstetrics in the three maternity hospitals showed an incidence of 50.8:100,000 Grade I, 20.6:100,000 Grade II and 3.2:100,000 Grade III (severe reactions), which deserves attention from anesthesiologists.

References:

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Abstract #: ES3-05

Pre-procedural lumbar imaging of the handheld ultrasound technology versus traditional palpation location in neuraxial anesthesia for cesarean delivery in obese parturients

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Background: The application of ultrasound pre-procedural lumbar imaging has been advocated as a tool to more accurately localize the target intervertebral space in obese patients. However, the long learning curve and the difficulty in acquiring neuraxial ultrasonography skills may limit the widespread use of the traditional ultrasound. In recent years, the research and development of handheld ultrasound device has overcome the limitations of conventional ultrasound for pre-procedural ultrasound imaging [1]. Our study aims to evaluate the benefits of the handheld ultrasound device for performing combined spinal epidural anesthesia (CSEA) for cesarean delivery in obese parturients. **Methods:** Eighty parturients with a body mass index(BMI) >30kg/m² scheduled for elective cesarean delivery were randomly allocated to receive palpation method (palpation group, n=40) and ultrasound pre-procedural method (ultrasound group, n=40) for performing CSEA. All participants underwent CSEA in the sitting position. The primary outcome was the first insertion success rate. Secondary outcomes were the time taken to identify the needle puncture site, the procedure time, the total procedure time, the number of needle redirections, the number of skin punctures, changes in the intended interspace and the incidence of complications. In addition, we assessed the accuracy of the handheld ultrasound in estimating the epidural space depth compared to the needle depth during epidural insertion. **Results:** Compared to the palpation group, the first insertion success rate was significant higher in the ultrasound group (72.5% vs 40.0%; P=0.003), less time taken to identify the needle puncture site (30[26,36] vs 39[32,49]; P=0.001); the incidence of paresthesias during epidural catheterizations was also lower (7.5% vs 45%; P< .000). There were no significant differences in the procedure time, the total procedure time, the number of needle redirections and skin punctures, changes in the intended interspace, the incidence of blood in epidural catheter between the two groups. Both groups had no occurrence of back pain and headache. The correlation observed between the ultrasound depth and the needle depth to the epidural ($r = 0.9$) was good. The mean difference between the epidural depths measured by the handheld ultrasound and needle depth was -0.29 cm [95% limit of agreement -0.52 to -0.05]. **Conclusions:** Our study suggest that pre-procedural lumbar imaging of the handheld ultrasound technology can improve the first insertion success rate, take less time to identify the needle puncture site, decrease the incidence of paresthesias in obese parturients (BMI >30kg/m²) compared to palpation method.

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Abstract #: ES3-06

Intracardiac Thrombi Observed during Echocardiogram in Women with Amniotic Fluid Embolism: A Case Series and Literature Review

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Introduction: We present a case series and literature review [Table] of intracardiac thrombi observed on echocardiogram in women with amniotic fluid embolism (AFE).

Case 1: 41y G4P3 38.5wk with Jervell Lange Neilson syndrome was induced for low BioPhysical Profile. A fetal deceleration brought the team to bedside. The patient was cyanotic, apneic, and in pulseless electrical activity (PEA) arrest. ACLS was initiated, the infant delivered via forceps, and she had return of spontaneous circulation (ROSC). A transthoracic echocardiography (TTE) identified thrombus in the IVC and RA. She taken emergently to the OR, heparinized for cardiopulmonary bypass (CPB), and thrombectomy performed. When weaning from CPB failed, transesophageal echo (TEE) revealed clot reforming in the RA and migrating into the PA, resulting in RV failure. A repeat thrombectomy was performed. Again, weaning from CPB was difficult, and TEE showed new clots in the IVC, SVC, RA, RV, and LV. Resuscitation was discontinued. Autopsy confirmed AFE diagnosis.

Case 2: 39y G3P1 36 wk twin gestation with asymptomatic Behcet's disease presented for a repeat cesarean delivery (CD). After delivery of both babies, the patient had chest pain, hypoxia, and declined into PEA. ACLS was initiated and she obtained ROSC. TEE demonstrated severe RV dysfunction, bowing septum into the LV, severe tricuspid insufficiency, and thrombus in the LV. The thrombus changed in size and appearance over time. She required intermittent ACLS and was fully heparinized to start CPB; however, TEE no longer showed intracardiac thrombus, so VA ECMO was initiated instead. She required massive transfusion and abdominal hysterectomy for hemorrhage. Attempts to wean ECMO resulted in critical dilation of the RV. She ultimately succumbed to her disease.

Case 3: 34y G2P0 39.4wk with MVP was induced for polyhydramnios/macrosomia. A fetal deceleration brought the team to bedside, where she was noted to be unresponsive with seizure-like activity. She was transferred to the OR for emergent CD and quickly declined into PEA arrest soon after arrival. ACLS was initiated and TEE confirmed absence of cardiac motility. VA ECMO was initiated without requiring heparinization, as PTT was above measurable limits and fibrinogen was undetectable. ECMO flows were labile, and the circuit ultimately clotted. TEE revealed new thrombus in all four chambers of the heart. Resuscitation was discontinued. Autopsy confirmed AFE diagnosis.

Discussion: With increased use of TTE/TEE in unstable obstetric patients,^{1,2} intracardiac thrombi during AFE is being observed [Table]. Although DIC in the setting of AFE is attributed to massive hemorrhage, it may also be contributing to intracardiac thrombi seen during echocardiography, which may be pathognomonic for diagnosis and/or a primary cause of death.

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3. Literature Review in Table

Abstract #: ES3-06

Author	Delivery Course	TTE/TEE findings	Life-sustaining measures (ECMO/ACLS/etc.) Anticoagulation Status	Outcome
Raymond 2020 Case 1	41y G4P3 at 38w <ul style="list-style-type: none">PMH: pacemaker/AICD for Jervell-Lange-Neilsen syndrome (congenital long QT syndrome with sensorineural hearing loss)CV collapse during uterine tachysystolePost mortem forceps delivery	TTE after ROSC: thrombus in the inferior vena cava and right atrium TEE post-thrombectomy #1, on CPB: clot reforming in the right atrium, migrating into the pulmonary artery resulting in RV failure TEE post-thrombectomy #2, on CPB: clots visualized in the superior vena cava, inferior vena cava, right atrium and right ventricle interfering with function of the tricuspid valve. Extensive clot burden continued to develop and was visible in real-time as it began to form in the left heart as well.	<ul style="list-style-type: none">ACLS with initial ROSC after 9 min, then intermittent ACLS until CPB for thrombectomyDespite full heparinization for CPB, continued reformation of clot resulted in thrombectomy procedures x 2 and inability to wean off CPB	Death, decision made to not proceed with a third thrombectomy procedure for continued clot burden. CPB discontinued and she expired.
Raymond 2020 Case 2	39y G3P1 at 36w <ul style="list-style-type: none">PMH: asymptomatic Behcet's disease (vasculitis)Twin gestationSpinal for repeat CDCV collapse 3 min after twin B delivery	TEE after ROSC: severe right ventricular dysfunction with septal bowing to the left ventricle and severe tricuspid insufficiency, with a space occupying lesion in the left ventricle compatible with mass or thrombus. The characteristics of the thrombus changed in size and appearance over time TEE on ECMO: complete resolution of intracardiac thrombus	<ul style="list-style-type: none">ACLS with initial ROSC after 5 min, but intermittent ACLS requiredFull heparinization for ECMOTransfusion resuscitation for DIC, partial reversal of anticoagulation with protamine	Death at 12 hours
Raymond 2020 Case 3	34y G2P0 at 39w <ul style="list-style-type: none">PMH: mitral valve prolapseSeizure activity during uterine tachysystoleCV collapse upon arrival to OR for CD	TEE during ACLS: confirmation of PEA arrest TEE on ECMO: extensive clot burden in all four cardiac chambers	<ul style="list-style-type: none">ACLS until ECMOTransfusion resuscitation for DICAnticoagulation not required for ECMO, as PTT above measurable limits	Death, resuscitation discontinued after ECMO circuit clotted
Collett 2019 <i>Anaesth Intensive Care. 2019 Mar;47(2):193-196</i>	34y G5P2 at 29w <ul style="list-style-type: none">HealthyCD under spinal for transverse fetal lieCV collapse upon incision into membranes	TEE after ROSC: extensive echodense masses within the right heart and inferior vena cava. The masses in the right atrium and the right ventricle were large, highly mobile and heterogeneous, with a gelatinous appearance. TTE in ICU 12 hours later: complete resolution of intracardiac masses, normal biventricular function	<ul style="list-style-type: none">ECMO sheaths placed during ACLS, but obtained ROSC after 17 minTransfusion resuscitation for DICNo anticoagulants given	Survival with neurological deficits from CVA
Maack 2018 <i>Acta Anaesthesiol Scand. 2018 Jan;62(1):134-137</i>	40y G2P1 at 40w <ul style="list-style-type: none">HealthyCV collapse after spontaneous rupture of membranesPost mortem CD	TTE during ACLS: large, highly mutable masses with a threadlike appearance in the inferior vena cava projecting into the right atrium, through the tricuspid valve and into the right ventricle. The right ventricle was initially dilated and the interventricular septum was displaced towards the left ventricle. TEE after ROSC: Gradually, the masses disappeared and the right ventricle resumed normal size. Noted now was left ventricular dysfunction. TTE in ICU 1 day later: pulmonary hypertension, a reduced left ventricular ejection fraction of 0.35 due to apical hypokinesia and right ventricular failure	<ul style="list-style-type: none">ACLS with ROSC after 12 minutesTransfusion resuscitation for DICNo anticoagulants given	Survival, discharged 13 days later without sequela
Kumar 2010 <i>Am J Crit Care. 2010 Jul;19(4):379-82</i>	34y G3P1 at 41w <ul style="list-style-type: none">HealthyCV collapse after SROM at 9 cm dilationROSC obtained, proceeded to OR for emergent CD	TEE after ROSC: a large clot was observed in the right atrium as it passed through a patent foramen ovale (PFO) into the left atrium. Severe right heart dysfunction. TEE during cardiac surgery: clot in both the right and left atrium, as well as traversing the PFO.	<ul style="list-style-type: none">ACLS with ROSCTransfusion resuscitation for DICCPB for thrombectomy: evacuation of intracardiac clots, no thrombi noted in pulmonary arteriesAnticoagulation after resolution of DIC	Survival, discharged on POD 10 with no sequela
Saad 2006 <i>Eur J Echo. 2006 Aug;7(4):332-5</i>	35y G5P3 at 40w <ul style="list-style-type: none">HealthyTrial of labor after CDCV collapse after first pushPost mortem CD	TTE after ROSC: a mildly dilated and severely hypokinetic right ventricle. The left ventricle showed fair contractility. An elongated mass was seen in the right atrium projecting into the right ventricular inflow through the tricuspid valve. TEE minutes later: no masses could be visualized in the heart, the main pulmonary artery or its proximal branches. TTE in ICU 1 day after: persistently dilated, hypokinetic right ventricle. Estimated pulmonary artery pressure of 45 mmHg with no intracardiac masses.	<ul style="list-style-type: none">ACLS with ROSC after 25 minutesTransfusion resuscitation for DICHeparinization for treatment of presumed pulmonary embolism	Initial survival with severe end organ damage. Suffered another cardiac arrest on day 4, from which she did not survive
Porat 2004 <i>BJOG. 2004 May;111(5):506-10</i>	35y G5P7 at 37w <ul style="list-style-type: none">HealthyTwin gestationCD under spinal for breech twin ACV collapse after delivery of twin B	TTE after ROSC: normal right and left ventricular function, suspected right atrial mass TEE after ROSC: highly mobile, non-obstructive, echodense mass (2.5 cm) in the right ventricle outflow tract. Mild to moderate tricuspid regurgitation with a peak gradient of 25 mmHg was observed.	<ul style="list-style-type: none">ACLS with ROSC after 10 minutesTransfusion resuscitation for DICAnticoagulation therapy initiated prior to discharge	Survival, discharged day 8 without sequela

Abstract #: ES3-07

Teaching Interdisciplinary Communication for High Risk Obstetrical Teams: Qualitative Analysis Shows that Interactive Classroom and Simulation are Complementary

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Narendra Vakharia, MD FRCPC - Dalhousie University

Background and Objectives: Team communication errors contribute to poor outcomes in over 50% of sentinel cases in obstetric care. [1] Communication skill training as part of interprofessional development curricula requires careful consideration of instructional design. This study reports ethnographic descriptions of how instruction unfolds through two common teaching modalities with the same learning objectives, (1) *simulation* with group-debriefing and (2) *guided problem-based learning (GPBL)* presentation and group work. Simulation is an excellent modality for eliciting behaviours that lead to errors and modeling good communication, but how interactions evolve throughout a simulation may not predictably achieve predetermined objectives. Simulation delivery requires specialized equipment and operators. GPBL can integrate a range of key evidence-based features of good and poor communication into cases, but does not enable practice within the bounded rationality of timely complex decisions and communications in clinical care contexts. The two instructional modalities were designed and implemented to teach evidence-based recommendations for communication skills to an interprofessional group of anesthesiologists, obstetricians, and nurses involved in high risk obstetric care. This study describes how the approaches unfold with reflection on their relative instructional benefits and limitations.

Methods: Participants were assigned through stratified randomization to one of two instructional modalities. Each session was video recorded with recordings imported into MAXQDA software for coding. Task-analysis identified whether and how predetermined objectives were met and were coded for frequency of occurrence focusing on “sameness” between simulation and classroom in accordance with the study protocol (IREB approved). Conceptual analysis within an ethnographic framework captured the gestalt of each approach to professional development of communication skills, considering the relational nature of the participants, resources available, and social norms within the contexts.

Results and Conclusions: This is the first analysis of these instructional modalities in obstetric interdisciplinary settings. In simulation, the focus on medical management errors dominated the reflective post-simulation group discussion and participation in debriefing followed communication patterns, with dominating voices, established during simulation. Classroom sessions featured a focus group-like, in depth exploration of real-life experiences of participants as they reflected on errors of anonymous “others” and system-issues. Engagement in classroom discussion was balanced across participants. Authors will share the design of integrated modalities, leaning on the relative strengths of each modality for future instructional design.

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National Patient Safety Goals. 2005. www.jointcommission.org/PatientSafety/NationalPatientSafetyGoals/

Abstract #: ES3-08

The impact of change in head and neck position on cricothyroid membrane localization and height in third trimester pregnant women

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Introduction: Ultrasound (US) studies in the non-obstetric population have identified that changes in head and neck position significantly affect cricothyroid membrane (CTM) localization. These studies may impact recommendations on neck incisions when emergency surgical airway is required. In such situations the Difficult Airway Society (DAS) guidelines recommend an 8 -10 cm vertical neck incision. No data is available for pregnant women, who are at increased risk for difficult intubation. We hypothesized that in third trimester pregnant women, the extended neck position would displace the CTM midpoint compared to the neutral position (primary outcome) and increase the CTM height (secondary outcome). Using US data as a surrogate for incision lengths, we aimed to investigate the distance above the sternal notch over which a theoretical incision would cover the CTM.

Methods: 50 pregnant women at >28 weeks gestation were recruited. Women were placed supine with standardized hospital beds, pillows, and left uterine displacement. A single investigator collected data after receiving standardized airway US training. The CTM was identified with US using a 6.0-23 MHz linear probe. The height of the CTM was measured using a built-in caliper. The mid-point of the CTM was marked on the skin with a standard surgical marker. Women were assessed in a neutral head and neck position and then in the extended neck position. A surgical ruler was used to measure the distance between the two skin mid-point marks and the distance from the sternal notch to the respective skin.

Results: Population demographics are described in table 1. There was displacement of the CTM midpoint position in 43/50 women. Maximal cephalad displacement was 7mm (average 3.94mm; range 0.5 – 7mm) and caudad displacement 5mm (average 3mm; range 2-5mm). On average there was a statically significant, 18% increase in CTM height from the neutral to extended position (CTM height in extension; 9.4-15.5mm, $P < 0.01$). In the neck extended position, based on US findings, we demonstrated that an 8cm, 9cm and 10cm incision captures 74%, 96% and 100% of CTMs respectively (incision ranges 4.57-9.66cm).

Discussion: This is the first study to demonstrate CTM height, movement of its position, and US evidence to support DAS guidance on front of neck access incision lengths in third trimester women. We suggest that cricothyroidotomy be performed in the neck extended position given the increase in membrane height. Given that the midpoint of the cricothyroid membrane can move up to 7mm, we suggest marking the CTM in the position in which cricothyroidotomy plans to be done. When performing cricothyroidotomy, we suggest that practitioners may perform a larger incision (eg 10cm) from the sternal notch in order to increase capture of CTMs.

References:

Dixit et al, Anaesthesia 2019, 74, 29–32

Fennessy et al, British Journal of Anaesthesia, 122 (2): 263-268 (2019)

Frerk et al, British Journal of Anaesthesia, 115 (6): 827–48 (2015)

Table 1 – Population demographics of patients undergoing cricothyroid membrane ultrasonography

Age, mean(sd)(years)	32.9 (4.7)
Gestational age (sd) (weeks)	35.73 (3.57)
Weight, mean(sd) (Kg)	80.1 (16.9)
Hight, mean(sd) (cm)	163.8 (7.5)
BMI, mean(sd)	29.9 (6.3)
Neck circumference, mean(sd) (cm)	34.9 (3.6)
Gravida, median (IQR)	2 (1, 2)
Para, median (IQR)	0 (0, 1)

Abstract #: ES3-09

Audit of Preoperative Fasting Times in Elective Cesarean Deliveries

Presenting Author: Arthur Wong

Presenting Author's Institution: University of Ottawa

Co-Authors: George Dumitrascu - University of Ottawa

Wesley Edwards - University of Ottawa

Background: Patients undergoing scheduled elective Cesarean delivery are recommended to fast preoperatively to reduce the risk of pulmonary aspiration. Clear fluids are permitted until 2 hours before induction of anesthesia, as supported by the CAS, SOAP, ACOG and ASA. Benefits of shorter fasting periods are extrapolated from ERAS studies, including decreases in insulin resistance, dehydration and preoperative anxiety, as well as increases in patient satisfaction [1,2].

However, it is not uncommon that elective Cesarean deliveries are delayed for other emergencies. For context, our centre's obstetric department is divided between two campuses, with 2 and 3 dedicated labour and delivery ORs, respectively. These labour and delivery units are separate from the main ORs. The goal of this project was to identify system issues that may contribute to prolonged fasting times.

Methods: After IRB approval, a chart audit examined patients undergoing elective Cesarean delivery over a 3-month period at our tertiary-care hospital. We recorded scheduled surgery time, last intake of clear fluids, administration of GI prophylaxis, and time of initiation of anesthesia (neuraxial insertion or induction of general anesthesia). It was noted if additional clear fluids were given during delays.

Results: Of the 236 patients reviewed, the average fasting time for clear fluids was 6.7 hours. This remained elevated at 6.3 hours even when cases with 3+ hour delays were excluded. Juice was provided to 24% of cases delayed for other emergencies.

As per departmental protocol, patients were contacted the day before surgery and instructed to stop clear fluid intake 3.5 hours prior to their scheduled surgery. However, upon arrival to hospital, 68% of patients had already fasted longer than 3.5 hours.

Conclusions: Our average fasting time is above the recommended time. Our preoperative instructions provide a buffer in case an earlier scheduled surgery is cancelled, but the majority of patients are further prolonging their fasting time prior to arrival unnecessarily.

With the unpredictability of Obstetrics, it would be ideal to have two separate perioperative teams for both scheduled and emergency deliveries. However, our current resources cannot routinely facilitate this. With fewer dedicated ORs, this is also difficult since one room must remain ready for emergencies. Finally, in cases of prolonged delays, juice was inconsistently provided.

Overall, there are several factors affecting fasting times. By using a multidisciplinary approach, clarifying our preoperative instructions to patients and being more proactive with allowing supplemental clear fluids in delays, we may improve quality of care for elective Cesarean deliveries.

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Abstract #: ES4-01

Efficacy of an Obstetrical Triage System in Low and Middle Income Countries: An Implementation Study in Cape Coast Teaching Hospital, Ghana

Presenting Author: Lauren Adolph

Presenting Author's Institution: Dalhousie University

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Richard Pinkrah - University of Cape Coast

Heather Scott - Dalhousie University

David Walawah - University of Cape Coast

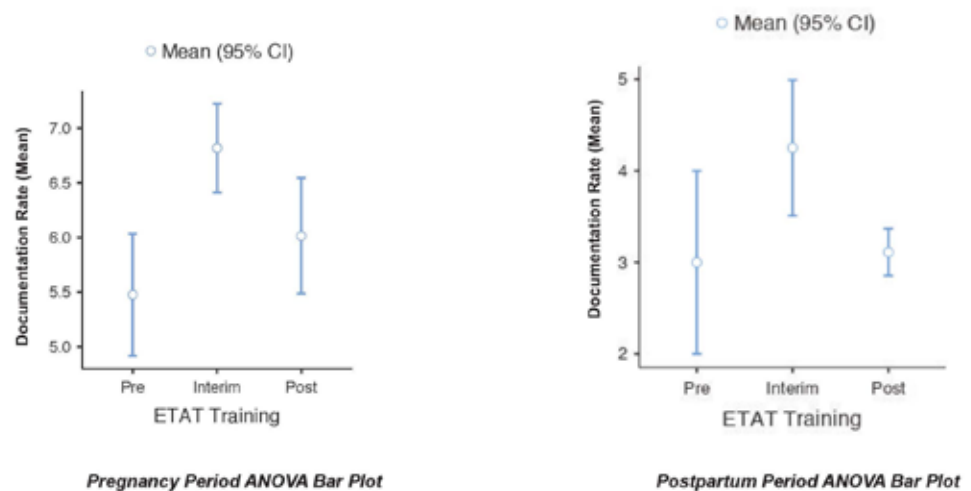
Objective: This study assesses the ability of a standardized obstetric emergency triage assessment and treatment (ETAT) system to improve documentation of triage assessment – a proxy measure for triage quality – in the obstetrical unit of Cape Coast Teaching Hospital (CCTH).

Methods: Institutional ethics approval was granted. We conducted a pre/interim/post study of women presenting to the obstetrical unit at CCTH. Data were collected via chart reviews of consecutive women presenting at three discrete intervals: Prior to ETAT training (PRE), after ETAT training (INT) and after ETAT re-training (PST). At each interval, documentation rates for ten key triage history elements were recorded: 1) reason-for-referral, 2) gravida/parity, 3) gestational age, 4) contractions, 5) cervical dilatation, 6) per-vaginal loss, 7) fetal heart rate, 8) fetal movements, 9) vital signs, and 10) care plan. The mean documentation rate of all history elements combined at each interval was compared using a one-way ANOVA. Documentation rates of each element at each interval were compared using a Chi-squared test. The analysis was stratified by pregnancy/postpartum status because some history elements were not applicable to the postpartum patient.

Results: Charts of pregnant (118 PRE, 121 INT, 133 PST) and postpartum (8 PRE, 8 INT, 8 PST) patients were included. In the pregnant group, the documentation rate of all elements increased over the two training periods ($\chi^2_{ps} < 0.05$). The mean number of elements documented increased between the PRE and INT periods ($p < 0.001$), decreased between the INT and PST periods ($p = 0.047$), but did not significantly differ between the PRE and PST period ($p = 0.349$). In the postpartum group, the rates of documentation of per-vaginal loss, vitals and care plan increased over the two training periods ($\chi^2 p < 0.05$), while this was inconclusive for the remaining elements.

Conclusion: These data support the efficacy of the ETAT triage training system implemented at CCTH, with the greatest improvement in documentation seen after its first implementation. Our results therefore suggests that there may be some benefit to more regular, and potentially earlier, retraining given the drop off in documentation rates between the INT and the PST periods.

Figure: One-Way ANOVA Comparison of Documentation Rate of All History Elements Combined by Training Interval



Abstract #: ES4-02**A promising future for artificial intelligence in obstetric anesthesiology: a survey of patients' perspectives.**

Presenting Author: William Armero, BA

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Introduction: Modern methods in computer science, such as artificial intelligence (AI), are expected to revolutionize healthcare, where successful clinical implementation will be dependent on mutual understanding between providers and patients. Recent work has studied the opinions of physicians on the general use of AI (1). Other reports have assessed primary care patient's openness to adopt mobile health tools (2). However, there is little known about patient's perspectives of AI use in inpatient and perioperative settings, where AI could have more direct applications. Obstetrics patients are a distinct population as they are often young, healthy, and highly engaged in their care. Here, we seek to investigate the perspectives of parturients on the use and implementation of new technologies within obstetrics and anesthesiology.

Methods: An IRB-approved, anonymous survey was administered on the labor and delivery suite at our tertiary care center to patients waiting comfortably for induction, labor, or cesarean delivery. Exclusion criteria included patients in major discomfort, preterm labor, patient refusal or other ethical considerations. The survey contained five hypothetical scenarios, one open-ended, eight multiple choice and seven demographic questions. Data were analyzed with chi-square, t-test, and cluster statistics using R v3.6.1 and SAS v9.4.

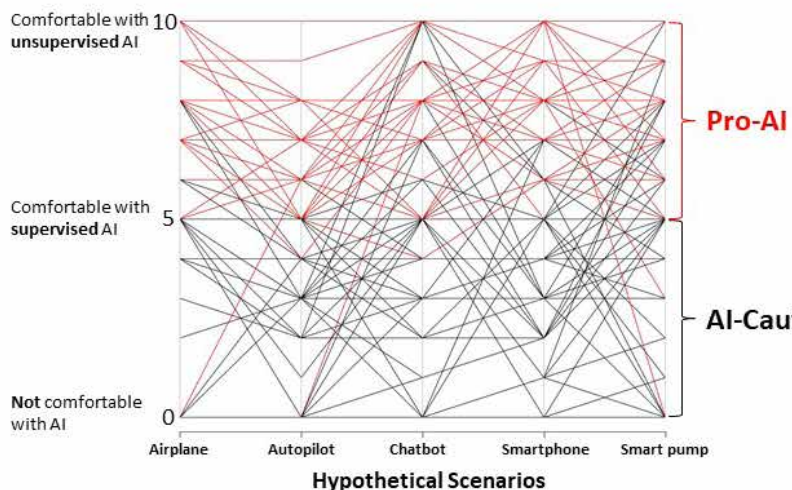
Results: Our preliminary data from 111 parturients showed a diverse range of racial, educational backgrounds, and age groups. All patients who met the inclusion criteria filled out the survey, of which only 4.5% missed one question. Overall, 68.5% of respondents believed that the benefits of AI in medicine outweigh the risks. Cluster analysis of the five hypothetical scenarios found two groups: patients that were more comfortable with unsupervised AI use (pro-AI) and patients who preferred supervision or no AI use (AI-cautious). Between both groups, there were no differences in anxiety, depression, general health, or demographics. Pro-AI patients had a stronger understanding of AI technology ($p=0.02$), were better educated ($p=0.03$), and reported using AI in their daily lives more often than AI-cautious respondents ($p=0.035$). Pro-AI patients also selected a broader range of potential benefits of technology while AI-cautious patients anticipated more risks.

Conclusion: These data support the continued need for the education of patients about technology and digital health, as patients who had a deeper understanding of AI were more supportive of its implementation. Additionally, patients with better awareness could anticipate more benefits, potentially improving communication with their physicians. Overall, these findings provide insight into the status of AI use in obstetric and perioperative care and will help develop strategies to implement new technologies.

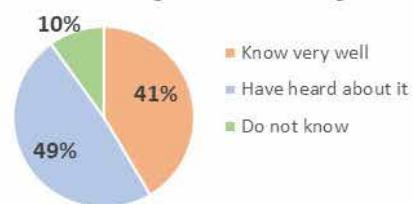
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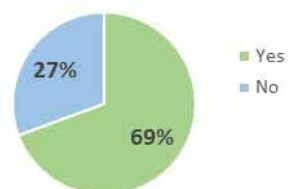
Abstract #: ES4-02



Patient Knowledge About AI Technologies



Patients believe that benefits of AI outweigh the risks



Abstract #: ES4-03

Use of Active Learning Strategies in Continuing Medical Education: a national survey

Presenting Author: Brenda A. Bucklin

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Background: The benefits of active learning (AL) are known but the predominate educational format in higher education is the lecture. The reasons for slow adaptation and use of AL in academic continuing medical education (CME) are not well understood. The purpose of this national survey of CME unit leaders was to determine knowledge, usage, attitudes, and barriers to AL strategies in academic CME.

Methods: A 20-item questionnaire was developed after a literature review of AL. Questionnaires were sent via email to ~350 Society of Academic Continuing Medical Education (SACME) members. Responses were collected with SurveyMonkey®. Data were analyzed using the IBM SPSS® software.

Results: One hundred forty-three SACME members from 91 CME units responded to the survey for an overall 41% response rate. Most respondents reported their self-perceived knowledge of AL as high. Advanced training was positively correlated with knowledge of AL (Spearman's Correlation = 0.23 at $p=.005$). More than 80% of respondents reported using AL methods in less than 50% of CME activities at their institutions, but higher levels of self-perceived knowledge were correlated with an increased percentage of CME activities using AL (Spearman's Correlation = 0.163 at $p=.042$). Most commonly perceived barriers to use of AL were lack of familiarity of faculty/presenters and increased preparation and planning that AL requires.

Discussion: The practice of medicine has changed dramatically during the last half century and medical knowledge has proliferated over the last several decades (1), but medical classroom teaching has not changed substantially and is still driven by the gold-standard lecture format.(2,3,4) CME leaders are well-trained to facilitate the use of AL in CME. Higher levels of self-perceived knowledge but not advanced training were associated with an increased percentage of AL-related activities. There is an opportunity for academic CME programs to use their unique position within medical education to influence physicians' practice by understanding the use and potential benefits of AL educational strategies in CME.

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Abstract #: ES4-04

Multidisciplinary Team Survey: Areas to Focus Efforts for Continuous Improvement During Postpartum Hemorrhage Events

Presenting Author: Robyn Dwan, DO

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Co-Authors: Jeanette Bauchat, MD - Vanderbilt University Medical Center

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Binh Tran, M.D. - Vanderbilt University Medical Center

Background: Simulation training has been shown to improve nontechnical aspects of teamwork within the healthcare field.¹ A multidisciplinary postpartum hemorrhage (PPH) simulation program was implemented to cultivate teamwork, develop communication and practical skills and identifying areas for systems improvement. We conducted a questionnaire to assess the impact of this training on labor and delivery team members.

Methods: A 15 question RedCap survey assessing providers' perceptions of safety culture and leadership during PPH responses using a five point Likert scale (strongly disagree, disagree, neutral, agree, strongly agree) was sent to participants via email. (Box 1) Questions regarding cognitive aid use were also included. An automated follow-up email was sent one week later.

Results: 386 qualifying individuals were sent a RedCap email survey and an overall response rate of 51.8% was achieved. Response rates for team members included: 39.5% obstetric team, 38.5% LD and postpartum nurses and 22% anesthesia team. Sixty-one percent of the respondents completed the PPH simulation training at the time of survey distribution. Of the respondents, 57.5% agreed or strongly agreed that an SBAR was used by the team to communicate during PPH. In addition, 90.5% of respondents agreed or strongly agreed that leadership on the team created an environment where things could be accomplished. Only 30.7% of respondents indicated that the PPH cognitive aid was used in the majority of the PPH within the past year, 29.1% were unsure if the cognitive aid was used and 5.5% did not know what a PPH cognitive aid was. The majority of respondents (67.8%) stated the cognitive aid is a helpful tool, but 10% responded that they do not know how to use it, who could use it, or felt uncomfortable to use or ask for it during a postpartum hemorrhage.

Conclusions: More than half of respondents had completed the PPH simulation training with the majority demonstrating a positive culture of safety, utilizing standard communication techniques and knowing the benefits of cognitive aid use. Continued emphasis on use of the cognitive aid during postpartum hemorrhage simulation training should increase the knowledge and use of the PPH cognitive aid. We anticipate continued improvement in collaboration, leadership, and communication in future surveys after the completion of multidisciplinary team training sessions.

References:

Grogan EL, Stiles RA, France DJ, et al. The impact of aviation-based teamwork training on the attitudes of health-care professionals. *J Am Coll Surg* 2004;199:843–848.

Abstract #: ES4-04

	Strongly Agree	Agree	Neutral	Somewhat Disagree	Strongly Disagree
People on the team have the information that they need to do their jobs well.	31.5%	58.5%	8%	2%	0%
The team encourages everyone to share ideas.	28.5%	51%	14.5%	5.5%	0.5%
Leadership on the team creates an environment where things can be accomplished.	50.5%	40%	7.5%	1.5%	0.5%
When people on the team experience a problem, they make a serious effort to figure out what is really going on.	28.5%	54.5%	13%	3.5%	0.5%
Everyone on the team feels able to act on the team vision.	16.6%	54.5%	22.5%	6.5%	0.5%
In the majority of postpartum hemorrhages you were involved with in the last year, SBAR (Situation, Background, Assessment, Recommendation) was used to communicate.	12%	45.5%	28.5%	11.5%	2.5%
The OB team communicates effectively with the patient and her family regarding the events of a postpartum hemorrhage.	12.5%	54.5%	22.5%	9.5%	1%

Abstract #: ES4-05

Leadership Styles and Success in Crisis Management

Presenting Author: Erin E. Haggerty, MD

Presenting Author's Institution: Massachusetts General Hospital - Boston, Massachusetts

Co-Authors: Erik M. Clinton, MD - Massachusetts General Hospital

Roxane Gardner, MD, DSc, MSHPEd - Brigham and Women's Hospital

Rebecca Minehart

Background: Critical events in obstetrics are rare and potentially devastating. Leadership is essential to team performance and patient safety¹, and most anesthesiologists lead implicitly². Leadership is theorized to range from authoritative (AL) to inclusive (IL)¹, with ambiguity about the most effective leadership style during a crisis. More complex or less algorithmic situations may benefit from creative and diverse ideas generated by inclusivity. With postpartum spontaneous coronary artery dissection (SCAD), the diagnosis can be missed³ due to contextual errors and cognitive biases hindering prompt diagnosis and treatment⁴. We aimed to determine whether leadership was implicit or explicit, and to characterize IL and AL behaviors demonstrated within interprofessional teams while treating a simulated patient with SCAD.

Methods: IRB approval was obtained. Between July 2018 and November 2019, 11 interprofessional teams consisting of anesthesiologists, OBs, family medicine physicians, MFMs, and CNMs participated in an 8-hour training course, and included a scenario involving a patient with epigastric discomfort and high blood pressure who eventually suffers from ST-elevation myocardial infarction secondary to SCAD. Two independent reviewers (EH, RDM) rated 11 videos leadership behaviors (Table 1) and other related observations. Leadership behaviors were scored on an ordinal scale with 0=Never (< 20% of team discussion), 1= Rarely (21-40%); 2=Sometimes (41-60%); 3=Mostly (61-80%); and 4=Very Frequently (>80%). Composite scores were generated by adding all scores for behaviors classified as IL or AL. Discrepancies were noted and resolved by consensus. Descriptive statistics were obtained using IBM SPSS version 26.

Results: 11 videos were analyzed, with direct agreement seen in 96% of data points, and consensus achieved in 100%. In 1/11 (9%) of cases, the patient suffered cardiac arrest from delayed management. Specific case data are presented in Table 2. Teams demonstrated a mean IL composite score of 6.55 (SD: 2.876) and a mean AL composite score of 4.36 (SD: 3.722). Descriptive statistics for specific leadership behaviors (IL and AL) are shown in Table 3.

Discussion: Few teams explicitly designated a leader, and most shared leadership, consistent with previous work². This may be confusing in challenging clinical situations when multiple providers arrive to lend their expertise and look to direct their communication to a specific person. Teams used IL behaviors more frequently. In the three teams that used AL predominantly, we noted team dysfunction in the form of increased tension and even outright conflict. Our sample size was small; future work should focus on conflict when teams use more AL behaviors and effects on patient outcomes.

References:

1. Minehart RD, et al. *BJA* 2020; doi: 10.1016/j.bja.2019.12.015
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Abstract #: ES4-05

Table 1. Inclusive and authoritative leadership behaviors. Adapted from Minehart RD, et al.³

Inclusive Leadership Behaviors	Authoritative Leadership Behaviors
Leader explicitly invites team members for their input	Leader does not invite input from others
Leader responds to contributions to encourage more sharing	Leader discourages contributions from team
Leader uses input to form plans	Leader relies on own opinions for plans
Leader motivates through encouragement	Leader motivates through threats

Table 3. Descriptive statistics regarding specific leadership behaviors seen in teams.

Leadership Behavior*	Minimum	Maximum	Mean	Std. Deviation
IL: Actively elicits information	0	4	1.82	1.471
IL: Thanks for contributing ideas	0	3	1.27	1.191
IL: Uses contributions in planning	1	4	3.09	1.136
IL: Motivates through encouragement	0	2	.36	.674
AL: Does not invite input	0	4	1.91	1.758
AL: Orders are based on leaders' own ideas alone	0	4	1.91	1.446
AL: Leader discourages contributions	0	3	.55	.934
AL: Motivates through threats	0	0	.00	.000

*As scored on a scale: 0=Never (<20% of team discussions), 1=rarely (21-40%), 2=sometimes (41-60%), 3=Mostly (61-80%), and 4=Very frequently (>80%)

Table 2. Case descriptions and characteristics.

Case No.	Team composition and responder role groups*	Leadership: Implicit, Explicit, or Both?	Inclusive Leadership Behaviors: Composite Score	Authoritative Leadership Behaviors: Composite Score	Additional observations
1	1: CNM 2: OB 3: MFM	Implicit	3	9	Unclear leadership throughout
2	1: MFM 2: Anes 3: Multiple providers (OBs, MFMs)	Implicit	8	7	Shared and inclusive leadership until STEM, then Anes directing care without inviting input
3	1: OB 2: Anes 3: MFM	Implicit	1	11	Competitive and conflicting leadership, high tension throughout case
4	1: OB 2: Anes 3: FamMed 4: Multiple Providers (FamMed)	Both	6	3	Implicit and shared until diagnosis, then explicitly designated, overall team dynamics were positive
5	1: FamMed 2: FamMed 3: Anes 4: OB	Both	9	1	Implicit until diagnosis, then explicitly designated (but then explicit leader was passive)
6	1: OB 2: Anes 3: MFM	Implicit	4	8	Implicit initially, then explicit leadership requested but not designated. Team did not appear cohesive
7	1: OB 2: Anes 3: OB	Implicit	6	2	Implicit and shared leadership between OBs throughout
8	1: CNM 2: OB 3: Anes 4: Multiple Providers (OBs, MFMs)	Both	9	3	Implicit and AL until pt arrested, then Anes explicitly leading ACLS and OB designated as leader (where more IL behaviors were demonstrated)
9	1: OB 2: Anes 3: MFM	Implicit	9	1	Implicit and shared leadership throughout, very inclusive leadership after STEM diagnosed
10	1: OB 2: Anes 3: OB	Implicit	10	0	Implicit and shared leadership throughout, very supportive team
11	1: FamMed 2: Anes 3: FamMed	Implicit	7	3	Implicit leadership by first responder throughout case, initial tension between first two team members was dispelled by third

*1: Student leader, 2: 3rd responder, 3: 2nd responder, 4: 4th responder

Abstract #: ES4-06

Satisfaction with Pain Relief During Labor and Delivery Following Access to New Educational Materials

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Background: Satisfaction with childbirth is a multidimensional issue(1). Prior studies have shown variance in overall satisfaction scores for labor and delivery regardless of analgesic approach, emphasizing the importance of shared decision-making and patient involvement(1-2). Shared decision-making is often facilitated through the use of educational materials, which are typically not designed for underserved populations(3). We hypothesized that women provided with educational materials which were tailored to a population with low literacy rates and English-proficiency would demonstrate a higher rate of satisfaction with their labor experience.

Methods: An educational website (thepainlesspush.com) was developed to provide parturients with information regarding pain relief options, risks, and benefits in English and Spanish at a 12th grade level with 6th grade level audio narrations(4). A prospective randomized study of 100 English or Spanish-speaking parturients admitted for planned progression to active labor was conducted. Patients received standard care, randomized with or without an hour of access to this website, followed by a post-delivery survey to assess satisfaction with multiple dimensions of the labor and delivery experience.

Results: Preliminary data analysis suggest a trend towards improved pain satisfaction when using the educational website, as P-values remain > 0.05 . Intervention group parturients were satisfied with their ability to decide the type of pain control ($P=0.09$), level of pain control ($P=0.09$), and noted adequate pain control ($P=0.09$). Additionally, patients receiving additional educational materials appeared to be more satisfied with the information provided ($P=0.08$) and thought that their choice of analgesia was safe for their baby ($P=0.10$).

Conclusions: Integrating patient education into the shared-decision making model has been shown to not only improve patient knowledge but improves their involvement in the shared-decision making process, leading to overall increases in patient satisfaction(3). By providing patient education tailored to underserved populations, we hope to see further increases in patient involvement and patient satisfaction.

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Abstract #: ES4-07

Futuristic Advanced Technology Based Communications in Labor and Delivery to Enhance Safety

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Prompt communication among various clinical providers is critical for team approach and optimal outcome in labor and delivery (L&D). Inadequate interdisciplinary communication, and inability to reach other clinicians were prominent themes in a survey study.¹ Traditionally, paging system, phone calls, and overhead announcements have been used for decades for communicating among clinicians and nurses. As per HCAPHS survey, paging and overhead call system are perceived as 'Noisy and Sense of Discomfort' by more than 50% of the patients in labor and delivery. The noise levels can be as high as 75-80 dB. The current millennium of rapidly advancing technology offers a great opportunity to build optimum inter clinical communication system in lieu of traditional paging system.

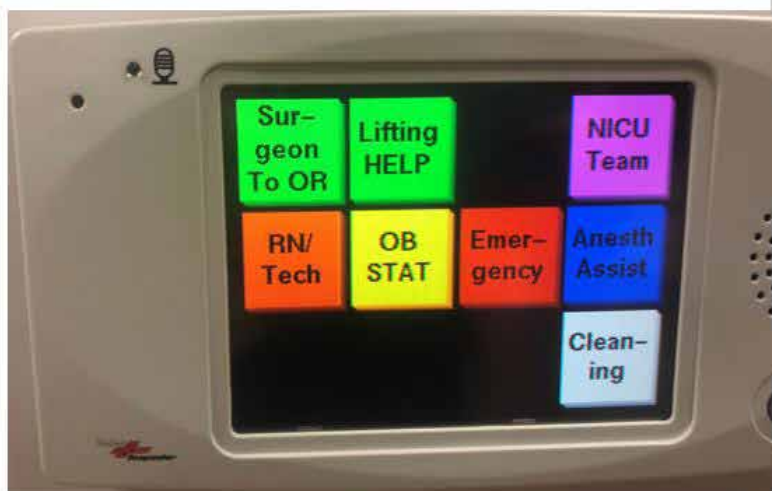
Description: A new communication system integrating three technologies, Motorola®, Vocera®, and Rauland® was developed to work on the hospital wireless network to allow voice, data, and doc halo capabilities on to a Motorola® smart phone. Static phone numbers are assigned by specific role. Each L&D room and operating room are provided with wall mounted touch screen panels to activate notification of a specific issue to targeted care providers. The panel is programmed as follows: **obCNM Birth team:** Messages intern, chief, CNM & OB attending, anesthesiology resident and baby nurse; **FM Birth Team:** Family Medicine resident, attending, anesthesiology resident and baby nurse; **NICU Team:** Opens the NICU notification options; **RN/Tech:** RNs or Techs for help; **OB STAT:** Additional screen options for OB emergencies – Shoulder dystocia, Stat C-section etc; Emergency: opens up an additional screen for Emergencies; **Anesth Assist:** OB anesthesiology attending, Anesthesiology Fellow, Residents, and Anesthesia technician for help; **Cleaning:** Blank screen for system cleaning. Once communication is established between teams, inter disciplinary communications can start among targeted staff. Subdivisions of NICU specific information is also built in. STAT cesarean delivery summons clinicians from Obstetrics, OB anesthesiology, Neonatology, and L&D Charge nurse, scrub technician and anesthesia technician. Rapid response team and code blue activation and airway emergency are also built in. The Vocera® system is also programmed to alert nurses of abnormal vital signs of patients in L&D. This system was evaluated if it changed labor and delivery workflow between pre implementation (April – September 2018) and post implementation (Jan 2019-June 2019).

Results: No overhead pages were made during this period. Post implementation women had a 10-minute reduction in decision to delivery time (47 to 41, P=0.027), decision to skin incision time by 9 min (25 to 16, P=0.022) and increased number of decisions to delivery occurrence within 30 min (50 to 69%, P=0.018). This new communication system aids in timely and closed loop communications between various disciplines which is key in L&D.

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J Perinatol 2011;31:240-5.

Abstract #: ES4-07



Abstract #: ES4-08

Noise Levels during Cesarean Delivery

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Background: In obstetric anesthesia, emergency deliveries may be necessary for fetal or maternal health. While most babies born via Cesarean are delivered in a controlled and routine fashion, emergency Cesarean deliveries require rapid completion of multiple steps to anesthetize and prepare the mother for operative delivery. This requires the accelerated coordination of nursing staff, obstetricians, and anesthesiologists, which may increase operating room noise. Excessive noise has been shown to both impair anesthesia residents' mental efficiency and short-term memory[1] and negatively affect accuracy and response times to changes in the pitch of the pulse oximeter[2]. Evidence is lacking on if and how noise levels differ specifically between elective and emergent Cesarean deliveries. This prospective study aimed to determine if noise levels in the operating room were higher during emergency Cesarean deliveries than elective Cesarean deliveries at one or more time points of interest.

Methods: We conducted a prospective observational study measuring noise levels in the Labor and Delivery operating rooms at a single academic medical center. A decibel meter was placed on the anesthesia machines and Electronic Medical Record (EMR) was used to correlate recorded noise levels to clinical activity. Eight specific time points of interest were evaluated and compared between elective and emergency Cesarean delivery. These time points include T1) Start of data collection, T2) Induction of general anesthesia or neuraxial block placement, T3) Five, T4) Three and T5) One minute before skin incision, T6) Skin incision, T7) Delivery, and T8) Five minutes before end of data collection. Data was collected on all women, aged 18 years and older, who underwent Cesarean delivery over the course of one year.

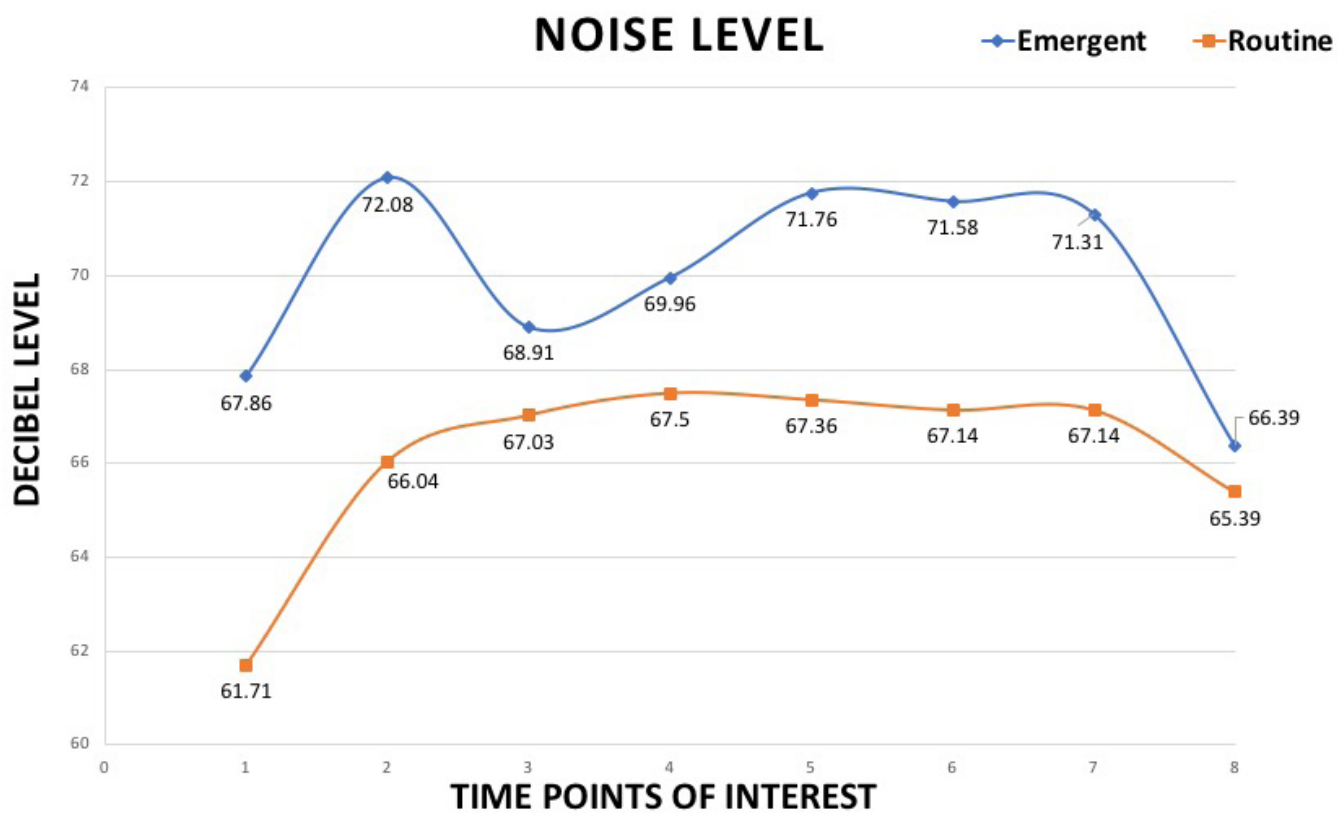
Results: The noise levels for 400 elective or urgent Cesarean deliveries and 40 emergency Cesarean deliveries were measured. The average noise level in the elective group was 66.16 decibels (dB) and 69.98 dB in the emergency group. The emergency Cesarean delivery group was noisier at all eight time points of interest, although the absolute difference in decibels between the two groups was modest. The difference in noise at six points of interest (T1, T2, T4, T5, T6, T7) reached statistical significant ($p < 0.01$).

Conclusion: Noise levels are increased in emergency versus elective Cesarean delivery. The added noise pollution may impair communication and performance during a critical event. Obstetrical patients are high risk for issues given the often urgent and emergent care of these patients in the operating room. The statistically higher decibel levels at six critical points of interest demonstrate this elevated risk for patient safety events. Noise pollution should be of concern to all healthcare providers.

References:

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Abstract #: ES4-08



Abstract #: ES4-09

The Influence of a Kybele Program on the Use of Spinal Analgesia for Labor and Regional Anesthesia for Cesarean Delivery in Tuzla, Bosnia and Herzegovina

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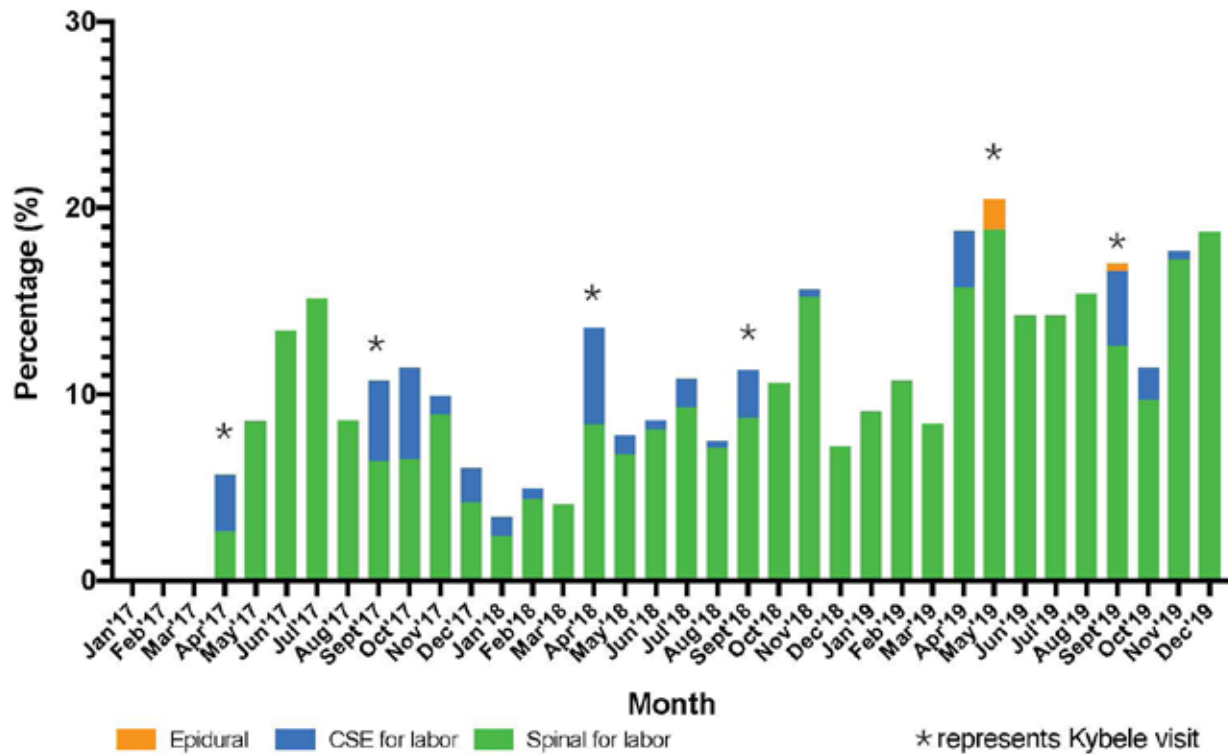
Introduction: University Clinical Center Tuzla (UCCT) is the second largest clinical center in Bosnia, with approximately 3,000 deliveries per year. Prior to Kybele's visit, regional anesthesia (RA) and analgesia techniques were not used in the Labor and Delivery unit. Members of the Department of Anesthesia at UCCT requested a multi-year Kybele Program in 2016 to help train physicians in the use of RA techniques for labor and cesarean delivery (CD). This study extends the efforts of Kybele and UCCT physicians to increase obstetric RA use.

Method: In May and September 2019, a Kybele team visited UCCT for two consecutive 5-day periods respectively, to conduct training in RA for CD and neuraxial analgesia for labor (NAL). The data were retrospectively collected, on the use of RA for CD and on the use of NAL, for the period of January 1st, 2019 to December 31st, 2019, and compared with 2018 data using Fischer's Exact test.

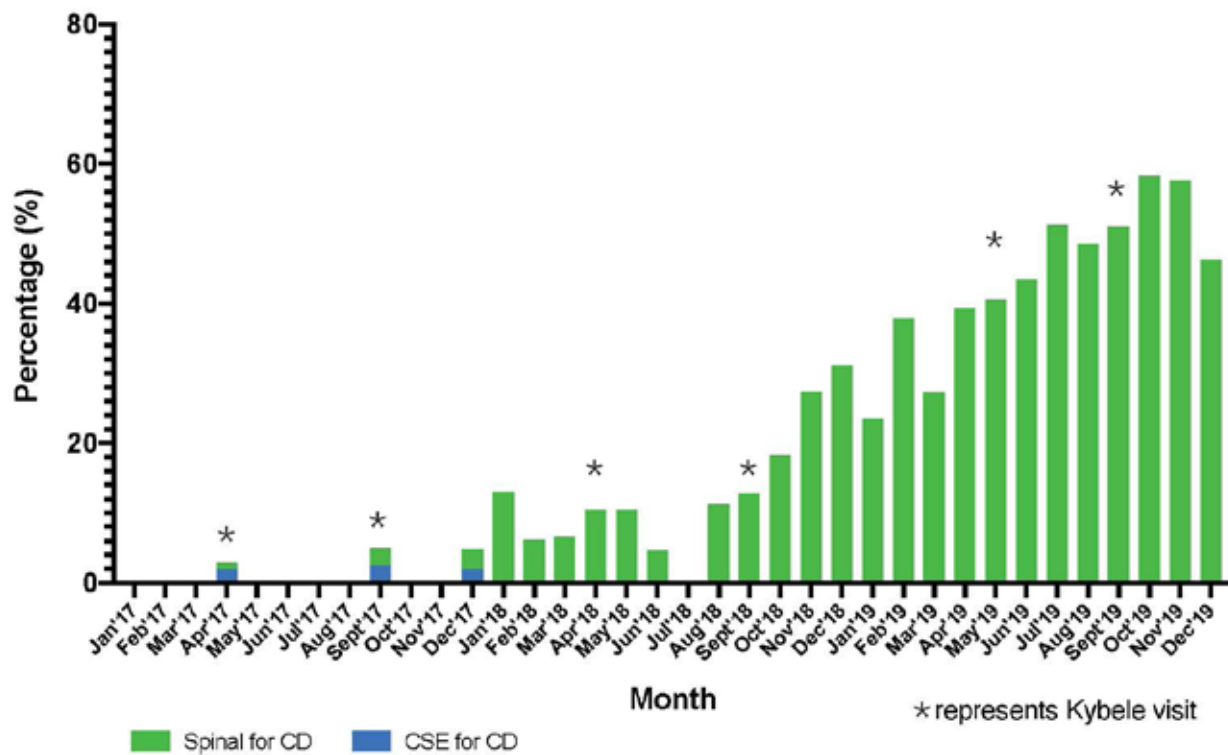
Results: The monthly and annual use of RA for labor and CD is shown in Figure 1. A total of 343 (14.3%) patients had NAL for labor during 2019, versus 221 (9.0%) in 2018, thus showing a statistically significant increase ($p < 0.00001$). Additionally, a total of 417 RA (43.2%) was done for CD, compared to 117 RA (12.2%) for CD in 2018 ($p < 0.00001$).

Discussion: Our efforts during the first visit resulted in the creation of a labor analgesia service. During the second visit, we concentrated on epidural/CSE for labor, while during the third and fourth visits we concentrated on spinal anesthesia for CD. During the fifth and sixth visits, faculty members from all around Bosnia were educated in neuraxial techniques for labor and CD. Conclusion: SSS analgesia is an excellent option for labor analgesia where there is limited or no experience with epidural/CSE analgesia. SSS analgesia was well accepted by patients and obstetricians. Spinal anesthesia for CD was also well accepted among patients and obstetricians. There remains limited availability of trained anesthesiologists and obstetricians and lack of patient education on the benefits of RA and NAL. The local team has started education sessions for their patients about the benefits of RA for labor and NAL for CD. At the end of 2019 practitioners from Sarajevo started using neuraxial techniques for labor and CD. Future Kybele team visits will concentrate on training additional faculty on the use of epidural/CSE for labor and RA for CD.

Monthly use of regional analgesia for labor in 2017-2019



Monthly use of regional analgesia for CD in 2017-2019



Abstract #: ES5-01

Incidental Spinal Ependymoma Identified Following Spinal Anesthesia for Cesarean Delivery

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Ependymomas are rare central nervous system (CNS) tumors, constituting about 1.8% of all CNS tumors. Patients most commonly present with pain, sensory symptoms, weakness, bladder or bowel dysfunction, with symptoms lasting for an average of 8 months prior to diagnosis [1].

A healthy 40-year-old gravida 6, para 5 woman underwent a primary cesarean delivery and bilateral tubal ligation due to breech presentation. The patient had multiple prior uneventful labor epidurals. Spinal anesthesia was performed without difficulty. The patient's hospital course was uneventful and she was discharged on postoperative day 3. She returned on postoperative day 6 with low back pain with radiation to the lumbar paraspinals and posterior right thigh. The patient denied urinary and bowel incontinence, and her neurologic exam was unremarkable. The pain was alleviated by hydrocodone and ibuprofen. Given a lack of neurological deficits, the patient was discharged home with pain management recommendations.

On postoperative day 13, she returned with new urinary retention and difficulty ambulating. Neurologic examination was remarkable for numbness in the bilateral lower extremities, 3/5 strength in hip flexion, 4/5 strength in dorsiflexion and plantar flexion bilaterally. Stat lumbar and thoracic spine magnetic resonance imaging (MRI) were performed and were suggestive of a large hypervascular mass with areas of hemorrhage occupying and slightly expanding the spinal canal from T11 through L4-L5 junction with a small amount of subarachnoid hemorrhage in the sacral canal, concerning for ependymoma. Neurosurgery performed a T11-L5 laminectomy for mass resection. Surgical pathology confirmed the diagnosis of myxopapillary ependymoma. She was discharged to inpatient rehabilitation on postoperative day 4 with residual but improved lower extremity weakness and neurogenic bowel and bladder.

There are four prior cases described in the literature of women who underwent neuraxial anesthesia for delivery, followed by neurologic symptoms and discovery of spinal ependymoma. [2,3,4,5]. Our patient likely had this large preexisting asymptomatic ependymoma that was discovered when spinal anesthesia caused localized trauma, hematoma, and progressive neurological symptoms.

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Abstract #: ES5-01



Abstract #: ES5-02

Neuraxial Anesthesia for Cesarean Delivery in a Parturient with Autonomic Hyperreflexia

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Presenting Author's Institution: University of Michigan

Co-Authors: Thomas Klumpner, MD - University of Michigan

Baskar Rajala, MD - University of Michigan

Introduction: Autonomic Hyperreflexia (AH) is a known complication of spinal cord injury (SCI). AH can be triggered by noxious stimulation below the level of the lesion. The result is reflex sympathetic activity that is unchecked by descending inhibition, causing generalized vasoconstriction below the lesion. Above the level of the lesion, intact descending inhibition results in vasodilation and bradycardia [1]. This severe increase in afterload can result in pulmonary edema, myocardial ischemia, or cerebral hemorrhage. Improvements in treatment of SCI have led to increasing numbers of pregnancies in this population with 14% of these women becoming pregnant at least once [2] requiring methods of anesthesia to ensure safe delivery utilizing neuraxial or general techniques [3].

Case: 30y G2P0 at 34.3 weeks' EGA, s/p C3-T4 fusion for a traumatic C5 SCI, which was since complicated by AH. She presented with increasing frequency of AH exacerbations and reported peak systolic BP to 190 mmHg. Initial examination revealed breech presentation and regular uterine contractions triggering AH. Cesarean delivery was planned. The patient was adamant about being awake for the delivery. Pre-anesthesia evaluation was significant for lower extremity contractures, clonus with spastic movements of her trunk and legs, and a bilateral T4 sensory level. She had very limited neck flexion and extension. After detailed discussion, a decision made to proceed with neuraxial anesthesia. A pre-induction a-line was placed. Using three assistants, the patient was placed in sitting position. CSE technique was used to induce neuraxial anesthesia with 3.75 mg hyperbaric intrathecal bupivacaine, 15 mcg fentanyl and 150 mcg morphine. The epidural was dosed with 6 mL lidocaine 2% with 1:200k epinephrine in divided doses. Her spasticity improved as the block height increased, and a T2 sensory level was obtained. Tight hemodynamic control was achieved with a phenylephrine infusion. Other short-acting vasoactive medications were immediately available. Emergency airway equipment was also readily available. There were no intraoperative episodes of AH and the case concluded uneventfully. Postoperatively, epidural ropivacaine 0.1% with 10 mcg/mL fentanyl was used to prevent AH, and was removed on POD1.

Discussion: A neuraxial anesthetic allowed the patient to be awake for delivery, prevented intraoperative AH, and provided a means to prevent AH episodes post-operatively. While doing so risked managing her airway under non-ideal circumstances, medications were immediately available to control any episodes of AH, emergency airway equipment was on standby and we were able to fulfill the patient's wishes in a uniquely complex scenario.

References:

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Abstract #: ES5-03

Back to Biochemistry: Anesthetic Management of a Parturient with Hyperornithemia-Hyperammonemia-Homocitrullinuria

Presenting Author: Victoria Melanson

Presenting Author's Institution: Emory University Department of Anesthesiology

Co-Authors: James Dolak - Emory University Department of Anesthesiology

Ben Shatil - Emory University Department of Anesthesiology

Case Report: 19yo G1P0 parturient at 38w2d with Hyperornithemia-Hyperammonemia-Homocitrullinuria (HHH) presents with premature rupture of membranes after an uncomplicated prenatal course. She was followed by maternal-fetal medicine, genetics, and nutrition. Anesthesiology was consulted, and a primary cesarean delivery (CD) was planned. The patient continued daily glycerol phenylbutyrate. Lipid, dextrose, and arginine infusions were initiated 12 hours prior to CD and were continued in the OR. Frequent lab draws monitored ammonia and glucose levels, which remained within normal limits. Intraoperatively, standard ASA monitors were placed before a single-shot spinal anesthetic with 0.75% bupivacaine 12.5mg, fentanyl 15mcg, and preservative-free morphine 150mcg. A phenylephrine infusion was initiated, and prophylactic tranexamic acid 1g was given to minimize blood loss. The CD was uneventful with 800ml EBL and infant APGAR scores of 8 and 8. Postoperatively, neurological status was closely monitored in the ICU. Ammonia levels stayed within normal range, and the patient's mental status remained at baseline. She was discharged on postoperative day 3.

Discussion: HHH is a rare autosomal recessive mutation of the mitochondrial ornithine carrier protein (ORC1) causing hyperammonemia, hyperornithemia, and homocitrullinuria. Normally, gluconeogenesis catabolizes protein into amino acids and subsequently ammonia, which is excreted in urine by the urea cycle. In HHH, hyperammonemia results from the inability to export mitochondrial ammonia to the urea cycle. Patients present with vomiting, altered mental status, ataxia, or seizures. About 25% of patients develop liver dysfunction causing mild coagulopathy, transaminitis, and, rarely, acute liver failure. Management of hyperammonemia includes a low-protein diet; lipid, arginine and dextrose infusions; and sodium benzoate or sodium phenylbutyrate to bind amino groups for excretion (Table).¹ While all HHH patients are at risk for hyperammonemia, parturients are more vulnerable due to augmentation of gluconeogenesis with the sympathetic stimulation of labor. Of the 100 cases of HHH reported,² three cases involved parturients,³ and none detailed the anesthetic management.

Thoughtful intrapartum management is critical to prevent hyperammonemia. CD is the preferred mode of delivery. Lipid and dextrose infusions prevent the stimulation of gluconeogenesis, and arginine facilitates urea cycle ammonia excretion as well as creatine synthesis, which produces ATP and evades catabolism. Neuraxial anesthesia minimizes the stress response through analgesia. A phenylephrine infusion maintains placental blood flow and avoids hypotension. Early uterotonics prevent blood loss, and resuscitation with crystalloids and blood products avoids a sympathetic response. Preparedness and prophylaxis are the keys to HHH management.

References:

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2. *Orphanet J Rare Dis.* 2015;10:29
3. *JIMD Rep.* 2019;46(1):28-34

Abstract #: ES5-03

Table

	<i>Preoperative</i>	<i>Intraoperative</i>	<i>Postoperative</i>
<i>Medications</i>	<ul style="list-style-type: none"> Continue glycerol phenylbutyrate (ammonia scavenger) Evening before CD: continuous infusions of intralipid 120g/day (1200 kcal), arginine hydrochloride 4g/m² BSA/day Morning of CD: continuous infusion of D10W + 5meq KCl at 1-1.5x maintenance rate; PRN insulin 	<ul style="list-style-type: none"> Continue intralipid, dextrose, and arginine infusions at present rate (citrulline may be used, as it converts to arginine); PRN insulin Pressors: 0.2mg/kg/min phenylephrine infusion at the time of spinal (titrate as necessary) Neuraxial anesthetic: spinal with 1.6mL 0.75% hyperbaric bupivacaine, 15mcg fentanyl, 200mcg preservative-free morphine Prophylaxis: antibiotics, tranexamic acid 1g IV Post delivery: 3 units oxytocin bolus followed by infusion of 20 units over one hour; consider additional oxytocin bolus, IM methylergonovine, and/or IM carboprost 	<ul style="list-style-type: none"> Continue glycerol phenylbutyrate; transition from IV arginine infusion to oral L-citrulline Transition off intralipid and dextrose infusions as PO intake is escalated to a full low-protein diet. Pain: acetaminophen 1000mg q8 hr. scheduled; ibuprofen 800mg q8 hr. scheduled; lidocaine patches q24 hr. scheduled; oxycodone IR 5-10mg q3 hr. PRN
<i>Labs and Management Strategy</i>	<ul style="list-style-type: none"> Q4 hr. plasma ammonia levels; q4 hr. glucose levels once dextrose infusion initiated; daily CBC and BMP <ul style="list-style-type: none"> If ammonia >100 µ/dL, give additional dose of glycerol phenylbuterate 	<ul style="list-style-type: none"> Q4 hr. plasma ammonia levels; q4 hr. glucose levels Maintain normotension to avoid sympathetic response and to maintain uterine perfusion Early use of uterotonic agents to minimize blood loss 	<ul style="list-style-type: none"> Q4 hr. plasma ammonia levels; q4 hr. glucose levels until normalized and transitioned to full diet ICU-level neurological evaluations Pain: multimodal analgesia; consider continuous epidural infusion for complicated CD or for opioid tolerance/addiction
<i>Special Considerations</i>	<ul style="list-style-type: none"> Access: 2 large bore IVs; consider central access for frequent blood draws Hyperglycemia: treat with insulin; do not reduce dextrose infusion 	<ul style="list-style-type: none"> Cross-matched PRBCs available Consider arterial line placement before spinal for close hemodynamic monitoring 	<ul style="list-style-type: none"> Low protein diet, <46g protein daily

Abstract #: ES5-04

EXIT-to-airway in a Patient with Severe Pre-eclampsia and IUGR

Presenting Author: Shreya Patel, MD

Presenting Author's Institution: Baylor College of Medicine, Texas

Co-Authors: Caitlin D. Sutton, MD - Baylor College of Medicine

Ex Utero Intrapartum Treatment (EXIT) procedures are performed when a fetus is anticipated to have critical issues after separation from maternal circulation to allow for fetal intervention with placental support. However, little is known about the feasibility of successful placental support during EXIT in the setting of potential placental dysfunction as in severe pre-eclampsia with resulting IUGR [1]. We present a case of an urgent EXIT-to-airway procedure in a patient with severe pre-eclampsia.

A 37 yo G4P0020 at 33w1d gestation with newly diagnosed preeclampsia with severe range blood pressures resistant to aggressive antihypertensive therapy presented for consideration of urgent delivery via EXIT procedure for suspected fetal airway compromise. On arrival, physical exam was notable for BP 170/86, 2+ bilateral lower extremity and sacral edema, normal lung and heart exam, and reassuring airway. Fetal ultrasound revealed polyhydramnios, absent stomach bubble, micrognathia, and fetal growth restriction (< 1%^{tile}). Laboratory results showed platelets of 191K and AST 71 and ALT 35. Due to persistently elevated blood pressures, decision was made to proceed with delivery.

Peripheral IV and arterial access was established. Intrathecal injection of morphine was given for post-operative analgesia. Antihypertensive boluses were titrated carefully and followed by 1 mcg/kg remifentanyl prior to induction. Rapid sequence induction with video laryngoscopy was performed successfully with stable hemodynamics. Sevoflurane was titrated up to a 1.5 MAC to assist with uterine relaxation for partial delivery of the fetus. Resulting hypotension (100/60s) was resistant to phenylephrine and norepinephrine but responded well to vasopressin without change to fetal heart rate (FHR). After hysterotomy, a mixture of atropine, fentanyl, and vecuronium was administered to the fetus IM. The fetal head and right hand were delivered for rigid bronchoscopy and placement of PIV and pulse oximeter. Shortly after fetal bronchoscopy, FHR decreased to 75 bpm and fetal IM epinephrine was administered. Due to loss of umbilical vein pulsatility and inability to obtain FHR from ultrasound, the fetus was delivered emergently prior to airway securement. Neonatal resuscitation was initiated in an adjacent operating room, the airway was secured via emergency tracheostomy, and spontaneous circulation returned. The placenta was delivered and appropriate uterine tone was achieved with intravenous oxytocin and transition to TIVA with propofol. A TAP block was performed prior to emergence. The patient was extubated uneventfully and monitored in ICU post-operatively.

EXIT procedures are generally performed after extensive preoperative and planning. The combination of severe preeclampsia and IUGR should prompt multidisciplinary discussion regarding the likelihood of abbreviated placental perfusion time and procedural planning should incorporate this probable issue.

References:

1. Steegers, E. Lancet, 2010.

Abstract #: ES5-05

Communication With Obstetric Patients: Demonstrating Professionalism and Showing Empathy

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Presenting Author's Institution: Vanderbilt University Medical Center

Co-Authors: David Chestnut - Vanderbilt University Medical Center

Laura Sorabella, M.D. - Vanderbilt University Medical Center

Historically, communication skills have been undervalued and even overlooked in the training of anesthesia professionals.^{1,2} With the adoption of the six core competencies for physicians, both accreditation and certification bodies now acknowledge the importance of these competencies in training, certification, and clinical practice.^{3,4,5} Further, health systems increasingly recognize and emphasize the importance of patient satisfaction with experience of care.^{6,7}

Communication with obstetric patients provides unique challenges for trainees, as they must learn and practice procedures on awake, non-sedated patients who may often have severe pain and anxiety. Additionally, the continuity of care provided throughout labor compels trainees to be cognizant of the emotional burdens of their patients (e.g., disappointment with a failed birth plan, apprehension with a preterm birth, panic during an emergent cesarean delivery, fear throughout a postpartum hemorrhage, mourning of an intrauterine fetal demise). Adding to complexity, trainees often must communicate through a translator during these multifaceted encounters.

To assist trainees in navigating these challenges during their obstetric anesthesiology rotation, faculty obstetric anesthesiologists with expertise in biomedical ethics, professionalism, and education have compiled a best-practice article with recommendations based upon personal experience and specific examples. Topics addressed include the following:

Etiquette when meeting the patient

Demonstration of empathy in the setting of severe pain and/or anxiety

Balanced discussion of risks

Effective communication during procedures

Proper disclosure of complications or errors

Special situations (e.g., fetal demise, using a translator)

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Abstract #: ES5-06

Neostigmine and Atropine for Post-Dural Puncture Headache in a Patient on Enoxaparin

Presenting Author: Jessica Rock, MD

Presenting Author's Institution: Medical College of Wisconsin

Co-Authors: Austin Ko, DO - Medical College of Wisconsin

Introduction: Post-dural puncture headache (PDPH) is a potentially debilitating complication following neuraxial anesthesia occurring in upwards of 88% of patients following unintended dural puncture and in approximately 1% of subarachnoid blocksⁱ. PDPH is generally treated with supportive care including rest, fluids, caffeine, oral pain meds, or, in more severe cases, epidural blood patch (EBP).

Case: A 28-year-old G6P1132 with medical history significant for protein S deficiency, deep vein thrombosis 7 months prior treated with therapeutic enoxaparin, asthma, and uncontrolled GERD, underwent uncomplicated spinal anesthesia for repeat c-section. Enoxaparin was held for at least 24 hours before and after spinal placement. On POD1, she complained of severe positional headache with neck stiffness and photophobia. As EBP would have required an additional 48 hours off of enoxaparin (24 hours pre- and post-procedure), she was treated that evening with initial doses of neostigmine 0.02mg/kg and 0.01mg/kg atropine in addition to supportive therapy of hydration, caffeine, rest, and Tylenol. She was given a second dose on POD2 with significant improvement in both headache and neck stiffness with occasional return of symptoms. A third dose was given the evening of POD2. POD3 the patient was able to perform normal activities of daily living with occasional frontal head pain not consistent with previous headache. POD4, her headache had completely resolved.

Discussion: Neostigmine and atropine have been shown to be effective for relief from PDPHⁱⁱ and have minimal expected side effects (abdominal cramps, muscle twitches, bladder hyperactivity). The proposed mechanism of action is related to effects on both CSF secretion and vascular tone in the central nervous system that help to reverse the symptoms of PDPH. One double-blinded, randomized, controlled trial demonstrated statistically significant decrease in blood patch need from 15.9% compared to 0% in neostigmine/atropine groupⁱⁱ. Clinicians can consider this treatment for patients who have relative or absolute contraindications to EBP.

Conclusion: Neostigmine and atropine can serve as an effective medical treatment for PDPH, especially in patients where epidural blood patch may be contraindicated or associated with additional risk.

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Abstract #: ES5-07

Electrocardiographic changes during ropivacaine epidural infusion for labor analgesia in a patient with SCN5A sodium channel mutation

Presenting Author: Ana Sjaus, MD FRCPC

Presenting Author's Institution: Dalhousie University, Nova Scotia

Co-Authors: Lynne McLeod, MD FRCSC - Dalhousie University

Introduction: Inherited ion channelopathies can be associated with a variety of abnormalities of cardiac rhythm and structure. The SCN5A gene encodes a subunit of the cardiac voltage gated sodium channel. Long QT, Brugada syndrome, dilated cardiomyopathy, arrhythmogenic right ventricle are reported in patients with this gene mutation [1].

Epidural labor analgesia can decrease the risk of cardiac dysrhythmia due to analgesia related attenuation of sympathetic tone. It facilitates obstetric intervention in the second stage of labor. While less likely to be cardiotoxic than bupivacaine, ropivacaine is also a Na⁺ channel blocker that can potentially exacerbate the ion channel dysfunction. This case report describes safe labor analgesia with epidural ropivacaine despite non-specific ECG changes during labor in a patient with newly diagnosed SCN5A mutation.

Clinical Features: The patient consented to publish details of the case report. An otherwise healthy, 21 year old primipara reported episodes of dyspnea and palpitations in pregnancy. Due to family history of Long QT Syndrome and dilated cardiomyopathy, she was investigated for inherited conduction abnormality. The exact nature of the abnormality was not known at the time of anesthetic consultation at 36 weeks of gestation.

Electrocardiogram and Holter monitor showed sinus tachycardia, an RSr' pattern with normal QRS duration and runs of ventricular tachycardia. QT duration was normal. Echocardiogram revealed a right ventricular free wall motion abnormality but was otherwise normal. An early epidural was recommended due to poor tolerance of tachycardia and risk of QT prolongation due to stress. Avoidance of QT prolonging medication was recommended.

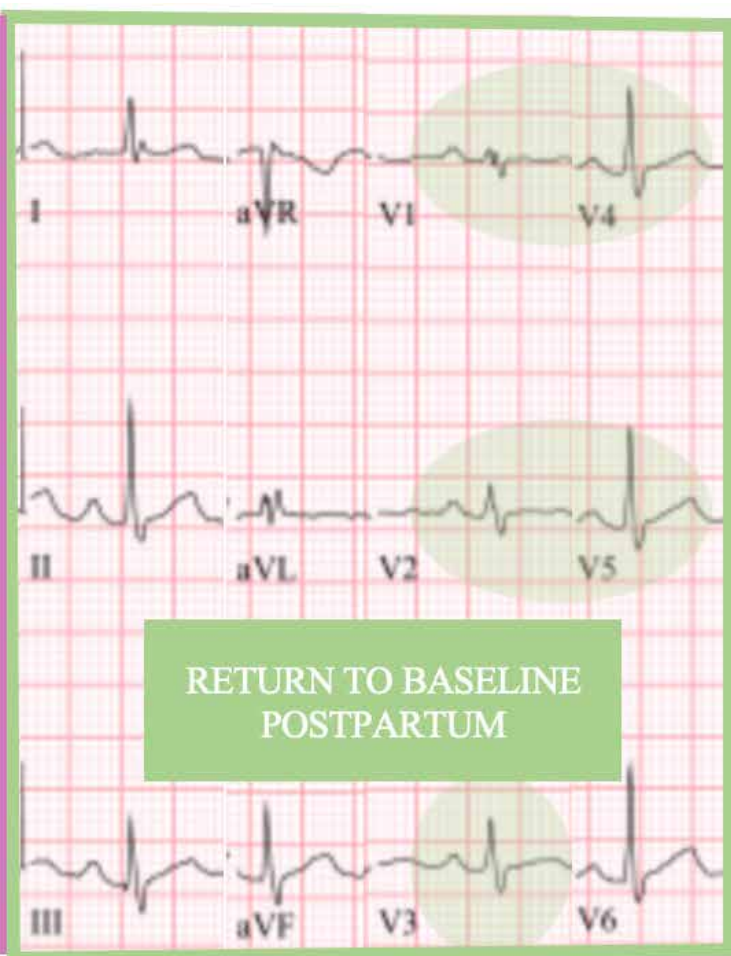
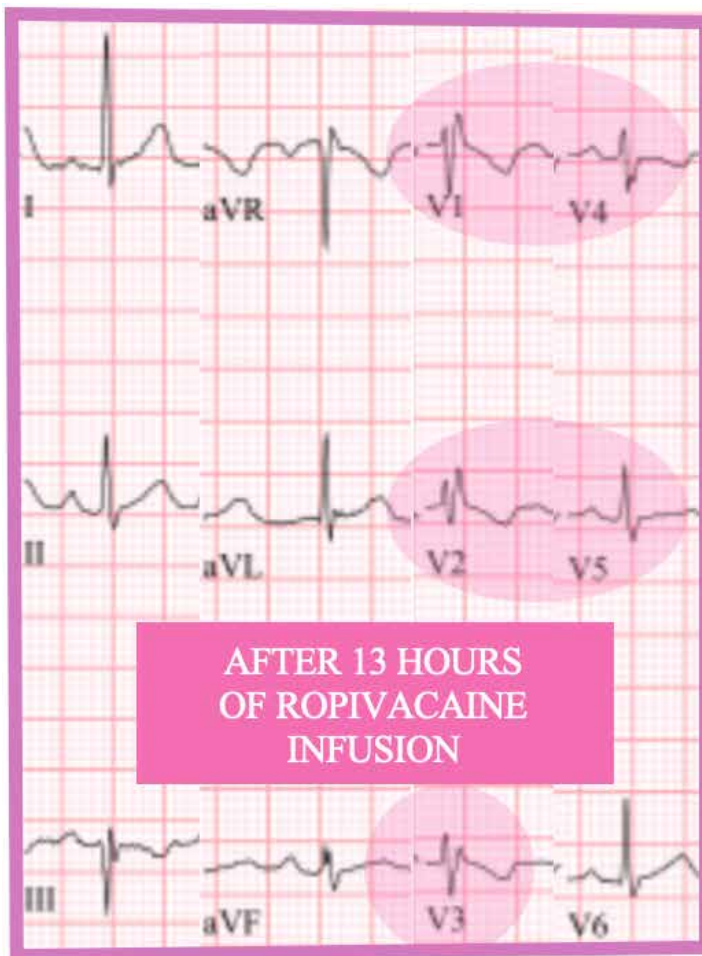
The diagnosis of SCN5A mutation was confirmed days prior to admission in labor. A standard continuous epidural was induced using a bolus of ropivacaine 0.2% and maintained by programmed intermittent bolus (PIB) protocol of ropivacaine 0.1%. As the patient's particular phenotype was unconfirmed, we continued epidural infusion, planning to convert to IV opioid should the patient develop long QT, bradycardia or ST elevation characteristic of Brugada syndrome. Continuous monitoring revealed persistent sinus tachycardia with an evolving partial right bundle branch block and ST depression. The QT interval remained normal. The patient reported several episodes of dyspnea consistent with prior complaints. She was monitored for 8 hours post-partum until ECG changes resolved to baseline. The neonate had ST changes of Brugada syndrome.

Conclusion: SCN5A mutation of the sodium channel can lead to dysrhythmias including cardiac arrest. Different SCN5A phenotypes can overlap in the same patient. Confirmation of the specific phenotype can help predict consequences of neuraxial analgesia, provoking medications and clinical conditions. A multidisciplinary approach is necessary for safe management of labor in these patients.

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Abstract #: ES5-07



Abstract #: ES5-08

Spontaneous Ventilation During Balloon Dilatation of Subglottic Stenosis in a Pregnant Woman

Presenting Author: Haley DeLaGarza, DNP, CRNA

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A 30yo 96 kg G1P0 with history of subglottic stenosis (SGS) and Crohn's disease presented with progressive shortness of breath during pregnancy. Her surgical history included 3 prior direct laryngoscopies (DL) with dilation. Dyspnea was initially attributed to her gravid state, but worsening symptoms in the second trimester prompted otolaryngology (ENT) to recommend DL with balloon dilation. Multidisciplinary planning included ENT, maternal fetal-medicine (MFM), and anesthesiology, and the procedure was planned for 27 6/7 weeks' gestation. All parties agreed to continuous fetal monitoring given the viability of the fetus as well as the risk of hypoxemia and hypercarbia associated with the procedure.

On the day of surgery, the patient had markedly audible breathing but was able to speak in complete sentences. Airway examination was reassuring. The patient's MFM, ENT, and anesthesiologist agreed upon a plan with contingencies based on both maternal and fetal status.

Prior to transfer into the operating room, the patient was given a bolus of dexmedetomidine 0.5 mcg/kg followed with an infusion of 0.4 mcg/kg/hr. All infusion dosing was based on ideal body weight (60 kg). Once in the operating room, standard monitors were applied along with oxygen via transnasal humidified rapid insufflation ventilatory exchange (THRIVE) at 20-30 L/min. An infusion of propofol was slowly titrated (50-125 mcg/kg/min) and was administered concomitantly with remifentanyl (0.08-0.1 mcg/kg/min). Very close communication occurred between ENT and anesthesiology teams to evaluate depth of anesthesia. On initial DL, the patient was noted to move non-purposefully. Movement resolved with intermittent boluses of ketamine (total 30 mg), and spontaneous respiration was maintained (8-10 breaths per minute). Vital signs remained stable throughout the procedure (oxygen saturation 98-100%, heart rate 75-102 beats per minute, and mean arterial pressure 65-82 mmHg). Tidal volumes were not able to be monitored due to the suspension, however at the conclusion of the procedure a mask was placed and tidal volumes were noted to be 600-900 mL with first post-procedural breath revealing ETCO₂ of 39 mmHg.

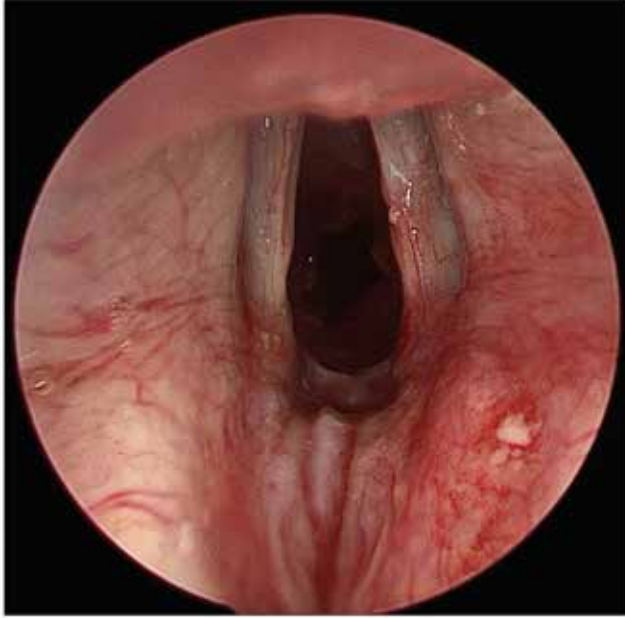
THRIVE is an emerging technique for the management of both SGS and pregnant patients. Previously, THRIVE has been used in an intentionally apneic pregnant woman at 23 weeks' gestation undergoing balloon dilatation for severe SGS. Intentional apnea utilizing neuromuscular blockade carries risks, namely of maternal hypoxia and hypercarbia with resultant fetal acidosis. Spontaneous ventilation during the procedure increases the likelihood of maintaining maternal carbon dioxide levels and avoiding fetal acidosis. We report the novel management strategy for balloon dilation of a pregnant patient with SGS utilizing THRIVE with spontaneous respiration to avoid complications associated with neuromuscular blockade and hypercapnia.

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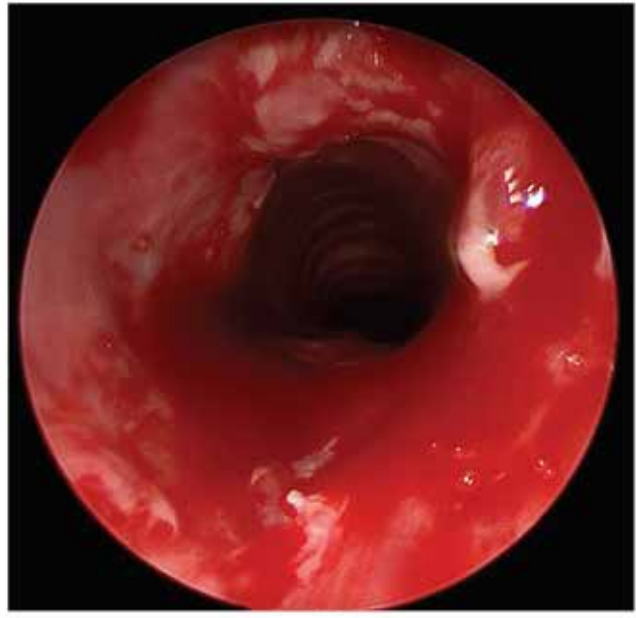
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Abstract #: ES5-08



Pre-dilation



Post-dilation

Abstract #: ES5-09

Management of a Peripartum Patient Who Received Intravenous TPA

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Presenting Author's Institution: Thomas Jefferson University Hospital - Philadelphia, Pennsylvania

Co-Authors: Garrett Gerney - Thomas Jefferson University

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Introduction: CVA is rare in pregnancy. Connective tissue changes, increased procoagulant factors, decreased anticoagulant proteins, resistance to activated protein C, and venous stasis, designed to decrease hemorrhage risk, paradoxically increase risk of a thrombotic event [1]. AHA guidelines for stroke management include IV TPA and mechanical thrombectomy [2]. We present a case of a term pregnant patient who presented with signs of stroke treated with IV TPA, who underwent C/S 48 hours later using spinal anesthesia.

Case report: A 34 yr old G2P1001 female at 38 6/7 wks gestation (prior C/S) presented with new onset confusion and word finding difficulty. Head CT r/o intracerebral hemorrhage. She received IV TPA for probable ischemic stroke (NIHSS 3). CT perfusion scan showed no large vessel occlusion or defects. Post TPA MRI/MRA showed subtle restricted diffusion FLAIR hyperintensity in the left temporoparietal region, representing post-ictal phenomenon. Continuous EEG demonstrated several electrographic, non-clinical seizures. Our patient was treated with levetiracetam and post TPA day #2, she underwent C/S under spinal anesthesia. Repeat MRI was consistent with resolving post-seizure related abnormalities.

Discussion: TPA is a serine protease that converts plasminogen into plasmin, promoting fibrin dissolution in blood clots for the treatment of ischemic stroke. It is a large molecule that does not cross the placenta [3]. Bleeding from TPA use near delivery is a concern. There is limited data regarding IV TPA and timing of neuraxial anesthesia. ASRA guidelines suggest a 48-hour time interval and normal clotting studies prior to needle/catheter placement and neurological monitoring every 2 hours after placement. We followed these guidelines.

Most seizures during pregnancy are in patients with preexisting epilepsy. The incidence of new onset epilepsy during pregnancy is 2.1%; the majority occur in the 2nd and 3rd trimesters and are tonic/clonic [4,5]. MRI/MRA, CT perfusion scanning, EEG analysis, and blood studies help confirm the diagnosis. Our patient was diagnosed with non-clinical seizures, characterized by abnormal EEG activity without tonic/clonic muscle activity. Amnesia, confusion, weakness in an arm or leg, difficulty speaking, and vision loss, may follow any seizure, confusing this diagnosis with stroke. Eclampsia is characterized by generalized edema, hypertension, proteinuria, and convulsions. Women with eclampsia can exhibit persistent occipital or frontal headaches, blurred vision, photophobia, epigastric or right upper quadrant pain, and altered mental status. Our patient demonstrated EEG evidence of seizures, not eclampsia.

Conclusion: Peripartum TPA administration does not preclude neuraxial anesthesia provided appropriate precautions are taken.

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Abstract #: S-01

Delayed Interval Delivery in a Parturient with Essential Thrombocythemia and a Triamniotic -Trichorionic Triplet Pregnancy

Presenting Author: Jakayla Harrell, MD

Presenting Author's Institution: Ochsner Clinic Foundation

Co-Authors: Melissa Russo - Ochsner Clinic Foundation

Introduction: Multifetal gestation confers unique considerations for the anesthesiologist as premature labor, ROM, and perinatal fetal and maternal morbidity and mortality are concerns in the periviable period. (1) Delayed interval delivery has been described by many institutions to improve chance of neonatal survival but not without maternal risks. Here we present a patient with essential thrombocythemia with tri-tri triplet gestation undergoing delayed interval delivery.

Case Presentation: Our patient was a G4P0 29 y.o. female, with history of IVF and jak-2+ essential thrombocythemia on weekly INF-alpha and daily prophylactic lovenox who presented in active labor at 22w2d with triamniotic-trichorionic triplets. An epidural was placed 12hrs after last lovenox dose. Patient rapidly progressed to complete dilation. AROM revealed thin meconium with subsequent vaginal delivery of Baby A. The cord was clamped and placenta remained in situ. Fetal heart tones on B and C were verified. The patient underwent expectant management with medications for tocolysis and infection prophylaxis. The epidural was removed PPD 1 after assurance of adequate tocolysis. CBC was drawn daily with fibrinogen, PT, PTT drawn q48hrs which remained normal. As patient remained on interferon therapy and platelets were normal, hematology recommended to hold lovenox during hospitalization. On PPD 5, active labor resumed and delivery was performed via cesarean for breech and transverse lie under spinal anesthesia. A friable uterus was noted intra-operatively. QBL was 450ml and no additional uterotonics needed. 24hrs of zosyn completed. Ampicillin, gentamicin, and clindamycin given for 96 hrs. Day of discharge was POD 7. Placenta pathology resulted chorioamnionitis.

Discussion: Delayed interval delivery has been reported to be 50 to 90% successful for remaining fetus survival with mean delivery of 18 days between 1st and 3rd triplet. (2) Neuraxial analgesia is vital in maintaining maternal comfort while ensuring tocolysis.(3) A balance exists between the former and the risk of eliminating pain as a sign of maternal or fetal complications.(3) Maternal complications have been reported with interval delivery including chorioamnionitis, abruption and post-partum hemorrhage. (2) In our case, anesthetic management included multidisciplinary perioperative anticoagulation planning for this patient with thrombocythemia on lovenox to deliver safe neuraxial analgesia and preparation for high risk delayed interval delivery.

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Abstract #: S-02

Anesthesia for Cesarean Section in a Patient with Gitelman Syndrome

Presenting Author: Alexandria Hart

Presenting Author's Institution: UNC Hospitals

Co-Authors: Jeremy Gue, MD - University of North Carolina Hospitals

Kathleen Smith - UNC Hospitals

Introduction: Gitelman syndrome (GS) is an autosomal recessive disorder characterized by renal dysfunction. Sodium chloride reabsorption is impaired, leading to a salt-wasting nephropathy that causes extracellular fluid contraction, hypokalemia, hypomagnesemia, metabolic alkalosis, and secondary hyperreninism and hyperaldosteronism. The disease is rare, with an incidence of 1 in 40,000. Onset occurs between late childhood and early adulthood with symptoms including fatigue, muscle weakness and cramping, and GI symptoms such as nausea and vomiting. Treatment is directed at correcting volume and electrolyte disturbances.

Case: 24yo G2P0010 with GS, port-related thrombosis on lifelong therapeutic Lovenox, and recurrent bacteremia related to port-site infections. She was diagnosed with severe GS at age 10, and required continuous IV fluids and electrolyte repletion (180meq K and 15mg Mag daily) via port prior to pregnancy. She followed closely with a nephrologist and PCP. She was extremely sensitive to mild stress, pain, and/or exertion, which would result in severe wasting of electrolytes, precipitating painful contractures that routinely required treatment with ondansetron, fentanyl, and midazolam. Given her complex medical history, a delivery plan was made with a multidisciplinary team of nephrology, MFM, OB anesthesia, and L&D staff. She was admitted for preoperative optimization 3 days prior to her scheduled cesarean. Nephrology assisted with IV fluid management and electrolyte repletion. She received one unit of PRBCs. Two peripheral IVs and an arterial line were placed, followed by a CSE with bupivacaine, morphine, and fentanyl. Her intraop course was complicated by mild uterine atony, treated with methylergonovine, misoprostol, and oxytocin. She was admitted to the MICU postop for monitoring and had an uncomplicated recovery.

Discussion: There is little published data or recommendations on the anesthetic management of GS in the parturient. These patients are at high risk of significant electrolyte and volume disturbances throughout pregnancy, especially in the peripartum period. A multidisciplinary approach is critical and should include MFM, anesthesia, and nephrology. A thorough preop assessment is imperative and should include ECG, electrolyte optimization, and awareness of potential complications associated with electrolyte derangements. A neuraxial technique is considered safe for both vaginal and cesarean delivery. Parturients with GS can have successful pregnancies and uncomplicated deliveries, provided close attention is paid to their increased electrolyte and volume repletion requirements.

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Abstract #: S-03

Urgent Cesarean Anesthetic Management During Acute Coronary Syndrome

Presenting Author: Katherine Herbert, MD

Presenting Author's Institution: Duke University - Durham, North Carolina

Co-Authors: Cameron Taylor, MD - Duke University

Introduction: Peripartum acute coronary syndrome (ACS) is rare with spontaneous coronary artery dissection (SCAD) being a common cause.^{1,2} Acute myocardial ischemia has the potential for maternal-fetal decompensation due to a supply-demand mismatch.³ Medical therapy for ACS has implications in urgent cesarean delivery anesthetic management. We present a case of a parturient with a presumptive SCAD diagnosis who required an urgent cesarean delivery.

Case Description: A 22-year-old woman G2P1 at 36 weeks of gestation presented with sanguineous nephrostomy drainage. Her pregnancy was complicated by asthma, anxiety, recurrent UTIs leading to hydronephrosis requiring percutaneous nephrostomy tube placement, and a penicillin allergy. Approximately 6 hours after initial antibiotic therapy for presumed pyelonephritis, she reported dyspnea and chest pain similar to a prior allergic reaction. The obstetric team administered epinephrine 1 mg intravenously; the patient noted worsening chest pain. Serial ECGs demonstrated T wave inversions in the anterior leads. The initial highly sensitive troponin T was < 6 ng/L with a subsequent level at 191 ng/L. She was transferred to the CCU and started on a heparin infusion for a presumptive SCAD diagnosis. Her TTE showed EF 50% with anterior/anteroseptal wall motion abnormalities. Her serial cardiac biomarkers trended to 24 ng/L while being medically managed. Initially, serial fetal tracings were category one; however, recurrent late decelerations developed necessitating an urgent cesarean delivery. After an interdisciplinary meeting, the heparin drip was discontinued to prepare for a neuraxial block. The PTT normalized after two hours, and a preoperative arterial line was placed. A lumbar epidural was sited without complication and bolused in aliquots of lidocaine 2% with sodium bicarbonate and epinephrine to T6 level. The patient remained hemodynamically stable and asymptomatic during the uncomplicated cesarean delivery. Postoperatively, patient noted chest pain with resolution by a dose of nitroglycerin. She was discharged home with cardiology follow up. An outpatient coronary angiogram demonstrated clean vasculature without evidence of dissection. The wall motion abnormalities persisted, though reduced in magnitude. The evidence suggests her inpatient coronary event likely was caused by vasospasm.

Discussion: ACS can potentiate urgent surgical intervention for the health of the maternal-fetal unit. As anticoagulation can be an integral therapy for ACS, the safety of neuraxial anesthesia should be thoughtfully considered. Intraoperative management should account for the recent cardiac injury. This clinical scenario requires thorough evaluation in the decision of neuraxial anesthesia and maintenance of hemodynamic stability to maximize patient safety.

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Abstract #: S-04

Profound Reaction to Uterotonics During Cesarean Section in Patient with Lupus

Presenting Author: Dan Hoang, DO

Presenting Author's Institution: University of Washington

Co-Authors: Nicholas Bishop, MD - University of Washington

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Mallika Thampy, MD - Swedish Medical Center, Seattle

Uterotonic medications such as oxytocin, carboprost, methylergonovine, and misoprostol are commonly used in the setting of postpartum hemorrhage. We report a case of a patient whose adverse reactions to uterotonic medications (misoprostol, carboprost) were severe enough to necessitate a general anesthetic (GA) and intubation.

A 47y G1P0 with lupus, hypothyroidism, depression (treated with sertraline and bupropion) and suspected pre-eclampsia presented at 39 weeks for induction of labor. She underwent cervical ripening with misoprostol before an oxytocin infusion was initiated for augmentation. She received a CSE early in her labor course; she eventually required a C-section for arrest of dilation despite high dose oxytocin infusion. Her epidural was converted for C-section using 2% lidocaine with uneventful fetal delivery.

Postpartum, she developed uterine atony despite oxytocin infusion. Sublingual misoprostol 400 mcg, and intramuscular carboprost 250 mcg (2 doses delivered 30 minutes apart) were administered to treat. Within twenty minutes of initial misoprostol and carboprost dosing, the patient developed rigors severe enough to mimic tonic-clonic movements, rigidity of her skeletal musculature, tachycardia to the 140s, systolic hypertension to the 200s, and pyrexia to 38.5. There was no elevation of EtCO₂, nor did she lose consciousness. The rigors and rigidity were severe enough to disrupt both surgical progress and the placement of a Bakri balloon, as the patient's legs were too rigid to be manipulated. Her anesthetic was then converted to GA and the patient was intubated (propofol, succinylcholine, and later rocuronium). Rigors and rigidity resolved after induction with paralytic but continued to have tachycardia to the 110s and systolic hypertension to the 150s. Hemostasis was eventually achieved but required interventional radiology for bilateral uterine artery embolization. Patient was extubated and taken to ICU with an otherwise uncomplicated postoperative recovery. Our differential diagnosis included serotonin syndrome, pre-eclampsia, eclampsia, thyrotoxicosis, local anesthetic systemic toxicity, and adverse drug reactions. We speculate the patient had an uncommon but severe reaction to misoprostol and possibly carboprost causing sudden onset of severe rigors, rigidity, tachycardia, and hypertension.

Abstract #: S-05

Anesthetic Management of a Parturient With Unicuspid Aortic Stenosis

Presenting Author: Chris Hull

Presenting Author's Institution: Northwestern Memorial Hospital

Co-Authors: Samir Patel - McGaw/Northwestern

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Introduction: Unicuspid aortic valve is a rare congenital malformation that usually presents in the 3rd to 5th decade of life with aortic stenosis, aortic regurgitation, or both. The estimated prevalence of a unicuspid aortic valve is 0.02% in adults¹. Given the significant hemodynamic changes that occur during pregnancy, women with valvular heart disease should be managed with a multidisciplinary approach throughout pregnancy. In this case report we describe the anesthetic management of a patient with moderate aortic valve stenosis from a unicuspid aortic valve presenting for induction of labor, which progressed to an urgent cesarean delivery after failed forceps delivery.

Case: A 28-year-old, G1P0 female with a PMH of unicuspid aortic valve with resultant aortic stenosis and aortic regurgitation presented for induction of labor. She had a recent echo which showed LVEF 63%, moderate aortic stenosis (peak gradient 44mmHg, mean gradient 29mmHg, AV area 1.15cm²), and mild aortic regurgitation. The obstetric plan was to do a forceps-assisted delivery in order to minimize hemodynamic changes from pushing. A radial arterial line was placed for close hemodynamic monitoring, and an early combined spinal-epidural technique was performed using an intrathecal dose of 25 mcg fentanyl. A PCEA was started with 0.0625% bupivacaine with 2mcg/mL fentanyl for continued labor analgesia. During forceps delivery, an adequate neuraxial blockade was achieved by incrementally dosing the epidural with 3% 2-chloroprocaine. Forceps delivery was unsuccessful, so the catheter was dosed again in order to achieve a T4 level for urgent cesarean delivery. Throughout the procedure, the patient's blood pressure was augmented with a phenylephrine infusion and boluses in order to maintain afterload. She had an uneventful cesarean delivery and postpartum course and was discharged on PPD #4.

Discussion: During pregnancy, there is an increase in plasma volume as well as cardiac output. Labor is characterized by a further 40-50% increase in cardiac output, which is mediated by pain-induced sympathetic discharge and auto-transfusion from uterine contractions. In aortic stenosis the stroke volume is fixed and patients become very sensitive to acute changes in preload and afterload, which can lead to myocardial ischemia and heart failure. Thus, considerations for these patients include invasive blood pressure monitoring for tight control of hemodynamics, early epidural placement, careful titration of local anesthetics, and vacuum or forceps delivery to minimize pushing during 2nd stage of labor. These patients should be managed with a multidisciplinary approach throughout pregnancy as well as during the delivery process.

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Abstract #: S-06

ANTENATAL ANESTHETIC CONSIDERATIONS IN OBSTETRIC PATIENT WITH THROMBOCYTOPENIA

Presenting Author: Shuchi Jain, DO

Presenting Author's Institution: Henry Ford Hospital - Detroit, Michigan

Co-Authors: Ami Attali, DO - Henry Ford Hospital

Joshua D. Younger, MD - Henry Ford Hospital

INTRODUCTION: Thrombocytopenia is defined as a platelet count of less than 150×10^3 per μL . This can result from decreased platelet production, increased platelet consumption, or sequestration (1). The etiology is often unknown and additional workup may be required. Mild thrombocytopenia is defined as a platelet count of between 70 and 150×10^3 per μL and severe if less than 20×10^3 per μL (1). Hemorrhage is a known complication of pregnancy and patients with thrombocytopenia are at a higher risk of bleeding. Neuraxial block may be denied in laboring patients with low platelet counts due to the risk for a spinal-epidural hematoma.

CASE: Our patient is a 25-year-old G1P0 with medical history of thrombocytopenia, who presented for induction of labor at 39 weeks. She mentioned history of epistaxis and menorrhagia since menarche. She underwent bone marrow biopsy in 2007 demonstrating normocellular trilineage hematopoiesis. Patient's platelet count ranged from 50×10^3 per μL to 60×10^3 per μL . She was discussed in maternal critical care conference and decision was made to avoid operative delivery, no neuraxial anesthesia if platelet count less than 75×10^3 per μL , and transfusion if patient required cesarean section. If at the time of delivery, patient's platelets were to be at or above 75×10^3 per μL , she would be deemed safe to receive epidural. Consideration was given to leave epidural in place for postoperative pain control. However, at the time of delivery, her platelets were 45×10^3 per μL and neuraxial anesthesia was not performed. Patient received intravenous sedation (fentanyl) for labor analgesia and was safely discharged home two days later.

DISCUSSION: In parturient with thrombocytopenia neuraxial anesthesia for analgesia is discouraged due to an increased risk of spinal-epidural hematoma (2). Though there is little data exploring this complication in the parturient, the estimated risk of epidural hematoma is 1:168,000 compared to 1:150,000 in the general population (2). Thus, it is important for pregnant patients with known thrombocytopenia to undergo further hematologic workup. Tests on platelet function are not routinely performed and may have merit in management of parturient with thrombocytopenia. Platelet mapping would allow for better assessment of actual platelet function rather than platelet quantity alone. Further research on obstetric patients with thrombocytopenia would also help to provide more data to create safe recommendations for such patients undergoing neuraxial anesthesia.

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Abstract #: S-07

HORNER'S SYNDROME FOLLOWING OBSTETRIC NEURAXIAL BLOCKADE – A CASE REPORT

Presenting Author: John Jalovec

Presenting Author's Institution: The Ohio State University

Co-Authors: Blair H. Hayes, MD - Ohio State University Wexner Medical Center

Case: A 32yo G3P0020 female presented at 39w5d gestational age for induction of labor. She had a PMH significant for GERD, hypothyroidism, depression and anxiety. An epidural catheter was placed at L3-4 shortly after admission for labor analgesia. Upon placement, the catheter was bolused with 10mL of 0.125% bupiv with 2mcg/mL fentanyl and continued on an infusion of a 0.0625% bupiv with 2mcg/mL fentanyl. Shortly after medication administration, the patient was noted to have left eye ptosis and left sided facial numbness. While Horner's syndrome was high on the differential, the obstetrics team and the patient felt it warranted a consult to neurology, who recommended MRI of her brain and cervical spine. The wire-wound epidural was removed to allow MRI imaging. Image results showed no acute abnormalities. A brief time following catheter removal, the patient's ptosis and facial numbness improved. As her labor pain worsened, epidural was replaced at L3/4 after counseling patient that her symptoms could return. The left eye ptosis returned with new onset associated left upper extremity paraesthesias. The infusion was then changed to an opioid only infusion. The patient had improvement in her Horner's syndrome and went on to have an uncomplicated SVD.

Discussion: Horner's syndrome, classically a triad of ptosis, miosis, and facial anhidrosis from sympathetic trunk blockade, is a rare complication of a labor epidural. This unexpected cranial spread of local anesthetic resulting in sympathectomy can cause maternal distress and may indicate imminent changes in a patient's clinical status.

Multiple factors can contribute to Horner's syndrome after obstetric neuraxial blockage including epidural septate and variability in the origin of sympathetic fibers. When patients present with Horner's syndrome, a full neurological evaluation should be completed to identify the patient's physical signs and to rule out more serious complications of epidural catheter placement such as intrathecal migration. Care should be taken to avoid maternal hemodynamic instability, maternal respiratory distress and ensure fetal well-being. If symptoms are present for longer than 24 hours, or are present with head and neck pain, further investigation should occur. Also, opioid only epidural infusion can be considered to continue to manage labor pain while the effects of the local anesthetic wear off.

In our case, an MRI may not have been necessary at that time. OB Anesthesia providers should feel empowered to educate our colleagues regarding the possibility of Horner's syndrome in lumbar labor epidurals. Timely recognition of Horner's syndrome can alleviate maternal anxiety and reduce the need for unnecessary and costly testing. Additionally, appropriate management of symptomatic patients can lead to improved perinatal pain control and reduce the need for repeat neuraxial procedures.

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Abstract #: S-08**Cesarean delivery in a parturient with neurofibromatosis 1 and Harrington rods: Is general anesthesia the only option?**

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Introduction: Neurofibromatosis 1 (NF1) is a neurocutaneous disorder, caused by a mutation in a tumour suppressor gene, with an incidence of 1 in 2500-3300.¹ Most patients present with café au lait spots and cutaneous neurofibromas. Neurofibromas also develop along peripheral nerves and, less commonly, in the central nervous system (CNS).¹ Neuraxial anesthesia (NA) can be complicated by the presence of peripheral neuropathy, spinal root compression, and scoliosis.^{1,2} Additionally, these patients may have difficult airways due to the presence of intraoral tumours and cervical spine involvement.¹ The sequelae of NF1 present several challenges for the delivery of obstetrical anesthesia including the decision to pursue NA or general anesthesia (GA).

Case Presentation: A 31-year-old G2P1 with NF1 underwent an elective repeat caesarean delivery (CD) for breech presentation. She previously had an urgent CD due to non-reassuring fetal heart rate under GA. She had no known history of intracranial or spinal tumours and no neurologic deficits. She had Harrington rods placed from T4-L3 for correction of scoliosis. Plain radiographs confirmed the presence of spinal instrumentation and residual thoracolumbar scoliosis. On physical exam, her airway was reassuring and she had limited flexion in her thoracic and lumbar spine. Neuraxial ultrasound revealed patent lumbar spaces with no subcutaneous tumours appreciated. While the patient expressed interest in NA, informed consent for GA was obtained due to the potential for CNS involvement, the absence of MRI neuroimaging, and the high risk for inadequate block. A healthy baby girl was delivered without perioperative complications.

Discussion: There are few case reports on the anesthetic management of parturients with NF1. In most cases, an MRI of the spine was obtained to assess for spinal tumours prior to neuraxial anesthesia^{3,4} or a GA was performed in the absence of neuroimaging⁵. There is no literature on the management of parturients with both NF1 and Harrington rods. Modern Harrington rods are MRI compatible but their presence distorts the images.⁶ In our case, GA was selected because of the paucity of information surrounding the safety of NA without preoperative MRI and the high risk for failed neuraxial blockade. However, with appropriate consent, NA may have been reasonable. Only one complication from a neuraxial procedure in a parturient with NF1 has been reported.⁶ The patient developed an epidural hematoma despite no evidence of neurofibroma on MRI.⁶ Ultrasound may be an alternative tool to identify large masses in the trajectory of needle placement for NA, but further research into the accuracy of neuraxial ultrasound in detecting neurofibromas is warranted.

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Abstract #: S-08



Abstract #: S-09**Just A Spinal Headache?**

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Presenting Author's Institution: University of Kentucky Department of Anesthesiology - Lexington, Kentucky

Co-Authors: Regina Fragneto

A 28-year-old female had a SVD with lumbar epidural analgesia at an OSH. The epidural placement was described as technically challenging and resulted in a one-sided block. Two hours after SVD she developed an occipital headache with dizziness and lightheadedness. These symptoms worsened and she presented to the OSH ED on PPD#3, where she was discovered to have a possible right-sided epidural hematoma on head CT. She was then transferred to our institution for further evaluation by our neurosurgeons.

At that time, she described her headache with radiation to the frontal region that decreased in intensity when supine, and was associated with light and noise sensitivity. Repeat head CT showed a 3-4 mm subdural hematoma over the fronto-parietal region without interval change. There was no mass effect, midline shift, or venous thrombosis. She was then admitted to the neurosurgery service for concern for intracranial hypotension and our Acute Pain Service was consulted for potential epidural blood patch. The first EBP was performed on the morning of PPD#4, but did not produce immediate relief of symptoms. Instead, mild relief was achieved about 2 hours post-procedure, but only lasted approximately 4 hours. On PPD#5 the Acute Pain Service was re-consulted as the patient still described a positional headache. A second EBP was not performed due to a lack of improvement in symptoms with the first EBP, no known history of dural puncture, and the confounding presence of her subdural hematoma. The patient was counseled that if this was truly a PDPH, her symptoms should resolve spontaneously within 1-2 weeks in more than 90% of patients. Consequently, the neurosurgery team discharged her later that day (PPD#5).

On PPD#25, the patient was brought to our institution's ED via ambulance as a stroke alert with worsening headache, left facial droop, and left-sided weakness and numbness. Head CT demonstrated a large right-sided subdural hematoma with 1 cm midline shift. She then proceeded to the operating room for emergent 2-burr hole washout. Follow-up head CT showed improvement in the subdural hematoma and the patient achieved resolution of her neurologic deficits. She was subsequently discharged on POD#2.

This particular case emphasizes that providers need to be mindful of not jumping to the conclusion that it's "just a spinal headache." When comparing the incidence of complications from neuraxial anesthesia, it's easy to see how this fallacy can become common thought. According to a cohort study¹ of more than 22 million women who experienced childbirth with neuraxial analgesia, there were 68,374 PDPH (309/100,000) compared to just 342 subdural hematomas (1.5/100,000). However, serious adverse events are associated with PDPH. Of the 342 cases of subdural hematoma, 100 were in women with PDPH, which is a rate of 147 hematomas/100,000 deliveries complicated by PDPH— a much more alarming number.

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Abstract #: S-10

Not Your Average Headache: Orthostatic Headache After Spinal Anesthesia for Cesarean Section Refractory to Epidural Blood Patch

Presenting Author: Anastasia Jones

Presenting Author's Institution: University of Florida

Co-Authors: M. Anthony Cometa - University of Florida

Tammy Euliano - University of Florida

Brandon Lopez - University of Florida

Introduction: Post-dural puncture headache (PDPH) is a common complication of neuraxial analgesia. Symptoms are caused by intracranial hypotension which can be managed medically, with various blocks, and/or with an epidural blood patch (EBP). Here we present a case of intracranial hypotension refractory to EBP.

Case: A 33 year old woman presented for repeat cesarean section after uncomplicated pregnancy. The operation was performed under spinal anesthesia accomplished after three passes of a 25g Whitacre needle at L4-L5. The procedure and post-op course were without complications. She was discharged post op day 3 with no complaints but returned on post op day 8 with a persistent orthostatic headache. Because she was heterozygous for Factor V Leiden and therefore at risk for clots, a CT head was obtained showing intracranial hypotension but no venous sinus thrombosis. She underwent EBP (10mL at L3-L4) with immediate improvement of her symptoms. However, she continued to have a low-grade headache that gradually worsened prompting the patient to seek evaluation by a neurologist 7 weeks post-op. He recommended repeat EBP based on findings of intracranial hypotension on repeat CT. EBP was performed (12mL at L4-L5) with improvement of her symptoms although the orthostatic headache never fully resolved. Due to persistent symptoms, CT myelogram was obtained demonstrating multiple dural cysts with early contrast extravasation at the cervical, thoracic, and lumbar spine. The patient was offered an epidural blood patch with interventional radiology but elected to continue medical therapy.

Discussion: Post-partum headaches have an extensive differential ranging from benign to life-threatening. It is imperative for anesthesiologists to be familiar with the evaluation due to frequent involvement in peripartum care and the high acuity of etiologies such as preeclampsia, meningitis, stroke, intracerebral and subarachnoid hemorrhage, and dural sinus thrombosis. The incidence of PDPH after spinal with a 25g Whitacre is 2-3%, and most cases don't require EBP. A persistent low pressure headache 7 weeks post-op warrants additional workup. In this case we discuss a complex post-partum headache due to intracranial hypotension in the context of multiple dural cysts with active extravasation.

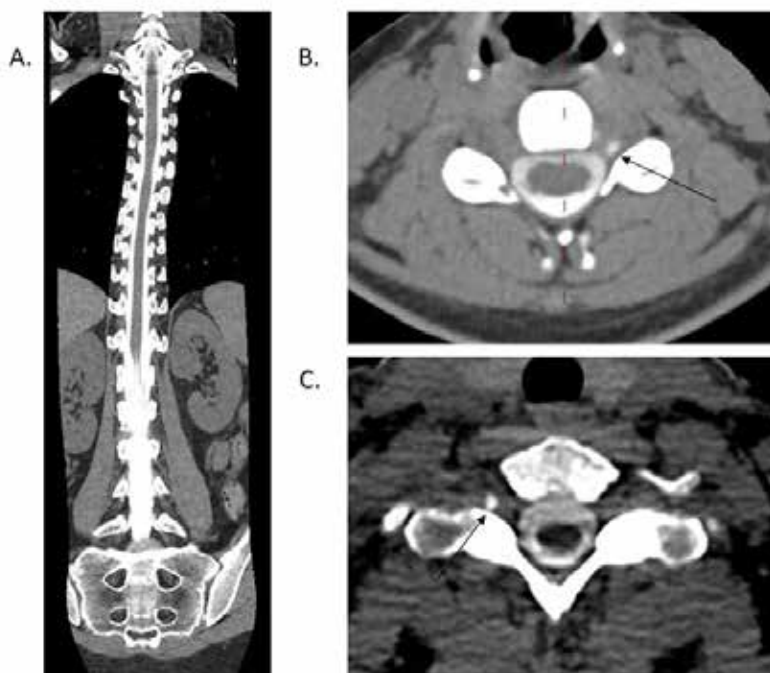
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Images of CT myelogram. A: Coronal spine section demonstrating early thoracic transforaminal extravasation. B. Early contrast extravasation left C4-C5 indicated with an arrow. B: Early extravasation (arrow) at right C7-T1.

Abstract #: S-11**Successful multidisciplinary management of a parturient with a unicuspid unicommissural aortic valve, severe aortic stenosis and Goltz syndrome****Presenting Author:** Cameron Jones, MD, FS**Presenting Author's Institution:** George Washington University Hospital**Co-Authors:** Michelle Burnette, MD - George Washington University Hospital

A unicuspid unicommissural aortic valve is a rare congenital defect that can lead to severe aortic stenosis. Its incidence is estimated to be .02% in the adult population (1). Women with aortic stenosis are at higher risk of developing complications during pregnancy including pulmonary edema, arrhythmias, and less commonly aortic dissection as well as adverse fetal outcomes. Higher risk of maternal complications is seen during third trimester through delivery and in the immediate post-partum setting when cardiac output is elevated. Unicuspid aortic valve induced aortic stenosis has to date, not been specifically described in the context of obstetric anesthesia.

A 23-year-old gravida 2 para 0101 with Goltz syndrome was transferred to our hospital at 33 weeks with severe symptomatic anemia (Hemoglobin 5.4) and admitted to our antepartum service. Transthoracic echocardiography showed a unicuspid unicommissural aortic valve with severe aortic stenosis (valve area 0.63 cm², mean gradient 54.79 mmHg) and a hyperdynamic left ventricle.

A multidisciplinary team comprised of maternal-fetal medicine, anesthesia, cardiac critical care and social work was assembled to coordinate delivery planning and further management. A 35-week 5-day induction of labor following betamethasone was planned. Prior to induction with oxytocin a radial arterial line was placed for continuous blood pressure and cardiac output/stroke volume variation monitoring, and a right internal jugular introducer catheter was placed for central venous access if advanced hemodynamic support was required. An epidural catheter was placed without difficulty, and using a continuous epidural infusion of 0.125% bupivacaine with 2 mcg/ml Fentanyl effective analgesia was achieved. During induction the cardiac bypass machine, cardiac surgery, and perfusion teams were on standby should veno-arterial extracorporeal membrane oxygenation have been needed. Forceps assisted delivery was performed upon reaching stage 2. She remained hemodynamically stable and comfortable with estimated blood loss of 300cc. Her epidural, arterial, and central lines were removed and she was transferred to the ward on post-partum day 1, and discharged home on day 2.

This case demonstrates the need for close multidisciplinary collaboration and careful planning in parturients with cardiac valvulopathies. While unicuspid aortic valve is quite rare, the strategies employed in this case to ensure proper care and appropriate emergency planning demonstrate that even rare and severe abnormalities can be managed to ensure optimal outcome, and that patients with severe cardiac abnormalities may still undergo vaginal delivery.

Following discharge, the patient was recommended for aortic valve replacement, however she was subsequently lost to follow up.

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Abstract #: S-12

Anesthetic Management of Emergent Craniotomy and Cesarean Delivery in Setting of Twin Pregnancy

Presenting Author: Sanjay Kadari, MD

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Co-Authors: Kimberley Nichols, MD - University of North Carolina

The anesthetic management of combined emergency cesarean section and craniotomy presents many unique challenges that require a multidisciplinary team approach and prompt communication to ensure successful maternal and neonatal outcome. Our case adds further to these challenges as the emergent case was conducted in the setting of twin pregnancy.

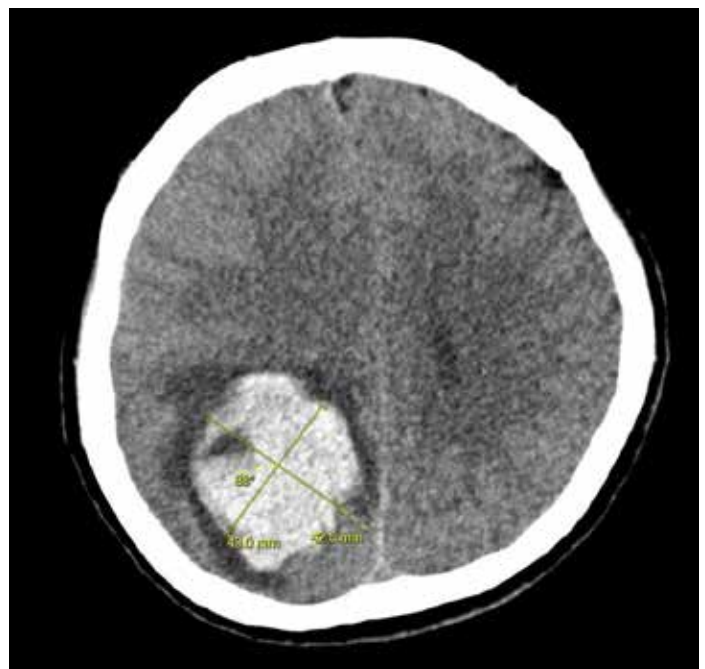
A 49 year old G5P3104 at 33 weeks and 2 days of gestation with DiDi twins was admitted for new diagnosis of fetal growth restriction of twin and developing preeclampsia. Patient was diagnosed with preeclampsia without severe features based on elevated blood pressures and elevated urine protein/creatinine ratio. Patient continued to have elevated pressures, however the systolic pressure maxed out in the 150s on subsequent days. Given blood pressures close to severe range, patient was managed as inpatient rather than home management. On hospital day 17, patient complained of intractable headache with blurry vision that quickly transitioned to neurological decline. CT head demonstrated a right parietal hemorrhage with midline shift. Decision was made to perform an emergency craniotomy and cesarean delivery.

Patient was emergently intubated prior to the operating room due to decline in neurological status. Cesarean delivery of twins was performed without complications. The neurosurgery team performed craniotomy and evacuation of the hematoma. Patient was transported to the intensive care unit, however, developed persistent elevated intracranial pressures throughout the day. Repeat imaging showed collapsed ventricles, increasing edema and brain compression and thus was taken back emergently for second decompression. This procedure was complicated with worsening hemodynamic changes and diffuse bleeding requiring administration of coagulation factors and vasopressors.

Intracerebral hemorrhage is an infrequent and severe complication of preeclampsia. As our case demonstrated, the onset can be sudden without precluding factors such as severe blood pressure readings or abnormal lab values. Certain risk factors such as age > 35 years, multiple gestation, greater parity, and coagulopathy have been identified with pregnancy related stroke¹. Literature reporting for anesthetic management of combined craniotomy and cesarean is scarce, and even more so, for twin pregnancies where the risk of postpartum hemorrhage and maternal/fetal morbidity is increased. In our case, careful detail to various aspects of anesthetic management such as airway establishment, intraoperative blood pressure and intracranial pressure management, and maintenance of uterine perfusion and tone was required.

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Abstract #: S-13**Uterine and Bladder Rupture in Morbidly Obese Patient with Difficult Airway****Presenting Author:** Shradha Khadge, MD**Presenting Author's Institution:** Mount Sinai Hospital - New York, New York**Co-Authors:** Jessica Siegelheim, MD - Mount Sinai Hospital

34 year old G9P4044 at 38w4d complicated by gestational DM, macrosomia, and polyhydramnios was admitted for premature rupture of membranes (PROM) and early labor. Maternal past medical history was significant for BMI 51, previous vaginal delivery followed by low transverse cesarean section (LTCS) x 2 (failed induction of labor for PROM) followed by vaginal birth after cesarean (VBAC) x 1, and spontaneous abortion (SAB) x4. Patient was counseled to have a repeat LTCS due to unstable lie and polyhydramnios in the setting of unfavorable cervix. All risks and benefits were discussed fully but the patient desired a trial of labor after cesarean (TOLAC). Successful dural puncture epidural was performed at L3-4, and the patient labored approximately 10hrs. She had a category II fetal heart tracing (FHT) when the decision was made to stop oxytocin and prepare for a cesarean section for arrest of descent. The anesthesiology team planned to use the working epidural given her airway exam was concerning for a difficult airway (Mallampati 3, BMI 51 with a thick neck, labor and pushing). Within 10min of discontinuing oxytocin, the patient began to have more severe variable decelerations and an increase in fetal heart rate baseline to 160s. The tracing progressed to minimal variability and deep late decelerations, then bradycardia. The patient was immediately taken to the OR for an emergent cesarean for category III FHT. The anesthesiology team confirmed an adequate level of epidural anesthesia, and the decision was made to continue using the working epidural due to the emergent nature of fetal distress. Upon opening the peritoneum, fetal parts were discovered with uterine and bladder rupture. The neonate was delivered without difficulty and handed to NICU team (Apgars 3, 8). A second large bore IV and arterial line were placed, and 1 U pRBCs was administered. The gynecologic oncology team spoke with the patient and husband to consent for an emergent hysterectomy and were able to quickly control the bleeding. The anesthesiology team discussed converting to general anesthesia but ultimately, since the patient was hemodynamically stable throughout and hemostasis was quickly achieved, decided to continue using the epidural. Urology placed bilateral ureteral stents, a suprapubic foley catheter, and repaired the bladder. The quantitative blood loss was 956mL. The patient recovered in the postanesthesia care unit. She was managed without issues on the general postpartum floor, and discharged home on postoperative day 5.

Abstract #: S-14

It's not always Post Dural Puncture Headache

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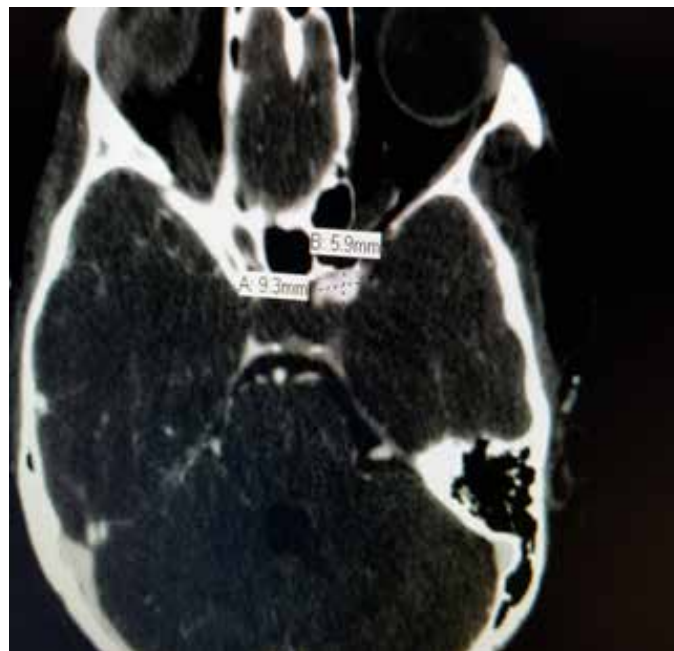
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Aneurysm incidence in general population and during pregnancy is about 2 % (1) and majority of the aneurysms are located in the anterior circulation (80-90%) while the remaining affects the posterior circulation.(2) Normal physiologic hemodynamic changes during pregnancy may increase risk of aneurysm formation ,progression and even rupture (3). However, the incidence of unruptured or incidental cerebral aneurysm during pregnancy is not well established (4). Labor epidural complicated by post dural puncture headache (PDPH) as a result of accidental dural puncture is not uncommon (5). One third of patients with accidental dural puncture are not recognized at the time of procedure and presents as PDPH post delivery (6). Lumbar epidural blood patch provide symptomatic relief in 93% of patients after first and in 97% of cases after a second epidural blood patch (7). We present a unique case of a refractory PDPH in a young parturient with an incidental intracranial aneurysm treated with endovascular embolization to relieve symptoms.

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Abstract #: S-15

An Undiagnosed Invasive Placental Pathology Presenting Spontaneously at 23 Weeks of Gestation

Presenting Author: Sana Khan

Presenting Author's Institution: Maimonides Medical Center

Co-Authors: Christina Dgheim, DO - Maimonides Medical Center

Kalpana Tyagaraj, MD - Maimonides Medical Center

Introduction: This is a case report of a 38 yo G6P2122 at 23 weeks gestation with a history of 2 prior cesarean sections, presenting to the emergency room with abdominal pain and shortness of breath. The patient became progressively hemodynamically unstable and was found to have hemoperitoneum secondary to placental percreta leading an emergent combined cesarean section and hysterectomy.

Case: Our patient presented to the hospital with shortness of breath and abdominal pain. She was found to have hypotension, tachycardia, with down-trending hemoglobin, requiring MICU admission. Abdominal ultrasound revealed free fluid in the abdomen along with placenta percreta.

Initially, her signs and symptoms were thought to be secondary to septic shock due to upper respiratory illness as her primary complaints were shortness of breath presenting during the flu season. However, upon IR guided paracentesis of the free fluid, she was found to have hemoperitoneum secondary to placenta percreta leading an emergent combined cesarean section and hysterectomy.

Upon arrival to the operating room standard ASA monitors were placed and the patient was intubated with an RSI induction. She had bilateral 18G IVs, central line, and a radial arterial line placed after induction. Massive Transfusion Protocol was initiated. During the case a total EBL was 11L of blood loss, 17 uPRBC, 13u FFP, 3u PLTs, 2u cryoprecipitate, and 4L of lactated ringers was administered. Serial arterial blood gases were drawn to monitor hematocrit, pH, and electrolytes. The fetus was delivered successfully and admitted to the NICU. The procedure proceeded with a cystotomy and ureteral repair, along with a hysterectomy. At the end of the procedure, the patient remained intubated and taken back to the MICU.

Discussion: The unique features of this case include the early invasive nature of the placenta leading to symptoms of hemorrhage at only 23 weeks of pregnancy, as these patients are usually planned for elective cesarean section, often combined with a planned cesarean hysterectomy at 36 weeks of gestation. Moreover initial diagnosis was delayed because the patient was complaining of shortness of breath and upper respiratory symptoms confounding it with diagnosis of Influenza infection amidst the flu season. Once the diagnosis was made an interdisciplinary team approach with anesthesiologists, obstetricians, interventional radiologists, and gynecologic oncologist was made to care for the patient.

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Abstract #: S-16**Massive Pulmonary Embolism and Cardiac Arrest during Cesarean Section****Presenting Author:** Kim Michael**Presenting Author's Institution:** New York Presbyterian Weill Cornell Medical Center**Co-Authors:** Jaime A. Aaronson, MD - New York Presbyterian Weill Cornell Medicine

Laura Burey - New York Presbyterian Weill Cornell Medical Center

Samantha Smith - New York Presbyterian Weill Cornell Medical Center

A 32 year-old G5P2 at 36w4d with breech fetus and history of two prior cesarean deliveries presented in preterm labor and was brought urgently to the operating room. Shortly after uterine incision and amniotomy, she complained of shortness of breath and quickly decompensated into PEA. Resuscitation began immediately, and return of spontaneous circulation was achieved in 6 minutes. Her uterine and abdominal incisions were closed, and she was transferred to the ICU, intubated and breathing spontaneously on a propofol infusion. Point of care ultrasound revealed RV distension and ventricular septal flattening. CT revealed right mainstem, segmental, and subsegmental pulmonary emboli with evidence of right heart strain. Bilateral lower extremity doppler ultrasound was negative for DVT. After multidisciplinary consultation with interventional radiology and cardiothoracic surgery and discussion of treatment options, the patient was started on a low dose heparin infusion (6 hours after cesarean delivery), in the setting of stable hemodynamics and pulmonary function. Alternative treatments, including surgical thromboembolectomy or catheter directed thrombolysis, were deemed too high risk for bleeding. On POD1, the patient progressively became hypotensive and anemic. CTA of the abdomen and pelvis revealed uterine bleeding with large hemoperitoneum. The patient underwent emergent bilateral uterine artery embolization. Low dose heparin was restarted on POD3. The patient was extubated by POD4, transitioned to enoxaparin on POD6, and discharged home without any neurologic or cardiac deficits on POD13.

Discussion: Pulmonary embolism (PE) accounts for 9% of pregnancy-related death in the United States.¹ The estimated incidence of PE in pregnancy is 3.6 events per 10,000 deliveries, with a mortality rate of 2.4%.² The incidence of massive or sub-massive PE is even lower, and the optimal management of these patients is unclear. A 2017 systematic review found a significant risk of bleeding after any type of invasive treatment option, especially if the intervention occurred after delivery.³ This case illustrates the management of a massive PE with a low dose heparin infusion that was complicated by postpartum uterine bleeding. Management of these patients should include multidisciplinary discussion of potential treatment options, with careful consideration of the risks and benefits of treatment.

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Abstract #: S-17**Cesarean section for a patient with progressive multifocal leukoencephalopathy****Presenting Author:** In Kim**Presenting Author's Institution:** Johns Hopkins Hospital**Co-Authors:** Oleg Turkot - Johns Hopkins Hospital

Human immunodeficiency virus (HIV) is a complex multi-organ medical disorder. One of the most feared but rare complication is progressive multifocal leukoencephalopathy (PML), an opportunistic infection characterized by progressive demyelination and inflammation of the white matter in the central nervous system. Given the rarity and lack of standard management for this condition, we present our anesthetic management of a patient diagnosed with PML who underwent a successful cesarean section (CS).

A 29 year old, 58kg, G2P1001 female presented to us at gestational age of 36 weeks and 6 days for repeat cesarean section in the setting of late fetal heart rate deceleration and severe preeclampsia (PEC). Her history is significant for HIV complicated by PML, herpes simplex virus type 2, depression, and prior cesarean section due to elevated HIV viral load. She initially presented to our hospital one month ago complaining of worsening right sided weakness, eventually leading to complete paralysis, along with aphasia and dysphagia during a four-month span. Her initial labs were significant for HIV viral load of 19,000 and CD4 count of 84. Diagnostic tests including brain biopsy and brain MRI were consistent with PML in the setting of uncontrolled HIV. She was immediately treated with antiretroviral therapy (ART), after which she exhibited lethargy and seizure-like episodes concerning for PML-immune reconstitution inflammatory syndrome (IRIS). She was started on prednisone and discharged home as her symptoms gradually improved.

Upon her admission for the repeat CS, repeat viral load was undetectable and physical exam was notable for unremarkable airway exam, improved right extremity strength but intermittent spasticity of her right arm, and resolution of dysphagia. Given that PML can exhibit uncertain and even erratic progression of neurologic symptoms, it was decided to avoid neuraxial anesthesia due to the concerns of worsening her already compromised central nervous system. We decided to proceed with general anesthesia with endotracheal tube for the CS. PML is an upper motor neuron disease that can lead to spasticity of the corticobulbar muscles. This can cause difficult mask ventilation and intubation due to limited mouth opening and masticatory muscle spasm. Patient received pre-induction radial arterial line and rapid sequence induction was performed with propofol, lidocaine, succinylcholine, and esmolol. Patient was intubated using a 7.0mm ETT with Glidescope Mac 3 blade on the first attempt. Intraoperative course was uncomplicated with estimated blood loss of 600 ml and total fluid intake of 2L. For postoperative pain control, we performed bilateral quadratus lumborum nerve block prior to extubation. Patient had an unremarkable postoperative course and was discharge home on postoperative day 3 with stable neurologic function.

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Abstract #: S-18

Cesarean section after an eclamptic seizure

Presenting Author: In Kim

Presenting Author's Institution: Johns Hopkins Hospital

Co-Authors: Oleg Turkot - Johns Hopkins Hospital

Eclampsia is a serious and sometimes fatal complication of pregnancy characterized by seizures in the setting of pre-eclampsia. It is one of the most common emergencies encountered by obstetric anesthesiologists and presents a challenge in anesthetic management. The maternity mortality rate in those who suffer from eclampsia is as high as 14% in developing countries. We present our anesthetic management of a patient who suffered an eclamptic seizure requiring an emergency cesarean section.

A 29 year old, 115kg, G1P0 female with past medical history of chronic hypertension presented to the emergency department (ED) at gestational age of 29 weeks and 1 days after suffering from a witnessed tonic-clonic seizure in her bathroom. In the ED, she had broken her seizure spontaneously and was obtunded in a post-ictal state. Initial vital signs were significant for blood pressure in 170s/110s, heart rate in 110-150s, and saturating 100% on room air. Physical examination was significant for morbid obesity, orientation to name and date only, limited mouth opening, mallampati class 4, and significant tongue laceration and swelling with active bleeding into the oropharyngeal space. She received IM betamethasone, 20mg IV labetalol, 6g bolus of IV magnesium, and 2g per hour IV magnesium infusion. Initial lab values were notable for urine protein to creatinine ratio of 1.6 and creatinine of 1.1 with no other abnormal findings. Head CT findings were consistent with posterior reversible encephalopathy syndrome with no mass or herniation. As the presentation was most consistent with eclampsia, decision was made to proceed with delivery. However, given patient's mental status, she was deemed unable to provide consent and a telephone consent was obtained from her father to proceed with necessary surgery with anesthesia. Given her recent eclampsia, severe ranging blood pressures, and physical exam concerning for difficult ventilation and intubation, we decided to proceed with combined spinal epidural for the cesarean section. Arterial line was placed prior to the procedure for close hemodynamic monitoring and patient was assisted in remaining upright for the neuraxial placement given her obtunded level of consciousness. Spinal anesthesia was successfully administered with hyperbaric bupivacaine and fentanyl, and the subsequent sympathectomy was augmented with phenylephrine infusion. Patient tolerated the surgery well without additional seizures and exhibited no change in her neurologic state. Surgery was overall unremarkable with estimated blood loss of 500 mL, urine output of 50 mL, and fluid administration of 750 mL. Postoperatively, patient was administered 1.5mg of epidural morphine with excellent pain control. Patient's mental state improved to her baseline on postoperative day 1 with improvement in kidney function and blood pressure.

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Abstract #: S-19

Considerations of Multiple Coagulation Factor Deficiencies in Pregnancy

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Introduction: Factor VII deficiency is a rare autosomal recessive coagulation disorder that can be inherited or acquired. There have been few cases of Factor VII deficiency during pregnancy. Factor VII deficiency can result in clinically significant manifestations, particularly excessive bleeding with surgical interventions. We present a case of management of a parturient with factor VII and XII deficiencies.

Case Report: A 37 year old G4P0 at 37th week of pregnancy with known factor VII and factor XII deficiencies presenting for elective cesarean section for breech presentation. Obstetric history is significant for missed abortion at 16 weeks, a 34 weeks intrauterine fetal demise and 25 weeks live birth with neonatal demise.

A visit to the hematologist occurred 8 months prior to delivery where patient was found to have mildly prolonged PT with factor VII deficiency (32%) and factor XII deficiency (45%). Several weeks later, patient continued to have mildly prolonged PT with factor VII deficiency (29%), but improved factor XII deficiency (73%). After this, patient was lost to follow up with hematology until patient presented to hospital for elective C-Section.

A multidisciplinary discussion was held with hematology, anesthesiology and the obstetrical team. The decision was made to obtain new factor levels prior to C-Section. Because of poor obstetric history, patient was kept on the labor floor for close monitoring of fetal heart rate.

Labwork returned with normal PT, normal factor VII levels (65%), and normal factor XII levels (111%). Packed RBCs, FFP, recombinant Factor VII and tranexamic acid were on standby. Spinal anesthesia was performed. Cesarean section was completed uneventfully with estimated blood loss of 700 mL with adequate hemostasis. Patient was closely monitored afterwards, with no evidence of increased bleeding and stable hemoglobin/hematocrit. Patient was discharged on 3rd post-operative day.

Discussion: Clinical symptoms and presentation of factor VII deficiency can range from asymptomatic presentation to life-threatening bleeding. Management of factor VII deficiency during pregnancy requires striking a fine balance between the hypercoagulability of pregnancy which may lead to thrombus formation, and achieving hemostasis to control antepartum and postpartum hemorrhage.

This is made more difficult with the poor correlation between patients who have factor VII deficiency and the severity of bleeding that they will experience.

Careful follow up and planning with meticulous attention to factor levels involving multispecialties in the care plan can yield favorable outcomes. In our patient, C-Section was delayed to obtain factor levels and to get the appropriate blood products ready to ensure conditions were optimized in the delivery plan of our parturient.

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Lee YJ, Ju DH, Yi SW, Lee SS, Sohn WS. Successful management of maternal factor VII deficiency in a cesarean section. *Obstet Gynecol Sci.* 2014;57(4):314–317.

Abstract #: S-20**A case of cesarean delivery in severe pulmonary hypertension associated with mixed connective tissue disease (MCTD)**

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Mixed connective tissue disease is a rare autoimmune disorder that has 3 other connective tissue diseases. Women with MCTD are at higher risk for exacerbations of the disease during pregnancy(1), it can also cause fetal growth restriction or increased rates of sudden intrauterine death. Pulmonary hypertension (PH) associated MCTD is a great concern for pregnancy(2).

The case described is a 44-year-old woman (G2P1) with 20 weeks of gestation admitted to the hospital because of oligohydramnios and fetal growth restriction (FGR). She diagnosed MCTD 9 years ago and she had been under stable condition clinically by the treatment of prednisone 10mg/day and cyclosporin 50mg/day. After the hospitalization, she received a transabdominal amnioinfusion to maintain an amniotic fluid pocket, however her membrane has ruptured completely which lead to serious neonatal condition. At the same time, she was diagnosed PAH by echocardiography and confirmed by pulmonary arterial catheterization (PAC) at 22weeks of gestation which estimated mean pulmonary artery pressure (mPAP) of 33mmHg and pulmonary vascular resistance (PVR) of 3.02wood units. Although a termination of the pregnancy was out of the question for the patient, her renal function has got worsen until 24 weeks of gestation. As a result, a caesarean section was scheduled for the week 26 considering the risk for mother's life. Multidisciplinary team consisted of obstetricians, neonatologists, cardiologists and anesthesiologists. Arterial line was inserted before the induction of general anesthesia and hemodynamic assessment with PAC and TEE was provided. PCPS was stand-by just in case. mPAP showed between 25 and 28 mmHg at the beginning of the operation. Newborn girl infant was sleep status and transferred to NICU immediately. After the delivery, mPAP was decreased to < 20mmHg and the patient remained stable throughout the operation, and the patient transferred to ICU with intubation to monitor PAP continuously. Follow-up PAC was underdone a week after with mean PAP and PVR were increased 30mmHg and 4.96wood units respectively. Methylprednisone pulse therapy was started because of the concern for exacerbation of the disease activity. Thanks for this treatment, mean PA was reduced and she was discharged with 10mg/day oral prednisone.

We experienced a case of cesarean section in a patient with MCTD. Based on our case, it is suggested that monitoring PAP with PAC perioperative period for MCTD patients with PH is useful and careful observation is required for postpartum period in these patients to avoid disease flares.

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Abstract #: S-21

A Cauda Equina Conundrum: Anesthetic Management For Repeat Cesarean Section

Presenting Author: Sarah Kroh, MD

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Background: Pregnant patients with a history of cauda equina syndrome often have residual neurological deficits and can present a unique challenge to the anesthesiologist on labor & delivery. There are only limited case reports of anesthetic management during cesarean section in this patient population.

Case: We report a 32 year old female gravida 2 para 1 who came to clinic for preanesthesia evaluation prior to elective repeat cesarean delivery with a history of cauda equina syndrome. This had developed between her first and second pregnancies due to a herniated nucleus polyposis at L4/5 and she underwent an emergency discectomy at the time of diagnosis. She had residual neurological deficits including bladder incontinence and right lower extremity weakness which required walking with a cane. She also developed secondary chronic pain managed via spinal cord stimulator. On initial evaluation she was adamant that she did not want general anesthesia. The informed consent process was lengthy and initially the patient desired spinal anesthesia with local anesthetics despite the significant risks explained to her. After additional phone calls, emails and an in person multidisciplinary care conference with anesthesia, obstetrics and neonatology she agreed to general anesthesia supplemented with single shot intrathecal morphine and an expeditious wake-up during skin closure in order to allow her to meet her infant as soon as possible. On the day of delivery the plan proceeded smoothly and she ended up extremely satisfied with her anesthetic care.

Conclusion: Care must be taken for pregnant patients with a history of cauda equina syndrome and other neurological comorbidities to formulate an individualized and safe plan for anesthesia and pain relief during labor and delivery. A preanesthesia evaluation well in advance of delivery allows time to review literature, address patient concerns and consult with colleagues.

The "double crush" hypothesis suggests patients with pre-existing neural compromise may be more susceptible to injury when exposed to secondary insults such as local anesthetics. Because of this the recommendation was made against traditional spinal anesthesia. However, morphine has not been shown to be neurotoxic and a single shot of intrathecal morphine can be a useful and well tolerated adjunct to general anesthesia in patients with existing neurological deficit.

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Abstract #: S-22**Breast cancer in pregnancy made complicated by a severe pain state: a case report****Presenting Author:** Michael Holland, MD**Presenting Author's Institution:** Rush University Medical Center**Co-Authors:** Jessica H. Kruse - Rush

Introduction: Pregnancy associated breast cancer (PABC) is rare occurring once in every 3000 pregnancies [3]. However, PABC is increasing in incidence as women are delaying childbirth. [2]. The basic definition of PABC is restricted to breast cancer diagnosed during or within one year of pregnancy [4]. Although the pathophysiology of PABC is not fully understood, the hormone milieu during pregnancy is thought to be a risk factor for hormonally mediated cancers such as breast cancer. Because of the rising incidence, poor prognosis, and increased clinical complexity, it is important for obstetric anesthesiologists to understand the care of patients with PABC.

Case: We present the case of a 39-year-old G3P1102 who was diagnosed with metastatic invasive ductal carcinoma ER+PR+ Her2 - at 25weeks gestation. The diagnosis was made when the patient presented with hip pain and was found to have pathologic fractures of the pelvis and right humerus from metastases.

Because the patient had numerous, painful bone metastasis to her pelvis she underwent cesarean section at 37 weeks under general anesthesia. At the time of delivery, the patient was on a home pain regimen including hydrocodone-acetaminophen 10-324mg 2tablets q4h PRN, hydromorphone 4mg q4h, fentanyl 100mcg/hr TD patch, and cyclobenzaprine 5mg q8h. Given her opioid tolerance, multiple measures were taken to meet her analgesic requirement in the perioperative period.

Intraoperatively, she received 100mcg of fentanyl, 5mg of morphine, and a total of 40mg of ketamine in addition to her continued home scheduled pain medications. Prior to extubation, she was given IV Tylenol and ketorolac and had bilateral TAP catheters placed with an infusion of ropivacaine 0.2% at 8cc/hr. Her pain was finally controlled in the intensive care unit by the addition of a hydromorphone patient controlled analgesia pump and a continuous ketamine infusion.

Discussion: This case exemplifies the intricacies of caring for patients with PABC. Because our patient's diagnosis was delayed, she suffered from cancer-induced bone pain, a complex pain state with only half of those affected experiencing pain relief with current modalities [1]. Although there is definitive treatment for cancer-induced bone pain, this is contraindicated in pregnancy [3]. Thus necessitating her high opioid regimen, which resembled opioid induced hyperalgesia and complicated her postoperative pain control. All obstetric anesthesiologists need a working knowledge of PABC and how to care for these patients.

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Abstract #: S-23

The successful delivery of a parturient with Eisenmenger's syndrome: a case report

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Co-Authors: Michael Holland, MD - Rush University Medical Center

Introduction: Parturients with congenital heart disease (CHD) make up 1- 4% of all pregnancies. The number of pregnancies complicated by maternal CHD is increasing in number as these women are living well into their reproductive years.[3] The physiologic changes that occur during pregnancy place all women at risk for circulatory dysfunction. This is even truer for those with CHD. Furthermore, those with pulmonary hypertension have the greatest risk with a 25-30% mortality rate.[2] Although pregnancy in pulmonary hypertension is contraindicated[1], this is ultimately a patient's choice.

Case: We present the case of a 25yo G2P1001 with a history of severe pulmonary hypertension due to an uncorrected secundum atrial septal defect. Her initial echocardiogram showed a large secundum ASD with left to right shunting and decreased right ventricular function. Her follow-up echocardiogram before delivery showed an bidirectional flow through the ASD meeting diagnostic criteria for Eisenmenger's syndrome; a syndrome with a 50% mortality rate in pregnancy [2].

When the patient presented for indication at 37 weeks gestation, her PICC line was accessed for CVP monitoring, an arterial line and an 18gauge IV were placed. For labor analgesia, an epidural was placed, and it's level gradually increased with a continuous infusion. She remained hemodynamically stable during labor induction. Prior to forceps delivery, the epidural was bloused with 50mcg of fentanyl and 5cc of 2% lidocaine to obtain surgical level anesthesia. The forceps assisted delivery was uneventful resulting in delivery of a healthy female with apgars 9/9. Shortly after delivery, she was transferred to the intensive care unit where she remained hemodynamically stable until her discharge on postoperative day six.

Discussion: Pregnancy is a sustained high-volume state causing increased stress on the heart and therefore, requires hemodynamic adaptations.[1] Increased cardiac output, increased plasma volume, and fluid shifts during pregnancy and delivery are poorly tolerated with those that have pulmonary hypertension. [4] The mode of delivery and anesthetic plan are dependent upon maternal wellbeing and fetal maturity. [2] As more patients with CHD are choosing to have children, it is imperative for the obstetric anesthesiologist to understand their unique management.

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Abstract #: S-24**Cervical Detachment: A Case Report of Uterine Rupture During Home Labor****Presenting Author:** Kelsey Kukuza, D.O.**Presenting Author's Institution:** Kaweah Delta Health Care District, California**Co-Authors:** Eric Morell, M.D. - Kaweah Delta Health Care District

Uterine rupture, defined as a full-thickness tear through the uterine wall, is a catastrophic event that can occur during any pregnancy, but, is most likely to occur during vaginal delivery after a prior cesarean.¹ Diagnosis may be challenging and almost always results in fetal demise. This case report discusses a 37-year-old female G5P4004 with two prior cesarean deliveries and two vaginal births after cesarean, that presented with severe abdominal pain after a trial of home labor. On exam, uterine contractions were observed with scant blood in the vaginal vault, fetal station -3, and no fetal heart tones nor fetal movement on ultrasound. The patient was taken emergently to the operating room for cesarean delivery. After rapid sequence intubation and surgical incision, uterine rupture was immediately apparent with an intra-abdominal fetal head and placenta. Complete circumferential rupture of the uterus at the isthmus with cervical detachment caused fetal demise and necessitated a total hysterectomy. She was resuscitated with three units of packed red blood cells, one unit of fresh frozen plasma and 4000 mL of crystalloid. Estimated blood loss was 2600 milliliters. She was monitored for three days and discharged from the hospital in stable condition.

In 2018, VBACs were responsible for 13.3% of the nearly 2.5 million babies delivered vaginally.² Interestingly, repeat elective cesarean has a 0.013% risk of maternal mortality which is higher than the 0.004% risk in TOLAC patients.³ In patients with a prior low transverse cesarean scar, there is an overall 0.3% risk of uterine rupture, which increases during TOLAC to 0.47%.³ If uterine rupture occurs, maternal and/or fetal morbidity and mortality can exceed 10%.¹ Prolonged fetal bradycardia is the earliest and most reliable indicator of uterine rupture in a suspected patient.⁴ Management requires immediate cesarean delivery to minimize the risk of fetal demise and maternal hemorrhage.⁵ Epidural anesthesia is a great option for TOLAC patients, allowing for rapid surgical anesthesia if needed. For patients desiring TOLAC and VBAC, it is important to counsel about the risks of uterine rupture and to perform labor in an environment with immediate medical and surgical care available.

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Abstract #: S-25

Transient Expressive Aphasia After Spinal Anesthesia for Cesarean Section

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Case: A 36 y.o G5P4 with a history of hypothyroidism and gestational diabetes presents for repeat cesarean section(C/S) at 36 weeks. The pregnancy was complicated by preterm labor, placenta previa and gestational diabetes, managed with magnesium, celestone and insulin. The patient was also a victim of domestic abuse. Spinal anesthesia with 1.6 ml 0.75% hyperbaric bupivacaine (12 mg), 0.15 mg morphine and 10 mcg fentanyl resulted in a T4 level. Ten minutes later, the patient became hypotensive and nauseous for 3 mins (lowest BP, 85/32), corrected with phenylephrine and ephedrine boluses. Surgery commenced and the patient's blood pressure was stable throughout. Shortly after the hypotensive event the patient began to have slurred speech which progressed to expressive aphasia. She was nonverbal for 45 minutes despite attempts at speech and then spontaneously regained fluent speech. Twenty minutes post-op while in PACU, the patient experienced another episode of transient aphasia (stuttering and paucity of speech) lasting 15 minutes. Neurology was consulted and a complete neurologic workup was negative. There were no further episodes and she was discharged on post-op day 4.

Discussion: Though uncommon, development of a transient focal neurological deficit (FND) shortly after spinal or combined spinal anesthesia has been reported in a number of cases (1). Hypoxia, hypotension or a thromboembolism could compromise cerebral perfusion and cause a transient ischemic attack (TIA). Other etiologies include high spinal block, conversion disorder and absence seizures.

In this patient there was no history of seizures and EEG revealed no abnormalities. CT/MRI brain were also negative. Carotid artery Doppler and Duplex ultrasound revealed no significant stenosis or hemodynamic abnormalities, ruling out an embolic source. Psychiatric illness was ruled out and counseling was recommended.

Similar cases where transient FND occurred shortly after spinal anesthesia have been reported in the literature (2). In almost all cases fentanyl or sufentanil were used as adjuvants. Cephalad spread of the local or opioid may affect cranial nerves in the brainstem and speech areas causing the transient FND seen clinically. The resolution of the symptoms and return to normal baseline function can be attributed to the clearance of fentanyl from the CSF. We could not rule out the possibility of conversion disorder perhaps triggered by the hypotensive episode.

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Abstract #: S-26

Amniotic Fluid Embolism In A 31 Year Old Whom Ultimately Survived

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Introduction: Amniotic fluid embolisms are rare events, occurring in approximately 2-6/100,000 births. Diagnosis of AFE had historically been considered a diagnosis of exclusion for maternal cardiac arrest and disseminated intravascular coagulation (DIC) during childbirth. The estimated mortality is 20% in the developed world. In 2016 a working group of the Society for Maternal-Fetal Medicine (SMFM) and the Amniotic Fluid Embolism Foundation proposed a definition of AFE based on the presence of four diagnostic criteria present. Here we present a case meeting all criteria for AFE in a patient who survived.

Case: An obese (BMI 47) 31 year old G6P4024 at 37w0d was admitted for repeat cesarean section secondary to three prior cesarean sections. She delivered uneventfully after CSE placement. Immediately after placental delivery, the patient lost consciousness. Cardiac arrest was quickly identified and ACLS initiated. ROSC was obtained after one round of CPR, with 1mg of epinephrine and 1.2mg of atropine given. Patient was intubated and arterial line placed. The patient then became hypotensive and blood was noted to be pooling under the drapes. She was resedated for surgical exploration. Massive hemorrhage was found. Central line was placed, massive transfusion protocol initiated, and epinephrine infusion started. TEE showed a hyperdynamic heart without valvular pathology. The patient's uterus was boggy despite oxytocin and methylergonovine. The patient required a total abdominal hysterectomy and left salpingo-oophorectomy to control bleeding. She continued to bleed secondary to DIC. In the ICU, she continued bleeding despite aggressive blood product replacement. Amniotic fluid embolism was diagnosed.

The patient required six OR takebacks for evacuation of blood and ligation of bleeding vessels. Estimated EBL was 45.5L, for which she received a total of 101 units of packed red blood cells, 98 units of fresh frozen plasma, 12 units of cryoprecipitate, and 11 units of pooled platelets.

The patient remained intubated in the SICU, developing MRSA pneumonia. Pulmonary status stabilized and she was extubated on POD #10. The patient required rehabilitation for deconditioning and delirium, but was ultimately stable for discharge on POD#20.

Discussion: This patient met the four diagnosis criteria for AFE with sudden cardiorespiratory arrest, overt DIC, clinical onset within 30 minutes of delivery, and absence of fever. Hypoxemia and right heart strain are also clinical features seen with AFE, which we did not see in this case. Possibly due to near immediate ionotropic and respiratory support after presentation of symptoms.

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Abstract #: S-27

Eisenmenger syndrome: Anesthesia for a Planned C-section

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Co-Authors: Diana Feinstein - Temple University Hospital

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33yo F G2P0010 @ 33w3d with history of unrepaired ventricular septal defect causing severe pulmonary HTN, subsequently requiring 4L nasal cannula, with baseline Sat's 87-89%, and mild Eisenmenger syndrome was found to have late fetal decelerations on planned non-stress test. Her superimposed pre-eclampsia/ HELLP was worsening with increased blood pressures and down trending thrombocytopenia at 70; plan was for delivery via primary c-section. She was 5'4", and 58.6kg. Home medications were continued: Sildenafil 60mg TID, Tyvaso 9 breaths QID, and Lasix 20mg three times a week. Last lasix dose given AM prior to c-section. Patient was counseled on pros and cons of epidural anesthesia versus general anesthesia (mainly epidural hematoma vs prolonged intubation). We proceeded with epidural anesthesia, with pre-induction arterial line placement, and continuous nebulized epoprostenol. All lines and fluids were meticulously de-aired. Plan for minimal crystalloid, with colloid replacement as needed. She was given Lidocaine with epi test dose, found to be negative, and then bolused with Chlorprocaine 3% for surgical anesthesia along with starting phenylephrine infusion. Patient received prophylactic antibiotics. Viable preterm female neonate with APGARS 9/9 was delivered uneventfully. Patient then received oxytocin infusion for hemostasis and Morphine via epidural for post-op pain control. EBL was noted to be 300ml and she received a total of Albumin 250ml and Normal Saline 500ml. She recovered without any sequelae and was discharged home as planned. She had normal follow-up with the Obstetrician and Cardiologist.

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Abstract #: S-28

Multiple unintentional dural punctures in a patient with prior spinal instrumentation without a post-dural puncture headache: is epidural scarring protective?

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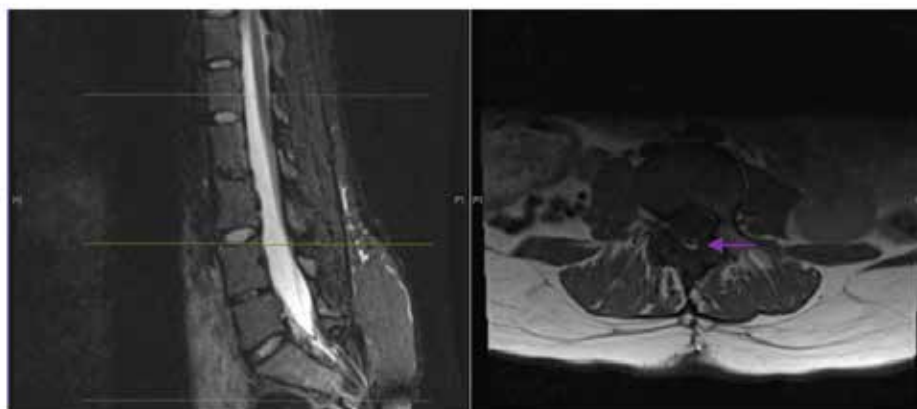
Introduction: Neuraxial analgesia can be difficult to perform in parturients with previous spinal instrumentation (SI). Challenges include distortion of surface anatomy, difficulty with positioning, and prior surgical disruption of ligamentum flavum making perception of loss of resistance (LOR) indistinguishable.¹ These patients often require multiple attempts at placement and are at higher risk for unintentional dural punctures (UDP). The incidence of post-dural puncture headaches (PDPH) from UPD vary from 60-86%.^{2,3} To the best of our knowledge, no studies have specifically looked into the incidence of PDPH in parturients with prior SI.

Case Presentation: Our case involves a 22 year-old G1P0 at 40 weeks and 2 days gestational age who presented in spontaneous labor to the labor and delivery unit. Her medical history included dextrocardia, short stature, scoliosis, and a tethered cord with a L4-L5 laminotomy, untethering, and clipping of filum terminale at age 12. A peripartum MRI of her lumbar spine showed multiple spinal anomalies including partial fusions of multiple vertebral bodies, a hypoplastic sacrum, and fatty infiltration of the filum terminale. As there was no re-tethering of her spinal cord, she was deemed an appropriate candidate for neuraxial analgesia in preanesthesia consultation.

Epidural placement was complicated by multiple attempts at three levels. LOR was found at L5-S1, and the intrathecal (IT) dose was administered with a 25-gauge spinal needle with slow drip of cerebral spinal fluid (CSF) from the 17-gauge Touhy after the spinal needle was withdrawn. Attempts to thread a catheter were unsuccessful, and the Touhy was withdrawn and redirected at the same level. LOR was re-obtained, and the catheter threaded easily. Aspiration through the catheter was negative, and test dose was administered. The patient developed a lower extremity motor block a few minutes later, and CSF was easily aspirated from catheter at that time. Her catheter was dosed as an IT catheter and provided adequate analgesia for labor. Postpartum, the catheter was removed, and the patient was serially followed with no complaints of PDPH.

Discussion: PDPH was an anticipated complication given that this patient had UDP twice with a large bore cutting needle. However, it is hypothesized that her very limited epidural space (Figure 1) likely from epidural scarring due to her prior SI may have limited the amount of CSF leak, decreasing her risk of PDPH. Further studies on PDPH in patients with SI would be helpful to assess the possible protective nature of epidural scarring.

Figure 1: The patient's MRI at L3-L4 reveals a very small epidural space.



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Abstract #: S-29

Considerations When Performing an Epidural Blood Patch on a Patient Anticoagulated with Low Molecular Weight Heparin: A Case Report

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Case Report: A 36yo G2P1001 with a history of endometriosis, asthma, childhood seizures and pulmonary embolism secondary to oral contraceptives presented for a planned cesarean section (CS) due to a 4th degree laceration with prior delivery. An epidural as primary was planned given concern for prolonged procedure due to dense adhesions from a prior surgery for endometriosis. In her third trimester, she was started on prophylactic Low molecular weight heparin (LMWH) 40mg BID, which she discontinued 12 hours prior to the CS. Initial epidural attempt was complicated by an unintentional dural puncture. Subsequent epidural placement was successful, and a T4 level achieved. CS proceeded without complication, with removal of the epidural catheter 4 hours after delivery and LMWH being restarted 12 hours after removal. Patient developed a post dural puncture headache (PDPH) approximately 24 hours following her dural puncture. Conservative measures were unsuccessful and a 30 mL epidural blood patch (EBP) procedure was performed after holding LMWH for 18 hours. The patient endorsed immediate symptomatic relief without obvious complications, and LMWH was resumed 12 hours thereafter.

Unfortunately, PDPH symptoms returned 74 hours after EBP. After holding LMWH for 18 hours, the procedure was repeated, again with prompt symptomatic relief.

Discussion: American Society of Regional Anesthesia and Pain Medicine (ASRA) guidelines recommend holding LMWH for 12 hours prior to performing neuraxial procedures in order to decrease the risk of hemorrhage and subsequent epidural hematoma (1). However, there are no guidelines specific to EBP in an anticoagulated patient, though additional risks and considerations do apply. The anticoagulant can impair or prolong clot formation leading to poor EBP efficacy, however, interrupting anticoagulation in the hypercoagulable post-partum state should also be time-limited.

Two case reports have documented successful EBPs in similar patient populations. LMWH was held for 12 hours prior in one case (2) and for 24 hours in the other (3). In both cases, LMWH was resumed 12 hours post-procedure. Balancing procedural bleeding risk and EBP efficacy concerns with the thrombosis risk of anticoagulation interruption, we held our patient's LMMH 18 hours (1.5 times the minimum recommended for neuraxial procedures). Two separate epidural blood patches were successful on this patient.

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Abstract #: S-30**Spinal chloroprocaine for obstetrical non-delivery procedures: a retrospective analysis of the practice at an academic center****Presenting Author:** Shane Mandalia, DO**Presenting Author's Institution:** University of Washington**Co-Authors:** Laurent Bollag, MD - University of Washington School of Medicine

Carlos Delgado, MD - University of Washington

Background: Chloroprocaine (CP), an ester local anesthetic, has been increasingly used for neuraxial anesthesia due to its shorter duration of motor blockade and similar safety profile following ambulatory procedures when compared to bupivacaine^{1,2}. In short-duration cases, improved recovery time, and earlier ambulation and hospital discharge times are reported³. During the local anesthetic shortage in 2018⁴, spinal CP became commonly used for short duration cases in our Labor and Delivery (L&D) unit. We reviewed all cases done with spinal CP to evaluate its effectiveness, safety and speed of recovery.

Methods: After obtaining IRB approval, a retrospective electronic chart review from July 2010 to Dec 2019 using the keyword "chloroprocaine" in obstetric patients was performed. Demographic data, obstetric data, and anesthetic/peri-anesthetic data (CP dose, block height, supplemental analgesics and intra operative episodes of bradycardia or hypotension, and times to block regression, ambulation and discharge from recovery) were obtained.

Results: Data from 25 patients were analyzed (Table). The most common procedure was cervical cerclage (72%, n=18). Mean surgical duration was 26 mins. Mean CP dose used was 47 mg. Median time to ambulation was 188 mins (n=19) and median time to discharge from recovery was 208 mins (n=15). The highest and lowest dermatomal levels achieved were T4 and T12, respectively, with a median level at T10 (n=12). No events of cauda equina or postoperative paresthesia were reported. One patient reported transient back pain on postoperative day 1 that self-resolved. One patient had a failed block which required a repeat spinal anesthetic.

Discussion: Spinal CP has been used in obstetrics, both for labor analgesia and cesarean delivery anesthesia. As part of a combined spinal-epidural for labor, the ED95 is reported to be 19mg⁵. In non-pregnant patients, a dose of 40mg is recommended for procedures up to 1 hour duration⁶. For cesarean delivery, the median dermatomal level after 40mg of CP was T4 and regression of the block was evidenced at 77 min⁷. In the non-pregnant population, times to ambulation and discharge were reported at 225min and 277min, respectively¹. Our reported median doses and time to recovery readiness fall within these reported ranges, however the analysis was limited due to its retrospective nature and the availability and reliability of the data, especially regarding time-charting. Block failure was rare and the limited use of additional analgesia supported this finding. No cases of cauda equina or postoperative paresthesia were observed, one patient reported back pain that self resolved, questioning the association with transient neurological symptoms. In conclusion, we have successfully and safely used spinal CP for short non-delivery procedures in our L&D unit.

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Abstract #: S-30
Table. Demographic, anesthetic and peri-anesthetic variables.

Variable		
Age (years)		32 (\pm 6)
Height (cm)		163 (\pm 6)
BMI		31 (\pm 7)
Gestational age (weeks), n=23		21 (\pm 9)
Type of procedure	Cerclage (n,%)	18 (72%)
	Dilation and Curettage (n,%)	3 (12%)
	Others (n,%)	4 (16%)
Spinal to incision time (min)		18 (15,21)
Surgery duration (min)		26 (20,37)
Chloroprocaine dose (mg)		47 (\pm 14)
Intraoperative sedation (n,%)		6 (24%)
Intraoperative hypotension (n,%)		5 (20%)
Intraoperative bradycardia (n,%)		1 (4%)
Failed blocks (n,%)		1 (4%)
Spinal to block regression time (min), n=13		119 (93,140)
Spinal to ambulation time (min), n=19		188 (170,218)
Spinal to discharge time (min), n=15		208 (172,272)
Postoperative paresthesia (n)		0
Cauda equina syndrome symptoms (n)		0
Transient neurological symptoms (n,%)		1 (4%)

Results expressed as mean (\pm SD), median (IQR 25,75), proportion where applicable.

Abstract #: S-31

Psychogenic non-epileptic seizures during a Cesarean delivery in a patient with Charcot-Marie-Tooth

Presenting Author: Shane Mandalia, DO

Presenting Author's Institution: University of Washington

Co-Authors: Shyam Deshpande, MD - University of Washington

Hani El-Omrani, MB, BCh - University of Washington

Introduction: Psychogenic non-epileptic seizures (PNES) mimic seizure-like movements or behaviors but lack abnormal cerebral electrical activity. PNES present unique diagnostic and therapeutic challenges in pregnancy, as multiple pregnancy-related conditions predispose women to seizures.¹ PNES is uncommon with a prevalence of 2–33/100,000,² and few reports have described PNES during pregnancy.^{1,3} To our knowledge, there have been no reported cases of PNES complicating a cesarean delivery (CD).

Case Description: A 27-year-old G4P2021 at term with a history of Charcot-Marie-Tooth and epilepsy on levetiracetam underwent a repeat CD due to worsening neurogenic bladder and lower extremity and abdominal neuropathic pain. She had not been taking levetiracetam consistently but was seizure-free for 2 years. Previous CD under spinal anesthesia was uneventful. A combined spinal epidural was placed, and CD proceeded routinely until 2 minutes before uterotomy when the patient had an acute episode of non-responsiveness, side-to-side head movements, closed eyes, and bilateral upper extremity asynchronous movements that lasted 30 s and self-resolved. A second 30s episode followed and was treated with midazolam 2mg. The infant was delivered minutes later and was vigorous. The patient subsequently experienced 2 more intraoperative and 6 more post-operative events of similar character. She maintained a patent airway and stable vital signs throughout. The patient incrementally received midazolam up to 8 mg and propofol up to 240 mg total for treatment of suspected recurrent seizures. She was admitted to the ICU post-operatively for monitoring for 1 day. Neurology consult resulted in EEG demonstrating non-epileptic event. The patient and infant were discharged in good condition on post-op day 5. A diagnosis of PNES was made based on the observed semiology and EEG findings.

Discussion: This case describes the unique challenges of intraoperative seizure-like activity in a parturient. Intraoperative seizure activity must be assessed promptly due to the potential risk to the mother and fetus. Differential includes but is not limited to underlying epilepsy, stroke, metabolic derangements, medication withdrawal or toxicity such as LAST and pregnancy-related disease such as eclampsia.¹ Maternal injury prevention, airway management, and maintenance of fetal oxygenation until delivery are of utmost importance. The use of benzodiazepines, hypnotics or rapid-acting antiepileptics can cause maternal and neonatal respiratory depression. PNES should be considered in the differential as a diagnosis of exclusion. PNES is usually psychological in origin – associated with emotional distress, anxiety and post-traumatic stress disorder – and it does not respond to typical seizure-arresting medications. In this case, the patient was counseled on the diagnosis and scheduled for continuity neurology care as an outpatient.

References:

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Abstract #: S-32**Chronic Dilated Cardiomyopathy Complicated with Pre-Eclampsia with Severe Features****Presenting Author:** Rishi Kadakia**Presenting Author's Institution:** Mount Sinai Hospital**Co-Authors:** Julio Marengo - Mount Sinai Hospital

Migdalia Saloum - Icahn School of Medicine - Mount Sinai West and St. Luke's Hospitals

A 38 year old female G1P0, presented at 34 weeks and 1 day in labor. Medical history was significant for GDM A2 on insulin, chronic HTN with superimposed pre-eclampsia with severe features, morbid obesity and prior pelvic surgery. During her interrogation it was endorsed that the patient had a brother who passed away at an early age from an unknown "heart condition". Her physical exam was remarkable for shortness of breath, chest discomfort and orthopnea; blood pressure: 172/103 mm Hg, heart rate: 129 beats per minute, SpO₂: 98%, respirations 18 per minute, temperature: 37.1 ° C. weight: 99.8 kg. height: 1.63 m. BMI 37.74. An EKG showed presence of new LBBB (not noted on her previous chart). Labs showed elevated liver enzymes, the remaining labs were NL. An urgent cardiology consult was called. TTE showed an LVEF of 10-15%, dilated left ventricle, moderate mitral regurgitation and normal right heart function. Due to the patient's worsening pre-eclampsia and new cardiac findings, upon discussion with the OB and MFM teams, urgent delivery was decided. Because of her history of prior pelvic injury it was recommended to proceed with cesarean delivery.

Aline was placed. The patient then received a CSE. The spinal anesthetic included 20mcg of Fentanyl, 200mcg of PF Morphine and 0.5mL of 0.75%Bupivacaine. Lidocaine 2% was administered in increments of 5 mL for a total dose of 10 mL. Cesarean delivery was uneventful. APGAR: 9/9. The patient was transferred to the SICU for observation. This is a patient presenting with chronic dilated cardiomyopathy, complicated by pre-clampsia for urgent cesarean delivery; limited evidence exists suggesting anesthetic guidance in this scenario, the time frame for optimization was short and vaginal delivery was not recommended. Medical literature often recommends optimization prior to delivery for patients with peripartum cardiomyopathy. Concomitant pre-eclampsia is considered to be especially deleterious in the setting of her reduced SV due to the presence of increased afterload. We believed that slow induction via the epidural catheter allows for development of surgical anesthesia as well as safe and gradual reduction in SVR. This leads to a decrease in afterload and avoids increases in myocardial oxygen demand. It is recommended a pre-induction Aline followed by placement of an epidural catheter and slow titration of local anesthetic to reduce sudden hemodynamic changes. It is important to assess your center's resources and to organize a multidisciplinary team to manage these cases.

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Abstract #: S-33

UNRECOGNIZED PERIPARTUM SPONTANEOUS RETROPERITONEAL HEMATOMA: A CASE REPORT

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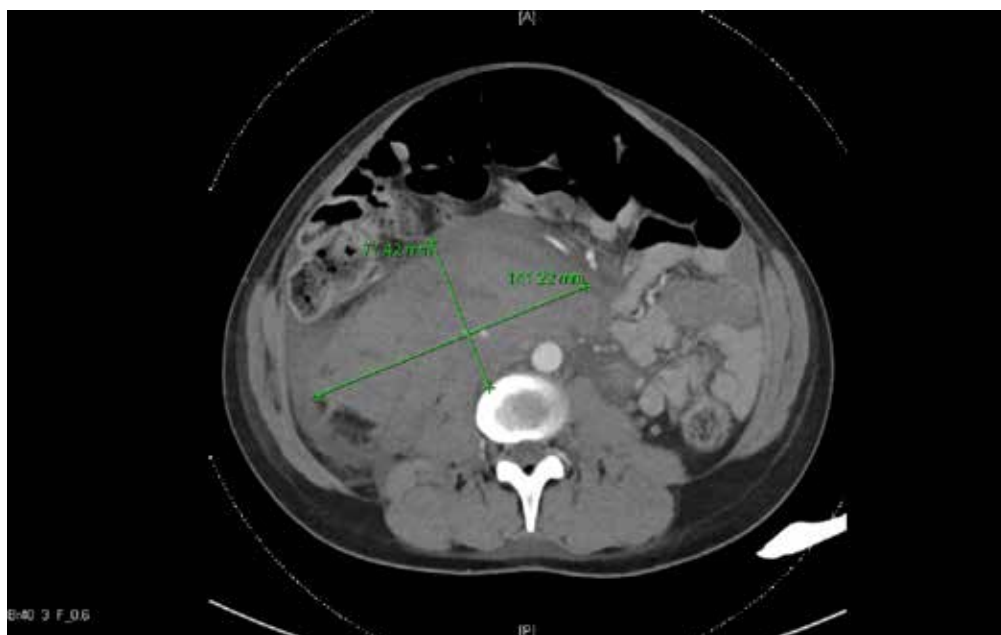
Introduction: Spontaneous retroperitoneal hematoma is a rare, potentially fatal entity that is often misdiagnosed, occurring more frequently in elderly, anticoagulated patients with abdominal pain as a presenting symptom.¹ Aneurysms of the visceral circulation represent just 0.1-10.4% of cases, with renal cell carcinoma accounting for 57-73%.² We present a case of spontaneous peripartum retroperitoneal hematoma in a parturient.

Case: A 29 year-old G4P2 with past history of sickle cell trait and chronic anemia with a hemoglobin (Hgb) 9.1 g/dL presented in preterm labor at 35 weeks gestation. An uncomplicated combined spinal-epidural (CSE) was placed for labor pain. The epidural catheter was removed on hospital day 2 when she was transferred to antepartum after arrest of cervical dilation at 4 cm. On day 3, she again complained of contractions with back pain, and a second uncomplicated CSE was placed. Laboratory values were remarkable for a Hgb 6.7 g/dL and fibrinogen of 203 mg/dL, but her vitals remained stable. She was transfused 2u pRBCs with resulting Hgb 7.8 g/dL. The epidural catheter was again removed as contractions subsided. On day 4, contractions increased, so augmentation of labor was begun due to concern for placental abruption. A third CSE was placed. After vaginal delivery, the patient became hypertensive with a witnessed tonic-clonic seizure and was transferred to the ICU where eclampsia treatment ensued. Exam was notable for new onset bilateral lower extremity (LE) weakness, numbness with intact reflexes, and 1-2 beat clonus with constant lower back pain. An MRI spine on day 5 showed no evidence of cord compression or epidural hematoma. Her symptoms continued until day 6 when CT scan showed bilateral ovarian artery aneurysms with rupture of the right, resulting in a 7.7x14.1x17cm retroperitoneal hematoma. The patient was urgently transfused 2u pRBCs and underwent emergent coil embolization. Over the next 6 days, the patient's abdominal pain subsided, her LE weakness improved, and her hemodynamics stabilized. After consultation with rheumatology and vascular surgery, a connective tissue abnormality without systemic vasculitis was the leading diagnosis.

Discussion: Although a rare diagnosis, the protracted nature of symptoms along with continued hematological abnormalities were unique. This case exemplifies why significant anemia without a source should warrant further investigation immediately. The onset of back pain coincided with preterm labor so it was not until LE weakness developed that a broadening of the differential ensued.

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Abstract #: S-34

Subdural Hematoma Formation Following Incidental Dural Puncture and Intrathecal Catheter Placement

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BACKGROUND: Subdural hematomas (SDH) are an extension postdural puncture headache (PDPH). The dural puncture leads to loss of cerebrospinal fluid and rupture of the intracranial veins.¹The subdural bleed causes intracranial hypertension, which leads to symptoms that diverge from those of PDPHs. The headaches experienced become non-postural and focal neurological symptoms are present.²

CASE REPORT: A 24 year old G1P0010 was induced at 38 weeks gestation due to gestational diabetes. She received a 1 liter bolus of crystalloid. A combined spinal-epidural (CSE) was attempted at the L3-L4 and L4-L5 spaces, but it was difficult due to undiagnosed scoliosis. The dura was accidentally punctured at L4 with 17G Touhy and an intrathecal catheter was placed. The intrathecal catheter was loaded with 5 ml of 0.25% bupivacaine and pain relief was achieved. A healthy baby was delivered 13 hours later. The estimated blood loss was 300 ml. On postpartum day 1, she had a 10/10 positional headache; it was worse in an upright position and better in supine position. The headache did not improve with acetaminophen. An epidural blood patch (EBP) was conducted at L4. Following the EBP, she had complete relief of her headache and was discharged the next day.

Her headache recurred after 24 hours of being discharged. She presented to the emergency room after 72 hours of unremitting 5/10 headache. The headache was still positional and associated with emesis and photophobia. Her vital signs were stable. A head CT was completed and it revealed a 6 mm right-sided SDH with minimal mass effect. She was admitted to the ICU. Initially, she was managed conservatively. A second CT scan showed no change in size of the SDH. Due to the unremitting nature of her headache, a second EBP was performed postpartum day 9. Following EBP, she had complete relief and recovery.

DISCUSSION: There should be a low threshold for evaluation of subdural hematoma via CT with contrast or MRI in patients who have been previously diagnosed with PDPH and refractory to conservative therapy and EBP.^{3,4} We believe that a second EBP should be common practice in setting of a failed EBP, especially in patients who required multiple epidural placement attempts in order to decrease the probability of possible subdural hematoma expansion.

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Abstract #: S-35

Management of a Parturient with Recurrent Mollaret's Meningitis

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Co-Authors: Heather Craig, MD - Montefiore Medical Center

Background: Mollaret's meningitis (MM) is a rare disease characterized by recurrent episodes of viral, aseptic meningitis. It is clinically indistinguishable from other meningitis variants. Symptoms are fever, headache, neck pain, vomiting, myalgias, arthralgias, and neurologic signs (positive Kernig and Brudzinski signs). Herpes Simplex type 2 virus (HSV2) was identified as the most common agent causing Mollaret syndrome, and the retrograde seeding of the cerebrospinal fluid by HSV2 results in meningitis. However, the exact trigger of recurrent episodes is unknown. Studies show that Acyclovir reduces the number and severity of occurrences. An extensive literature search revealed little information and no recommendations for the anesthetic management of a parturient with MM.

Case Report: A 28-year-old G2P1001 with a 17-year history of MM and a prior cesarean delivery 8 years ago was admitted at 36 weeks gestation in pre-term labor. Her previous delivery was accomplished under neuraxial anesthesia (NA) and her postoperative course was not complicated by an episode of meningitis. Her last exacerbation occurred one year ago and was successfully managed with IV Acyclovir. She was not taking any medications. She desired a trial of labor (TOL) after cesarean and requested labor analgesia. She denied fever, neck stiffness, and photophobia. Her vitals, labs, and physical exam were within normal limits. A combined spinal-epidural was placed under routine sterile precautions. Her TOL was unsuccessful and a healthy baby girl was delivered by repeat cesarean delivery. Her epidural catheter was removed upon discharge from the PACU. Her postpartum course was uneventful, and she was discharged home 3 days later. Two months after delivery, she denied any signs or symptoms of an acute meningitis exacerbation.

Discussion: MM is very rare and information regarding the anesthetic management of a parturient with this disease is lacking. We had concerns that performing NA in this patient may trigger an acute exacerbation. However, by definition, this syndrome has a benign course and usually resolves spontaneously without residual deficit. After discussion with the patient, she agreed it was an acceptable risk. We considered treating her with Acyclovir prophylactically, however; she was asymptomatic, afebrile, and had a known favorable response to treatment with Acyclovir in the past. We decided to adopt a wait and watch strategy and reserve treatment in the event she manifested symptoms of acute meningitis. Our patient had an uneventful labor course and postpartum recovery. We hope our case report will aid those who manage parturients with MM.

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Abstract #: S-36

ANESTHETIC MANAGEMENT OF A POST-PARTUM PATIENT WITH FACTOR V LEIDEN DURING THROMBECTOMY AND INFERIOR VENA CAVA FILTER RETRIEVAL WITH SUBSEQUENT RIGHT VENTRICULAR AND PULMONARY EMBOLISM

Presenting Author: Cory McCurry, D.O.

Presenting Author's Institution: Henry Ford Health System

Co-Authors: Prabhkiran K. Nakai, MD - Henry Ford Health System

Joshua D. Younger, MD - Henry Ford Hospital

INTRODUCTION: Factor V Leiden (FVL) results from a single point mutation in the factor V gene. FVL renders factor V insensitive to the actions of activated protein C, a natural anticoagulant. As a result, individuals who carry the FVL variant are at increased risk of venous thromboembolism (VTE) (1). Patients with FVL are especially at risk for VTE in pregnancy due to the concomitant physiologic changes in the coagulation system and physical changes associated with pregnancy.

CASE: A 28-year-old G1P0010 presented 15 days post-partum for a thrombectomy and IVC filter retrieval due to extensive thrombosis of the IVC, iliac and renal veins. The patient has a past medical history of heterozygous factor V Leiden and CKD stage III due to focal segmental glomerulosclerosis. At 24 weeks her prenatal course was complicated by the development of right pulmonary artery embolism. At 34 weeks gestation she underwent pre-term delivery via c-section due to IUGR 4%ile, absence of end-diastolic velocities on fetal dopplers and concern for pre-eclampsia. On POD #2 the patient developed abdominal pain with acute blood loss anemia. CT abdomen demonstrated rectus sheath hematoma. Anticoagulation was held, protamine sulfate was administered and she had an IVC filter placed. The patient subsequently presented to the ER after a syncopal event and repeat abdominal CT showed extensive thrombosis of the IVC, extending through and above the IVC filter as well as into the renal and iliac veins. She was transferred for ileocaval thrombectomy and IVC filter removal. Monitored anesthesia care was provided during the procedure. High-intensity heparin drip was maintained with additional boluses to maintain ACT above 250. After significant improvement in clot burden, the IVC filter was removed at which point the patient developed acute hypoxia and PA pressures increased from 27/3 (13) to 65/25 (42). Pulmonary angiogram confirmed embolism to the proximal right pulmonary artery. She was intubated emergently. Echocardiography revealed a mobile echogenic mass in her RV which required urgent sternotomy and cardiopulmonary bypass for removal of a RV apical thrombus, pulmonary embolectomy and closure of a PFO. She was extubated POD #1 and eventually discharged home in stable condition.

DISCUSSION: Factor V Leiden is associated with an increased likelihood of VTE in pregnant patients, especially in the post-partum period (1). These concerns are more pronounced in patients with a prior history of VTE. Although IVC filters mechanically provide protection from lower extremity VTE migration to the lungs in those with contraindications to anticoagulation, thrombosis at or below the filter may occur (2). Retrieval of a thrombosed filter requires careful anesthetic management and anticipation of clot dislodgement.

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Abstract #: S-37**Repeat Cesarean Section on Patient with Cor Pulmonale, Recurrent Pulmonary Emboli, Hemoglobin H – Constant Spring Thalassemia who desires Neuraxial Anesthesia for delivery.**

Presenting Author: Eric McDaniel, MD

Presenting Author's Institution: University of Minnesota

Co-Authors: Chen Thay Chau, MD - University of Minnesota

Lisa M. Corbett, MD - University of Minnesota

A 33 year old G₃ P₂₀₀₂ presents to our department through the preoperative assessment clinic (PAC) for repeat Cesarean section (C-section). Her history is significant for two uneventful C-sections now in the setting of Cor Pulmonale secondary to recurrent deep vein thromboses (DVT) and pulmonary emboli (PE) despite IVC filter, which requires a constant infusion of Treprostinil. In addition, the patient has Hemoglobin-H-Constant Spring Thalassemia with a significant dermatology allergy to adhesives. A general anesthetic was required however the patients strongly desired a neuraxial technique and was willing to have a general anesthesia only as a last resort. Technically challenging pre-induction catheters were placed including: large bore intravenous access, arterial line, 9.0 French MAC central line, and a pulmonary artery catheter. Epidural placement was technically challenging, but successful, and was slowly titrated to effect. C-section was performed without complications and she transferred to the cardiovascular intensive care unit postoperatively for observation for two days.

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Abstract #: S-38**Marfan Syndrome, Aortic Stenosis, and Scoliosis in a Parturient in Preterm Labor****Presenting Author:** P.J. McGuire**Presenting Author's Institution:** Yale School of Medicine**Co-Authors:** Aymen Alian - Yale School of Medicine

Ellesse Credaroli - Yale School of Medicine

Kristen Fardelmann - Yale School of Medicine

Antonio Gonzalez-Fiol - Yale School of Medicine

Marfan syndrome is a connective tissue disorder that is known to affect the ocular, musculoskeletal and cardiovascular systems. Aortic dissection during pregnancy is one of the most feared complications. The incidence is low with aortic root diameters less than 45 mm.^{1,2} The history of previous pregnancies has been associated with increased risk of aortic complications.¹

A 26-year-old G4P2 at 35 weeks gestation presented in active labor. Her past medical history included Marfan syndrome status post Bentall procedure and pulmonary embolism on therapeutic enoxaparin. Her most recent TTE indicated aortic stenosis (AS) with a peak/mean gradient of 63/39 mmHg, respectively. Functionally, she reported > 4 METs without cardiovascular or respiratory symptoms (NYHA I). In addition, her past surgical history included 2 previous cesarean deliveries (CD) and surgically corrected scoliosis with Harrington rods. Her last dose of enoxaparin was more than 24 hours prior to presentation.

Due to a failed spinal anesthetic, her first CD was performed under general anesthesia (GA). She subsequently underwent cardiac and spine surgery followed by her second CD under GA. Given the patient's history of mechanical AVR, need for therapeutic anticoagulation after surgery, and extensive hardware of the spine, the decision was made to proceed with GA.

Prior to induction, an arterial line was secured. Induction proceeded with 100 mcg remifentanyl and incremental propofol (total 200mg) to maintain tight blood pressure control. Succinylcholine followed and intubation was achieved without tachycardia or significant blood pressure change. Anesthesia was maintained via volatile anesthetics and remifentanyl infusion. Phenylephrine infusion was titrated to maintain blood pressure within 20% of her average preoperative values. A low dose oxytocin infusion was titrated to adequate uterine tone. After bilateral transversus abdominis plane block, she was extubated and transported to PACU without vasoactive support. Initially admitted to the CCU for 24 hours of monitoring, the patient had an uneventful course.

Cardiovascular disease is the leading cause of maternal mortality in the US.³ Our patient met criteria for mWHOIII with a 19-27% risk of a maternal cardiac event.² In parturients with moderate to high-risk of complications, individualized management should be conducted with early anesthetic consultation and early multidisciplinary team planning as preterm labor is common.² Prevention of tachycardia, maintenance of preload and systemic vascular resistance are of utmost importance for the parturient with AS. Although neuraxial anesthesia is preferred, GA was provided to this high risk parturient without complication.

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Abstract #: S-38

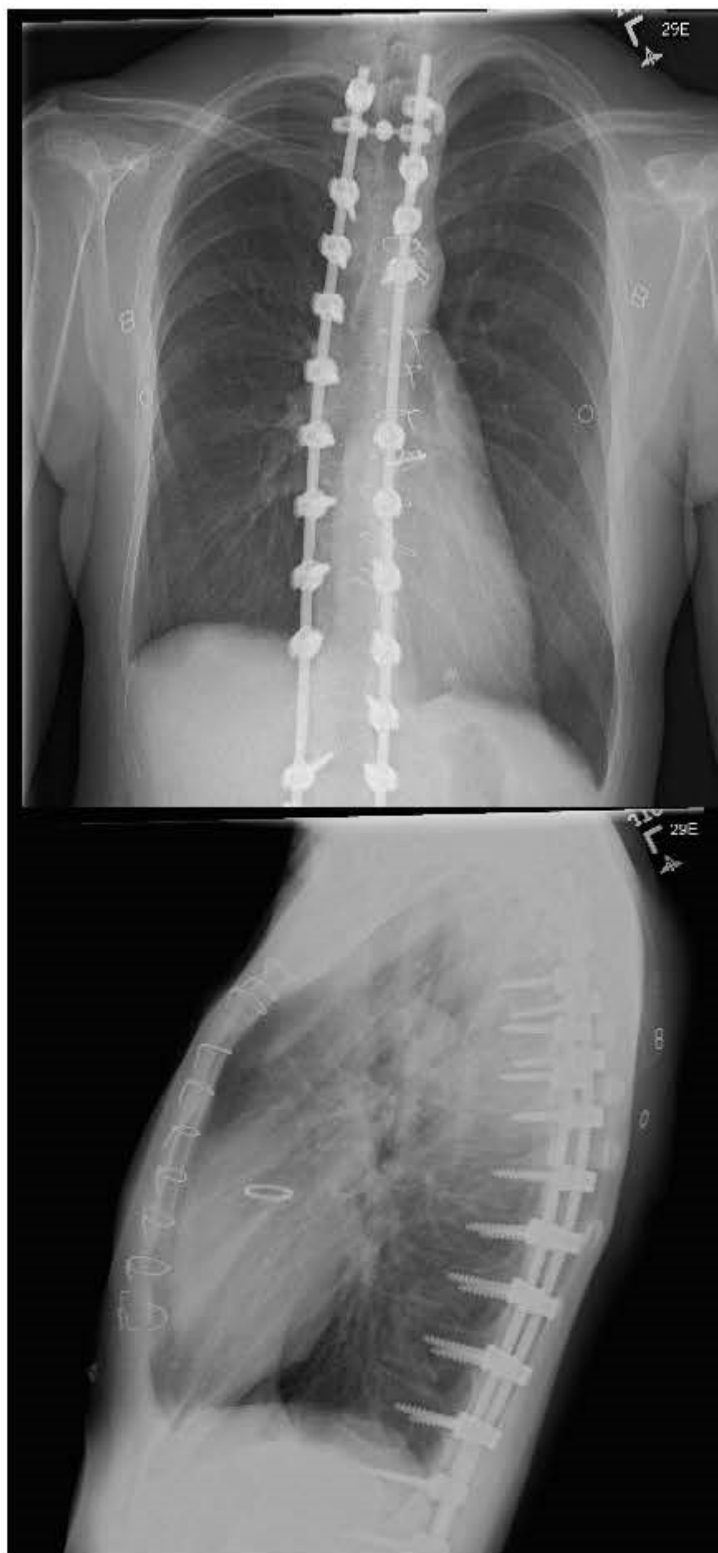


Figure 1. PA and lateral chest films demonstrating extensive spinal hardware

Abstract #: S-39

ROTEM-guided Resuscitation of a Parturient Undergoing Cesarean-Hysterectomy

Presenting Author: P.J. McGuire

Presenting Author's Institution: Yale School of Medicine

Co-Authors: Aymen Alian - Yale School of Medicine

Kristen Fardelmann - Yale School of Medicine

Angelique M. Garay - Yale School of Medicine

Antonio Gonzalez-Fiol - Yale School of Medicine

Obstetric postpartum hemorrhage (PPH) may be associated with coagulopathy and fibrinogenemia. Point-of-care viscoelastic testing (POCVT), such as ROTEM, may be used to guide goal-directed resuscitation during these events.

A 36-year-old G4P1 at 34 weeks gestation presented for repeat cesarean delivery with likely hysterectomy in the setting of placenta accreta. Comorbidities included allergy-induced asthma, obesity (BMI 32) and depression. Following neuraxial evaluation with lumbar ultrasound, anesthesia was induced via CSE with 12 mg hyperbaric bupivacaine, 10 mcg fentanyl, 100 mcg epinephrine, and 100 mcg morphine intrathecally. An arterial line and two large-bore IVs were also in place. After confirmation of a T4 level bilaterally, surgery was initiated. A vigorous fetus was delivered breech with Apgars 8 and 9 at 1 and 5 minutes, respectively. One gram tranexamic acid (TXA) was given as prophylaxis for anticipated bleeding. The obstetric team proceeded with hysterectomy which was complete at 1530. Blood was noted in the upper portion of the vagina and lower peritoneum. The bladder was back-filled with methylene blue which confirmed an intraoperative cystotomy and bilateral ureteral injuries. ROTEM and laboratory values are outlined in Figure 1 and Figure 2.

It was decided to convert to general anesthesia due to new abdominal discomfort now unresponsive to epidural bolus and anticipated massive blood transfusion. Phenylephrine infusion maintained systolic blood pressure above 100 mmHg. Overall EBL was eight liters. The patient was transferred to the MICU intubated, sedated, but not requiring pressor support. She was extubated on POD 1 and was discharged home on POD 7.

POCVT has been shown to minimize empiric fixed ratio FFP transfusion in PPH without compromising hemostasis.¹ Early fibrinogen depletion is associated with progression to coagulopathy and severe PPH.^{1,2} Fitem amplitude has been shown to guide fibrinogen concentrate administration and minimize FFP transfusion with its associated transfusion-related circulatory overload.² In our case, ROTEM allowed for rapid clot evaluation, minimized transfusion via guided cryoprecipitate fibrinogen repletion, and eliminated the need for FFP administration.

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Abstract #: S-39

	Baseline	13:20	14:30	15:30	15:20	16:20	19:30	20:40	23:00	01:00
A10 Fitem (mm)	24	17	11	10	-	11	15	15	15	17
Fct (%)	22.2	27.1	28.2	17 (ABC)	12	22.1	22	29.1		22
Platelets (x1000/ μ L)	177	147	122		75	27		60		74
Fibrinogen (mg/dL)		259	155			231		259		
Transfusion product		2 units pRBCs: 1L albumin	2 units pRBCs: 2 units cryo	1 unit pRBCs: 2 units cryo	4 units pRBCs: 2 units cryo	2 units cryo: 2 units platelets	2 units platelets		1 unit platelets	
Rx			1g IXa							
tBL		0.5 L	2.5 L	3L	5L					8L

Figure 1

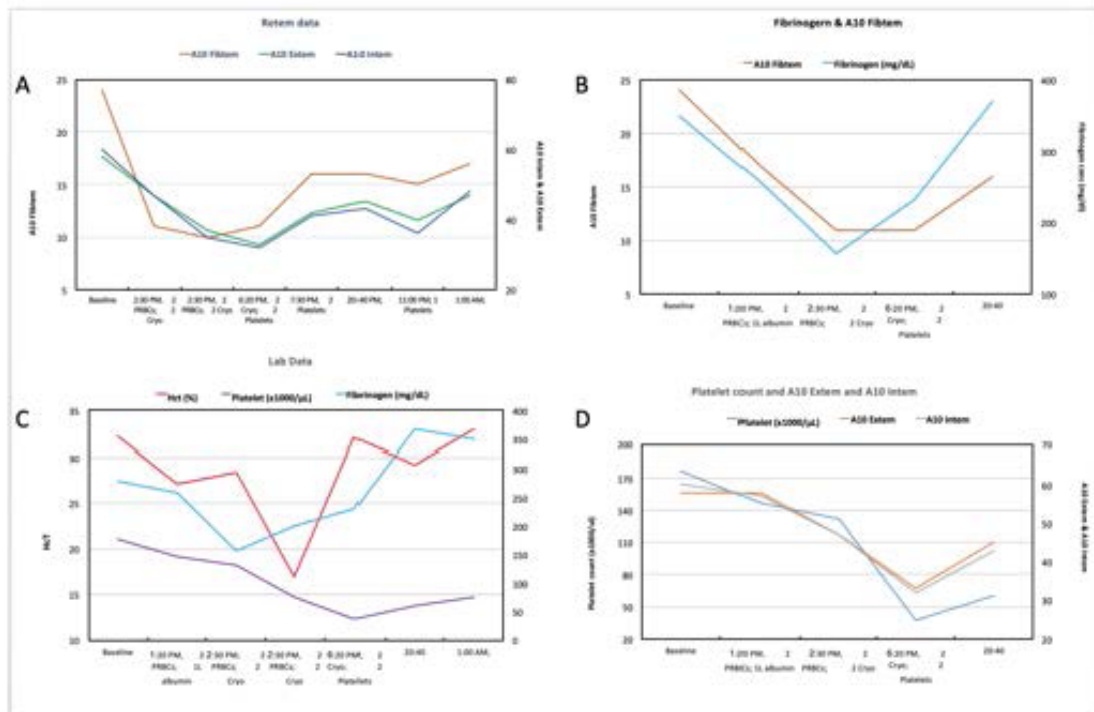


Figure 2. ROTEM-amplitude at 10 min (A10) for FIBTEM, INTEM and EXTEM. Interventions and times on the X axis. 2B. Fibrinogen and FIBTEM A10 correlation. 2C. Laboratory work data and interventions on the X-axis. 2D. EXTEM and INTEM Amplitude at 10 minutes correlation to platelet count and interventions on the X-axis.

Abstract #: S-40**Successful Outcome of Large Ovarian Mass Excision After Emergent Cesarean Delivery****Presenting Author:** P.J. McGuire**Presenting Author's Institution:** Yale School of Medicine**Co-Authors:** Aymen Alian - Yale School of Medicine

Antonio Gonzalez-Fiol - Yale School of Medicine

Courtney McGuigan - Yale School of Medicine

The incidence of ovarian cysts during pregnancy is estimated to be 0.02-2% depending on the stage of pregnancy.¹Management is controversial and often centers around risk of torsion or malignancy.²Although some advocate for elective removal in the second trimester, asymptomatic masses with no malignant features can be conservatively managed until cesarean delivery or six weeks postpartum.³Massive ascites in pregnancy can be contributed to multiple factors, including low concentration of proteins with an altered albumin/globulin ratio, portal obstruction or hemoconcentration in the portal circulation.⁴

A 34-year-old G5P2 at 33 weeks with a right mucinous mass (Table 1) presented in preterm labor for urgent cesarean delivery. Given her history, a total abdominal hysterectomy, right salpingo-oophorectomy and debulking was planned and coordinated with the gynecologic oncologist team(GYN/ONC). The patient was previously diagnosed in 2017 with a 25-cm left (L) ovarian mucinous borderline tumor and underwent a L-salpingo-oophorectomy. In 2019, she was diagnosed with R ovarian mucinous borderline tumor and had a laparoscopic cystectomy given her strong desire to conceive. During pregnancy she experienced severe abdominal pain, which was managed with oxycodone. Preoperatively, the patient was noted to be jaundiced and labs showed an upward trend in liver function test (LFT's), low albumin and total protein, and normal ROTEM.(Table 1)

The patient was brought to the operating room where a CSE was placed. A T4 level bilaterally was achieved and the obstetric team started surgery. A baby boy weighing 2240 grams was delivered. Intramuscular 0.2 mg methylergonovine was given for uterine atony. The patient underwent general anesthesia per GYN/ONC preference for right ovarian mass resection. An arterial line was placed for optimal hemodynamic control. The mass was excised weighing 4100 grams and measuring 30 x 30 x 9.5 cm. There was an abundant amount of mucinous ascites present. Excellent hemostasis was achieved, and the estimated blood loss was 1000 ml. The patient received 500cc albumin. The patient was extubated uneventfully, and the epidural remained in place for post-operative pain control. She was discharged home on post-operative day four.

The Parturient with an ovarian mass presents a challenge to anesthesiologist as the mass may compromise other organs, and lead to chronic pain. Our patient's ascites and liver enzymes abnormalities were probably related to portal obstruction as well as tumor/cancer mediators. The need and time for surgical intervention depends on the malignancy grade and symptomatology. When caring for a parturient with an ovarian mass, a multidisciplinary approach is recommended.

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1. de Haan et al. Views Vis Obgyn, 2015, 7(1):25-31.
2. Yen et al. Fertil Steril. 2009 May;91(5):1895-902.
3. Aggarwal et al. Eur J Obstet Gynecol Reprod Biol. 2011;155(2):119-124.
4. Vaijyanath AM et al. J Obstet Gynaecol Res 2002;28:199-202.

Abstract #: S-40

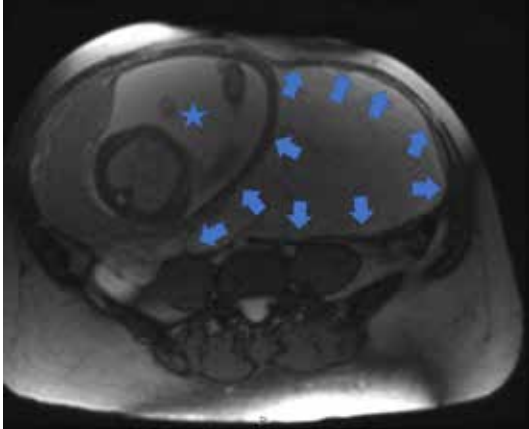
Laboratory results	Day of surgery	1 month before surgery
PT	10.5	9.7
PTT	28.4	24.8
Fibrinogen	480	579
Total Protein	5.0	7.2
ALT	253	218
AST	122	126
ROTEM		
EXTEM	Reference Range	
CT (Seconds)	56	43-82
A10 (mm)	82	46-67
INTEM	Reference Range	
CT (Seconds)	188	122-208
A10 (mm)	79	46-67
FIBTEM	Reference Range	
A10 (mm)	24	7-22
Imaging		
		

Table 1. PT-Prothrombin time; PTT - Partial thromboplastin time; ALT - Alanine transaminase; AST - Aspartate aminotransferase; CT - Clotting time; A10 - Amplitude at 10 min. → - Ovarian mass; ★ - Uterus.

Abstract #: S-41**Anesthetic Management of a Parturient with Twin Gestation Complicated by TRAP sequence****Presenting Author:** P.J. McGuire**Presenting Author's Institution:** Yale School of Medicine**Co-Authors:** Aymen Alian - Yale School of Medicine

Kristen Fardelmann - Yale School of Medicine

Antonio Gonzalez-Fiol - Yale School of Medicine

Daisy Leon-Martinez - Yale School of Medicine

Elizabeth Reinhart - Yale School of Medicine

Twin reversed arterial perfusion (TRAP) is a rare condition affecting monochorionic twin pregnancies in which one of the twins serves as a "pump" into an "acardiac" twin by utilizing retrograde blood through placental arterio-arterial and venovenous anastomoses. The incidence of TRAP is estimated to be approximately 1:9,500 -11,000 pregnancies.¹ The perinatal mortality of the pump twin without in utero treatment is approximately 50-75% largely due to sequelae of heart failure or preterm delivery.² This risk increases as the size of the acardiac twin increases.³

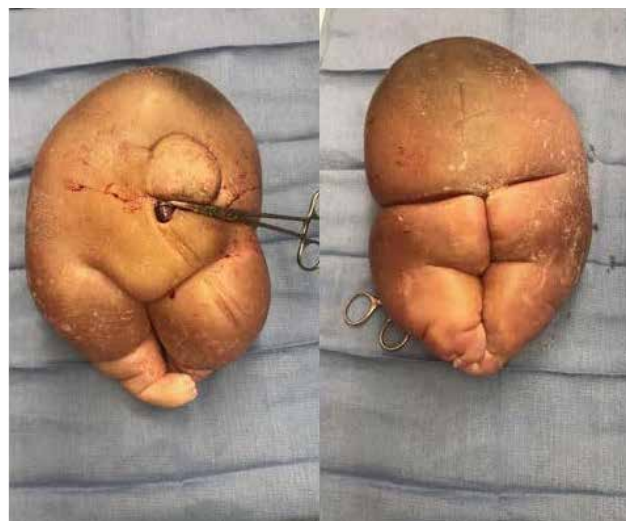
A 38-year-old G6P5 with a twin gestation complicated by TRAP sequence presented at 32 weeks with preterm contractions and abdominal discomfort in the setting of polyhydramnios. Due to religious and ethical beliefs, the patient had refused any intervention to interrupt the vascular communication between the twins. During her admission she underwent amnioreduction and received betamethasone. An ultrasound (US) revealed that the acardiac twin growth was increasing the risk of hydrops fetalis in the pump twin. Hence the plan was to continue serial US evaluation and perform a cesarean delivery (CD) at 34 weeks.

At 34 weeks gestation, a CD was performed under spinal anesthesia. A baby girl and the acardiac twin weighing 1760 and 3176 grams, respectively, were delivered without incident. An oxytocin infusion was started at 18 U/h and after 3 min increased to 36 U/h. In addition, the patient required 1000 mcg of misoprostol for uterine atony. Hemostasis was achieved and the estimated blood loss was 1500 ml. At the end of the surgery a transversus abdominis plane block was performed for postoperative pain control. In recovery, while hemodynamically stable, her hematocrit was noted to be 20.3%. The patient was transfused 1 unit of packed red blood cells. Her course was otherwise uneventful and she was discharged home on post-operative day three.

In utero intervention is aimed at reducing the burden for the pump twin, a decision that may conflict with the patients religious or ethical beliefs. TRAP poses the challenge to all practitioners involved to respect the potentially complex psychosocial conundrum the diagnosis may bring onto a patient. The surgical staff caring for the patient should also be debriefed regarding the TRAP implications. In our case, a huddle before CD was used to discuss the risk for uterine atony and PPH as well as the morphology of the acardiac fetus to psychologically prepare the surgical staff for the delivery. The staff was then prepared to provide support to the family in the postpartum period.

References:

1. van Gemert M, et al. Birth Defects Res A Clin Mol Teratol. 2015 Jul;103(7):641-3.
2. Quintero RA, et al. Am J Obstet Gynecol. (2006)194:982-91.
3. Lee H, et al. Am J Obstet Gynecol. 2007 May;196(5):459.e1-4.



Abstract #: S-42**Anesthetic Management of a Parturient with Diabetes Insipidus****Presenting Author:** P.J. McGuire**Presenting Author's Institution:** Yale School of Medicine**Co-Authors:** Aymen Alian - Yale School of Medicine

Kristen Fardelmann - Yale School of Medicine

Antonio Gonzalez-Fiol - Yale School of Medicine

Victoria Greenberg, MD - Yale School of Medicine

Diabetes insipidus (DI) is the inability of the kidneys to concentrate urine leading to polydipsia and polyuria. Complications include hypernatremia, dehydration, weakness, confusion, and seizures. Neurogenic DI (NDI) is most common and caused by inadequate synthesis or release of vasopressin (ADH). 50% of women with DI decompensate in pregnancy.

A 24-year-old G1P0 at 35 weeks gestation presented for obstetric anesthesia consultation in the setting of NDI. She reported a motor vehicle accident prior to pregnancy; she presented several months later with polyuria (8L/day) consistent with NDI. Treatment ensued with desmopressin 50 mcg TID that was increased to QID in pregnancy. Her liver enzymes, platelets, electrolytes and urine chemistry were normal throughout pregnancy. At 40 weeks, she had spontaneous rupture of membranes and was admitted for augmentation of labor. Electrolyte values and urine specific gravity were normal with low urine osmolality. She received a labor epidural uneventfully and was allowed to drink to thirst. The 1st and 2nd stages of labor progressed rapidly and she vaginally delivered a male infant with Apgar scores 3 and 8 at 1 and 5 minutes, respectively, complicated by shoulder dystocia. Postpartum, her laboratory values were stable with normal serum sodium and she was discharged on postpartum day two.

Increased ADH release, increased aquaporin insertion in the collecting ducts, and placental release of vasopressinase in pregnancy culminates in a decreased plasma osmolality (270 mOsmol/kg compared to normal 275-295 mOsmol/kg) and decreased serum sodium levels by 4-5 mmol/L. Liver dysfunction, as seen with preeclampsia (PEC), HELLP syndrome, and acute fatty liver disease in pregnancy, may increase concentrations of vasopressinase leading to lower levels of ADH. As it is safe in pregnancy and breastfeeding and resistant to vasopressinase, desmopressin is the first line treatment for NDI.

Intrapartum management includes monitoring for hypernatremia, liver dysfunction, and fluid status with continuous fluid resuscitation. Intravascular volume depletion and decreased potency of local anesthetics in hypernatremia may impact neuraxial anesthesia. Due to the similar structure of oxytocin and ADH, high concentrations of oxytocin may produce clinical effects comparable to ADH and fluid retention. Conflicting needs for aggressive fluid resuscitation in NDI and judicious fluid administration in PEC may be challenging. Due to an increased GFR and excretion of magnesium in NDI and pregnancy, magnesium levels may be insufficient to prevent eclamptic seizures. With careful multidisciplinary care of DI in pregnancy, women can have an uncomplicated course with low fetal and maternal morbidity.

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1. Quigley J et al. *Obstet Gynaecol.* 2018;20:41-8.
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3. Adonakis G, et al. *Clin Exp Obst & Gyn* 2011;38(3):301-2.

Abstract #: S-43

Uterine Rupture After Spontaneous Vaginal Delivery

Presenting Author: Michael Chappetta, MD

Presenting Author's Institution: Ochsner Health

Co-Authors: Roneisha McLendon, MD - Ochsner Health

Introduction: Uterine rupture is morbid obstetric complication that is defined as a full thickness defect of the uterine wall and serosa. There are two categories of uterine rupture: rupture in the scarred uterus and rupture in the unscarred uterus⁸. We present a case of uterine rupture in an unscarred uterus.

Case Report: We present a 26 yo G3P3 with no significant medical history who had an uncomplicated labor resulting in a spontaneous vaginal delivery of a 3260 g neonate. Her postpartum course was complicated by hemorrhage. After delivery she received misoprostol, carboprost and oxytocin for lower uterine segment atony. However, bleeding persisted and a Bakri balloon was placed after multiple attempts with immediate improvement in tone and bleeding. Twenty minutes after placement the patient exhibited signs and symptoms of hemorrhagic shock with blood pressure as low as 60/30 and altered mentation. She was emergently taken to the operating room for an exploratory laparotomy. Large bore intravenous access was obtained and the massive transfusion protocol was initiated. She had a large, full-thickness defect at the right aspect of the lower uterine segment. There was difficulty achieving hemostasis and a hysterectomy was performed. Total blood loss was estimated to be 8L with 5L loss intra-operatively. She was resuscitated with 8 units of packed red blood cells, 6 units of fresh frozen plasma, one unit of cryoprecipitate and one 6-pack of platelets. Post-operatively she was transferred to the ICU and extubated on postoperative day one. She was discharged home on postoperative day five.

Discussion: Uterine rupture is a morbid but rare condition, especially in a healthy uterus. Studies by Gibbins et al demonstrated 4.54 ruptures per 100,000 deliveries and these patients were more likely to require blood transfusion and hysterectomy². In most of the reported cases, ruptures occurred in the gravid uterus. The risk factors in these cases include the use of uterotonics during induction of labor, fetal macrosomia, multiparity, maternal age, and previous obstetric surgical procedures^{1,2}.

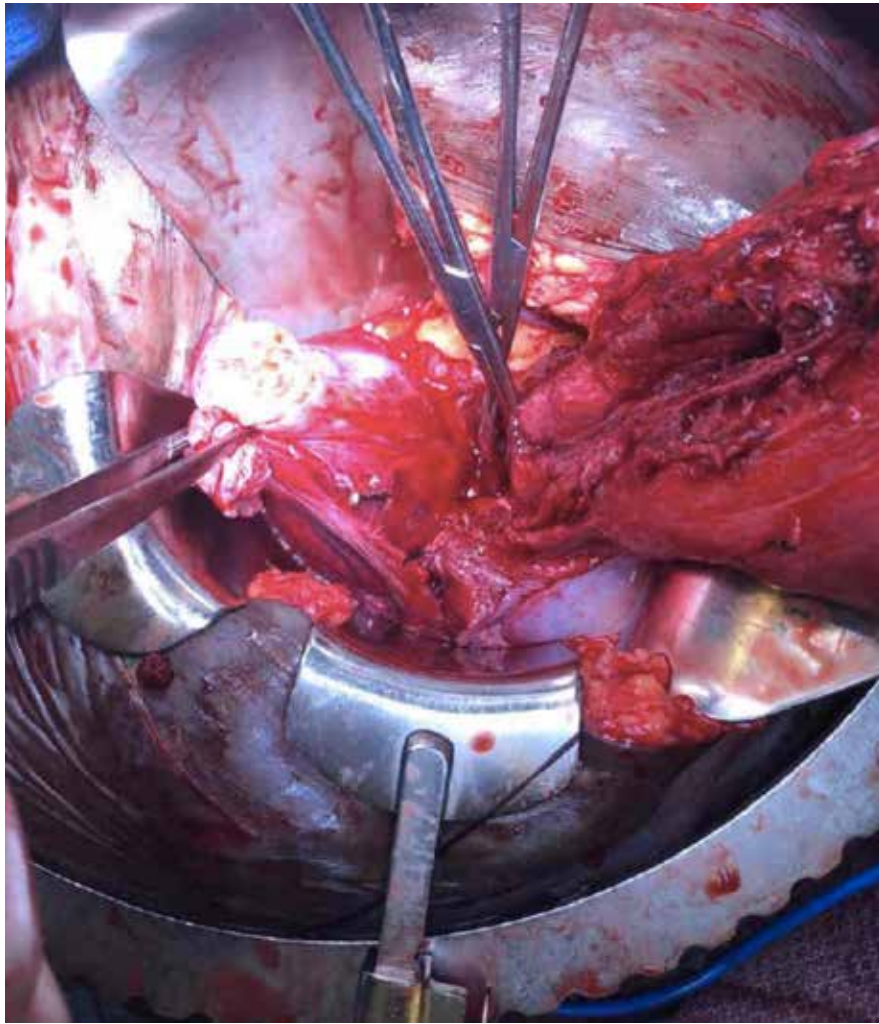
However, in our case the patient was postpartum and appeared to have hemorrhage due to atony. Impaired collagen synthesis or recent steroid usage are possible explanations, but neither was reported in her medical history³. There are reported cases of a Bakri balloon causing rupture of the uterus^{4,6}. This represents the most probable cause, as there were multiple attempts with an increase in hemorrhage and symptoms of shock twenty minutes after successful placement.

Morbidity is high in uterine rupture and multidisciplinary management is a must. Signs and symptoms should be quickly recognized, which may include increased abdominal pain, maternal tachycardia, altered mental status and coagulopathy^{5,7}.

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1. Al-Zirqi 2017
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3. Grigoriadis 2019
4. Kapoor 2018
5. Lane 2019
6. Leparco 2013
7. Mazzone 2006
8. Mavromatidis 2015

Abstract #: S-43



Abstract #: S-44**Obstetric Anesthesia and the Woman with Severe Mental Illness**

Presenting Author: Courtney Mechling

Presenting Author's Institution: University of Pittsburgh Medical Center (UPMC) - Hopwood, Pennsylvania

Co-Authors: Patricia L. Dalby - University of Pittsburgh School of Medicine (UPSOM) and University of Pittsburgh Medical Center

Grace Lim, MD, MS - University of Pittsburgh UPMC Department of Anesthesiology & Perioperative Medicine

Introduction: Women with severe mental illness (SMI), including schizophrenia, bipolar disorder and affective psychosis, represent up to 3% of pregnant women, with increasing fertility due to greater use of second generation antipsychotics. They are at risk for disease exacerbation with pregnancy, and increased rates of obstetric complications compared to healthy women. We present 2 cases of pregnant women with complex SMI for management of labor and delivery.

Case 1: 33-year-old G1 complicated by obesity, gestational diabetes, bipolar disorder was admitted for four months due to manic episode with psychotic features. She was discharged two weeks prior to induction of labor, readmitted for recurrent mania, and had a scheduled cesarean delivery due to concern for deterioration of her mental state with a trial of labor. She was agitated during spinal anesthesia placement, but did not require sedation. Postpartum course was uncomplicated; she was discharged to inpatient psychiatric care as planned.

Case 2: 34-year-old G1 with schizophrenia was admitted to psychiatric hospital after suicide attempt during first trimester, inpatient until admission to obstetric ICU for induction at 39 weeks. She had an epidural placed uneventfully for labor analgesia, failed induction due to fetal bradycardia and underwent emergency cesarean with epidural anesthesia. Postpartum course complicated by continued delusions necessitating inpatient psychiatric care.

Discussion: Pregnancies in women with SMI are often unplanned and/or unwanted, with higher abortion rates and less prenatal care. These women have more medical comorbidities including obesity, chronic hypertension, type II diabetes, and thromboembolic risks, thus presenting medical management challenges. These patients are more likely to have induction of labor, operative and emergent deliveries, as well as obstetric complications, leading to longer hospital stays and higher costs of care. Neonatal outcomes are poor in this population, with higher rates of stillbirth, infant death < 1 year, fetal distress, IUGR, and fetal anomalies compared to the general population.

Early peri-delivery planning is essential for effective care of pregnant women with SMI, especially in cases of persistent psychosis requiring prolonged inpatient psychiatric care with or without monitoring in an obstetric care environment. A multidisciplinary team of maternal-fetal medicine, psychiatry, and obstetric anesthesiologists should assess the patient's mental state, comorbidities, medications, and capacity for consent to develop a delivery plan. Treatment of SMI via medical management or electroconvulsive therapy is based on individualized risk-benefit analysis, and recommendations should include a detailed schedule for acute decompensation, including medications, routes, doses, and need for hospital security or behavioral management services.

References:

1. Jones et al. Lancet 2014; 384: 1789-99
2. Zhong et al. BMC Pregnancy Childbirth 2018; 18: 120

Abstract #: S-45

WHERE'S THE BLOOD? RECURRENT PANCYTOPENIA IN PREGNANCY IN THE SETTING OF A NEGATIVE WORKUP

Presenting Author: John Merriman, MD

Presenting Author's Institution: University of Illinois - Chicago - Chicago, Illinois

Co-Authors: Heather C. Nixon, M.D. - University of Illinois Chicago

Introduction: Pancytopenia in pregnancy is poorly described and generally associated with infection, autoimmune diseases or bone marrow derived cancers. Pancytopenia associated with pregnancy has not previously been described, but may be a diagnosis of exclusion and no information is available to guide providers regarding treatment and care. Here, we present a case of pancytopenia of unknown etiology and presumed to be associated with pregnancy.

Case: Our patient was a 22yo G2P1 at 37wks gestation who presented in spontaneous labor. The patient had a history of pancytopenia with no definitive etiology following her first uncomplicated pregnancy that completely resolved, but remitted at 4 months' gestation of her current pregnancy (17 wks GA - WBC 1.3, Hgb 7.1, Plt 42). Her workup included tests for autoimmune and infectious etiologies, which were negative. Bone marrow biopsy demonstrated normocellular lines with no suspicion of cancerous cells. During her gestation, her labs varied widely (WBC 0.4-1.5, Hgb 5.9-9.8, Plt 19-85). She received multiple intermittent transfusions of both RBCs and platelets with appropriate responses in lab values. Based on bone marrow results and transfusion course, the underlying pancytopenia was considered to be a productive rather than consumptive process. Steroid administration did not impact laboratory values. Multidisciplinary planning included MFM, hematology, and Anesthesiology services and centered on contingency discussions regarding transfusion and anesthetic strategies for delivery. It was discussed that if the patient's platelets were above 75K at the time of her delivery, she could receive neuraxial analgesia or anesthesia with full neutropenic precautions. However, platelets would not be transfused for placement.

At the time of her presentation for labor, labs were WBC 1.2, Hgb 9.8, **Plt 27**. She was transfused platelets to a value of 49K per hematology recommendations of a goal of 50K, but no further transfusions were necessary. The patient ultimately had an uneventful vaginal delivery (EBL 150cc) without neuraxial placement.

Discussion: Our patient demonstrated pancytopenia repeatedly in her pregnancy courses without an identifiable etiology, indicating a possible pregnancy-associated pancytopenia. Pancytopenia mandates adaptability on the part of the providers. Analgesia, hemorrhage risk, and infectious risk are all directly impacted. Additionally, it is important to determine if the resultant thrombocytopenia is a consumptive vs. production etiology. Following transfusion responsiveness as well as bone marrow biopsy results can make this determination. A production etiology may allow for safe labor analgesia placement and removal of catheter, while consumptive etiologies may be more concerning for epidural hematoma. Close interdisciplinary communication and effective patient counseling are paramount for good patient outcomes.

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Riveros-Perez, E. (2018) *Int J Women's Health* 10:117-125

Abstract #: S-46

A Case of A Postdural Puncture Headache In A Patient On Therapeutic Enoxaparin: A Treatment Dilemma

Presenting Author: Mercades Meuli, DO

Presenting Author's Institution: Albany Medical Center - Delmar, New York

Co-Authors: Margaret O'Donoghue, MD - Albany Medical Center

Postdural puncture headaches (PDPH) are the most frequent complication occurring after neuraxial anesthesia occurring at an incidence of 0.7% in obstetrical patients that underwent a labor epidural and up to 50% of patients that have an accidental dural puncture with a touhy needle (1). Treatment for PDPH can be conservative with hydration and bedrest when mild, but when severe, epidural blood patches (EBP) are the standard of care (2,3). We discuss a case of a postpartum patient with an active DVT on therapeutic enoxaparin with a severe PDPH with cranial nerve symptoms.

The patient is a 34 year old female that presented to labor and delivery and underwent a labor epidural that was complicated by multiple attempts and required replacement. Her past medical history is significant for a BMI of 47, active DVT, asthma, and history of opiate abuse on buprenorphine. Her last dose of therapeutic enoxaparin was 11 hours before epidural placement. On postpartum day one she developed a severe positional headache with diplopia and muffled hearing. As she was currently on therapeutic enoxaparin, she was switched to a heparin drip with plans to do an EBP 24 hours after her last dose of enoxaparin. A sphenopalantine ganglion block (SPGB) was provided with improvement of symptoms but unfortunately the relief was temporary. The patient underwent an uneventful EBP on POD two after shutting the heparin drip off four hours in advance. The patient immediately felt relief. The heparin drip was restarted four hours post EBP and therapeutic lovenox was restarted 24 hours post EBP. She was discharged home on POD four.

This case created a therapeutic dilemma between treating a severe PDPH and stopping anticoagulation for an active DVT in a postpartum patient that is at high risk of developing another thromboembolism. Per ASRA guidelines, recommendations are to delay neuraxial procedures for at least 24 hours after the last dose of therapeutic enoxaparin or risk a spinal hematoma (4). While waiting the recommended 24 hours, new emerging research has supported the role of SPBG as a non invasive procedure that is effective for treating symptoms of a PDPH (5). In this case, the SPG block provided short term relief before the headache and cranial nerve symptoms returned. In addition, as the patient was placed on a heparin drip while off enoxaparin, there was concern that a blood patch would be dissolved upon resumption of therapeutic anticoagulation. Fortunately, this did not happen and the patient's PDPH symptoms did not return.

References:

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4. Reg. Anesth. Pain Med., 28 (2003), pp. 172-197
5. Regional Anesthesia & Pain Medicine 2018;43:880-884.

Abstract #: S-47**Maternal hypoglycemia: an unusual diagnosis in the differential for high neuraxial block****Presenting Author:** Maitri M. Shah, MD**Presenting Author's Institution:** University of Arkansas for Medical Sciences - Little Rock, Arkansas**Co-Authors:** Jill M. Mhyre, MD - University of Arkansas for Medical Sciences

A 40 year-old G12P10 woman at 35w4d gestational age received combined spinal epidural (CSE) anesthesia for cesarean delivery of breech twins in the setting of preeclampsia (PE) with severe features. She had a history of chronic hypertension, asthma (twice daily inhaler use), diet-controlled gestational diabetes, and obesity (BMI 48 kg/m²). Admitted on the day of surgery with headache and vision changes, she received magnesium sulfate (Mg) 4g over 30 minutes and 1 g/hr for seizure prophylaxis, and 2 puffs of albuterol for wheezing. Two hours later, she received preoperative 975mg acetaminophen, 30mL sodium citrate, and 20mg famotidine. She had been NPO for 9 hours and had decreased level of consciousness (LOC) on arrival to the OR, but was able to sit up for the procedure. Following spinal injection of 1.4mL 0.75% hyperbaric bupivacaine, 150mcg morphine, and 15mcg fentanyl, an epidural catheter was secured without epidural medications. Phenylephrine infused between 45 and 75mcg/min maintained mean arterial pressure and heart rate within 20% of baseline. After assuming a supine position with left uterine displacement, she complained of SOB. We elevated her back with some improvement. She appeared progressively somnolent and then apneic; apnea was relieved with a chin lift, consistent with undiagnosed obstructive sleep apnea. Mg was paused for possible toxicity. Although high spinal block was suspected, she continued to respond to stimulation with excellent bilateral grip strength. Assessment of a sensory level was challenging due to her diminishing LOC. With CPAP, oxygen and chin lift, she maintained RR, tidal volume, and SpO₂. Upon considering a differential for decreased LOC, medication record review revealed 25 mg diphenhydramine and 10 mg metoclopramide 2 hours preoperatively for undocumented indications, and a blood glucose (BG) of 92g/dL during a prior admission. We empirically gave 5g of dextrose (D50) with improved LOC. Subsequent finger stick BG 73g/dL confirmed hypoglycemia. We gave another 10g of D50 and LOC returned to baseline of sedated but not somnolent. In PACU, the Mg level returned at 3.3mg/dL, excluding Mg toxicity.

Discussion: Our patient's large buttocks and twin gestation increased suspicion for high neuraxial blockade when she complained of SOB, followed by rapid development of somnolence and apnea. Fortunately, we were able to relieve her apnea with chin lift and CPAP, and she continued to respond to stimulation, verifying grip strength and phonation. Preoperative diphenhydramine and metoclopramide, preeclampsia, spinal anesthesia and hypoglycemia all likely contributed to her somnolence, with hypoglycemia being a reversible component. Undiagnosed sleep apnea in the context of sedation and neuraxial anesthesia may mimic high neuraxial blockade.

Abstract #: S-48

When the Blood Pressure Won't Budge: Management of Renal Artery Stenosis in the Parturient

Presenting Author: Ryan Militana, DO

Presenting Author's Institution: University of Illinois at Chicago

Co-Authors: Erin Haggerty, MD - Massachusetts General Hospital

Heather Nixon, MD - University of Illinois at Chicago

Introduction: Hypertension is a frequent medical complication of pregnancy and has the potential for serious morbidity and mortality. Although rare, renal artery stenosis (RAS) usually caused by either atherosclerosis or fibromuscular dysplasia leads to severe hypertension. Hypertension in pregnancy may have many etiologies, but if refractory, RAS must be considered. The diagnosis may be difficult to make due to poor sensitivity of renal ultrasonography, but if diagnosed early, may be treated with angioplasty to avoid further complications. When patients present at more advanced gestation or without a diagnosis, it may complicate management with a higher likelihood of the development of preeclampsia as well as preterm delivery.

Case Presentation: A 39 y/o obese (BMI 44) G4P3 at 23+6 wks GA with PMH of cHTN and PCKD presented with elevated BP (234/111). Her home regimen of high dose lisinopril and HCTZ was switched to labetalol and nifedipine for pregnancy. Her BPs were stabilized with multiple medications and due to the severity and refractory nature of the BP, at 24wks GA, a renal ultrasound was performed showing enlarged kidneys, cysts and elevated left renal artery velocities indicating a likely dx of RAS. The patient had multiple subsequent ER and MFM visits with severe range BPs, but continued to have adequate fetal growth and no other preeclampsia severe features. At 26+6 wks GA the BPs were over 200 systolic and fetal assessment (umbilical artery Doppler and BPP) demonstrated need for delivery. Pressures were stabilized with a nicardipine drip, but concerning FHTs necessitated urgent delivery via CD. Her neuraxial placement was complicated by an unintended dural puncture and an IT catheter was utilized without intraoperative complications. Pt remained in the ICU for BP management and developed AKI (Cr 2.04).

Discussion: RAS is a rare etiology of hypertension but may result in severe and elevated refractory blood pressures. If known prior to pregnancy or early in gestation, angioplasty may be performed to allow parturients to reach a viable term. When patients do not receive adequate prenatal care, it may be difficult to titrate antihypertensive therapy and may confound the diagnosis of other pregnancy related causes of severe hypertension including preeclampsia and worsening cHTN. Other causes such as glomerulonephritis, pheochromocytoma, and illicit drug use should and can be ruled out with laboratory markers. However, the definitive diagnosis of RAS may be difficult as renal ultrasonography is operator dependent and up to 40% of examinations are unsatisfactory due to body habitus or overlying bowel gas. Thus, it is important to maintain high clinical suspicion where appropriate despite a negative ultrasound and consider renal angiography. If a presumptive dx of RAS is made, it may be possible to maintain pregnancy with close follow up, aggressive blood pressure management and fetal assessment as was done in this case.

Abstract #: S-49

An unusual case of Vestibular Schwannoma in pregnancy: a clinical conundrum

Presenting Author: MANASI MITTAL

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Introduction: Vestibular schwannomas are rare acoustic nerve tumours which show an accelerated growth during pregnancy. We describe the management a large acoustic neuroma with raised intracranial pressure (ICP) diagnosed during pregnancy.

Case report: A 32 year old, 32 weeks pregnant lady presented with vomiting, headache, diplopia and fluctuating GCS. Investigations revealed a large cerebellopontine (CP) angle tumour with features of raised ICP. Opinions were divided regarding continuation of pregnancy or immediate caesarean section (CS). It was also debated whether to perform CSF drainage with or without tumour resection. It was decided to proceed with (CS) and external ventricular drain (EVD) insertion simultaneously under general anaesthesia (GA). The patient was prepped awake for both surgeries. GA was administered and EVD inserted first followed by CS. The anaesthetic management focused on controlling the ICP and maintaining optimal cerebral and placental perfusion. The surgery was uncomplicated and the patient subsequently had a tumour resection 6 weeks afterwards.

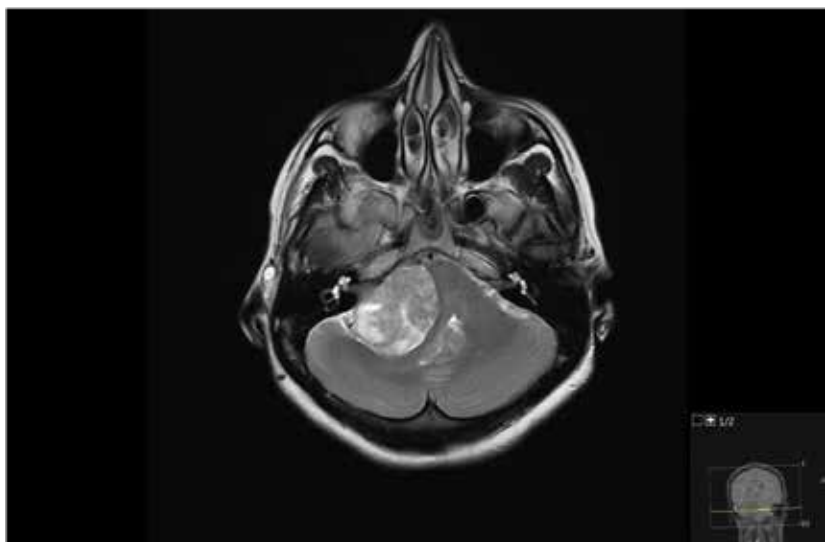
Discussion: Acoustic neuromas are rare slow growing tumours that present more frequently in women and symptoms are known to worsen during pregnancy. The combination of a preterm pregnancy and worsening ICP presented us with an interesting clinical conundrum. The need to control the pressure symptoms with either a shunt, EVD or tumour resection was a priority. Shunt was ruled out due to high chances of malfunction in 3rd trimester. A long term EVD carried a risk of infection. An immediate tumour resection was ruled out due to peripartum status and risk of deep vein thrombosis. The obstetricians were also concerned about the risk of delivering a preterm baby via CS.

Our decision for a simultaneous EVD and CS led to a further dilemma regarding the timing of interventions. An EVD insertion after Caesarean delivery could be technically difficult as blood loss could lead to a sudden fall in cerebral perfusion. On the contrary, a delay in CS to insert the EVD first could lead to foetal exposure to anaesthetic agents.

Case reports in literature have described management of similar tumours in pregnancy depending upon the symptoms and stage of pregnancy. Options range from conservative management, CSF diversion, tumour resection and CS, all of which have their own pros and cons². Our report describes how management needs to be individually tailored according to each patient's neurological status and stage of pregnancy. Combined neuro-obstetric cases are infrequent and it is important that there is a team of specialised obstetric anaesthetists who can work together with neurosurgeons, obstetricians and neonatologists to ensure the best outcome for mother and baby.

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Abstract #: S-50**Obstetric anesthetic management of a patient with newly diagnosed myotonia****Presenting Author:** Anna Moldysz, MD**Presenting Author's Institution:** University of Iowa Hospitals & Clinics**Co-Authors:** Kokila Thenuwara, MD - University of Iowa

Cynthia Wong

Myotonic dystrophies (DM) are a group of neuromuscular disorders characterized by skeletal muscle weakness and myotonia, cardiac conduction abnormalities, cardiomyopathy, cataracts, hypogammaglobulinemia, and insulin resistance. Here we report a patient who was diagnosed with myotonic dystrophy in the third trimester of pregnancy.

A 34-year-old G2P1 parturient was evaluated at 29 weeks' gestation for severe muscle cramping in her hands with inability to relax her grip, leg stiffness upon standing, and facial stiffness. Neurology evaluation was concerning for myotonic dystrophy type 2 or myotonia congenita; genetic testing was ordered. A preliminary anesthetic plan was formulated that included an EKG on admission, a neuraxial anesthetic technique, and avoidance of succinylcholine should the patient need a general anesthetic. The results of genetic testing were available several weeks later and were consistent with a diagnosis of DM type 2. Further cardiopulmonary workup was planned prior to delivery. Genetic testing also revealed that the patient was heterozygous for a CACNA1S mutation of unknown significance. Because other CACNA1S variants are associated with malignant hyperthermia susceptibility (MHS), the anesthesia planned was altered to avoid all triggering agents. An elective cesarean delivery with spinal anesthesia at 39 weeks' gestation was planned.

There are several types of myotonic dystrophies that vary phenotypically and genetically. Type 2 DM involves gradual muscle weakness that includes pharyngeal and laryngeal muscles, proximal limb muscles, and the diaphragm. Uterine smooth muscle may also be affected, leading to increased risk for atony and hemorrhage. Most patients with DM have symptoms that continue unchanged throughout their pregnancy; however, a small percentage have symptoms that worsen during pregnancy and resolve after delivery. Many can deliver vaginally, but skeletal muscle weakness and uterine smooth muscle abnormalities lead to higher rates of cesarean section and instrumental deliveries.² Although there are several case reports associating DM with MHS, the overall incidence of MHS in patients with DM is similar to that in the general population, and therefore, no MH precautions are recommended.³ However, our patient was found on genetic screening to have a CACNA1S variant of unknown significance. Given the association of CACNA1S mutations with MHS,¹ a nontriggering anesthetic was planned.

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Abstract #: S-51

Ballantyne Syndrome: A Case Report.

Presenting Author: Justin C. Morello

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Co-Authors: Colleen Martel - Ochsner Clinic Foundation

Introduction: Ballantyne Syndrome (BS), also known as Mirror Syndrome, is a rare disorder which can occur during pregnancy¹. Although the etiology of BS remains unclear the disease is believed to be the result of severe fetal hydrops of both immunological and non-immunological etiology¹. The first case was reported in 1892 by JW Ballantyne. Since then, there have been fewer than 100 cases described².

Case Presentation: Our patient is a G1P0 who presented as a transfer of care after multiple fetal abnormalities were recognized on ultrasound at 29 WGA. Ultrasound at 29 6/7 WGA showed interval development of fetal hydrops. At that time the patient wished for no intervention after counseling. She was sent home with close follow up and home blood pressure checks. At 31 1/7 WGA she experienced a fetal demise and was admitted for induction. An epidural was placed without complication for analgesia. She then developed decreased urine output, headache, hypertension, and lower extremity pitting edema. Laboratory studies were consistent with pre-e. The fetus was delivered and several hours later she was found to have decreased oxygenation, tachycardia, and severe range blood pressure. A Chest x-ray was unremarkable. She underwent a CT Angio to rule out PE and was started on prophylactic lovenox 2/2 albuminuria, protracted delivery, hypoxia, and tachycardia. The CT angio was negative for a PE but did show small bilateral pleural effusions. Diuresis resulted in an excellent response and she was ultimately weaned off supplemental oxygen. She was discharged in stable condition. Two days later she represented to the OB ED with severe range blood pressure despite outpatient treatment with labetalol, a persistent headache, and palpitations. She was admitted and treated with 24 hours of IV magnesium therapy for post-partum pre-e and then discharged. Genetic testing on the products of conception revealed a 46 XX karyotype. Both the chromosomal microarray and Noonan syndrome testing were normal.

Discussion: The characteristic feature of BS is generalized maternal edema that “mirrors” the edema seen in the hydropic fetus and placenta³. Hypertension and proteinuria are also commonly seen³. Pulmonary edema, a severe maternal complication of BS, occurs in approximately 1/5th of cases³. All of these findings were present in our case supporting the diagnosis of BS. The exact pathogenesis of BS remains unknown. However, there may be increased production of mediators seen in pre-e and therefore overlap between the two conditions².

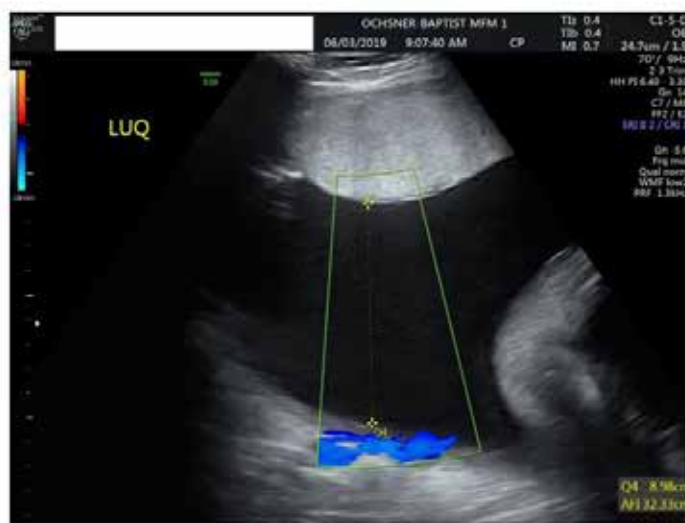
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Abstract #: S-51



A. Significant fetal scalp edema.



B. Moderate Polyhydramnios (AFI of 32).



C. Ascites in the fetal abdominal cavity.



D. Significant subcutaneous edema around the chest wall and large bilateral pleural effusions.

Abstract #: S-52

Paramyotonia Congenita: A Case Report.

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Presenting Author's Institution: Ochsner Clinic Foundation - Jefferson, Louisiana

Co-Authors: Melissa Russo - Ochsner Clinic Foundation

Introduction: Paramyotonia congenita (PC) is an extremely rare congenital autosomal dominant neuromuscular disorder. PC was first described in the literature during the late 1800s by Eulenburg¹. Since then there have only been a handful of case reports in the literature on the anesthetic management of these patients in the obstetric population. PC is often termed as “paradoxical” myotonia because the muscle stiffness typically appears after exercise whereas in classical myotonia stiffness is alleviated by exercise². Interestingly, another distinguishing feature of PC is that it is exacerbated by hypothermia².

Case: Our patient is a 25 year old G6P3023 female who presented for scheduled IOL at EGA of 39 weeks and 0 days. On initial anesthetic evaluation she reported a strong family history of PC and that she takes daily acetazolamide as a prophylactic medication to prevent crisis. She also reported having had several general anesthetics in the past without complication. She was otherwise healthy. Pre-delivery lab work showed mild anemia with a Hgb of 11. On admission, her labor room was warmed, she was given warmed IV fluids, and provided with warmed blankets. Prior to the augmentation of labor an epidural for analgesia was placed without complication. Her blood pressure, oxygenation, and temperature were closely monitored throughout laboring process. Her labor course was uncomplicated and resulted in a spontaneous vaginal delivery. Her postpartum course was also uncomplicated.

Discussion: PC can be difficult to diagnose. The diagnosis is often made through the patient's self-reported symptoms and history². The key feature of PC that must be present is myotonia with increased exercise or movement². Usually, myotonia must also worsen with hypothermia³. The definitive diagnostic test is genomic sequencing of the SCN4A gene³. This case report supports the existing literature that obstetrical patients with PC can be safely managed when appropriate precautions to prevent crisis are implemented. It is imperative that every attempt be made to maintain normothermia which can include warming the patient's room, providing warmed fluids and blankets, and possibly the use of forced air warming devices. In addition, epidural level checks should be performed to pin prick to avoid the use of ice.

Conclusion: In summary, this case highlights that safe pain relief for labor can be accomplished using epidural analgesia without triggering a PC crisis if proper precautions are followed.

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Abstract #: S-53

Placement of Epidural Blood Patch Through Pre-Existing Epidural Catheter

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Presenting Author's Institution: Allegheny Health Network - Pittsburgh, Pennsylvania

Co-Authors: Erica Coffin, MD - Allegheny Health Network

Peter Morkos, BS - Michigan State University College of Human Medicine

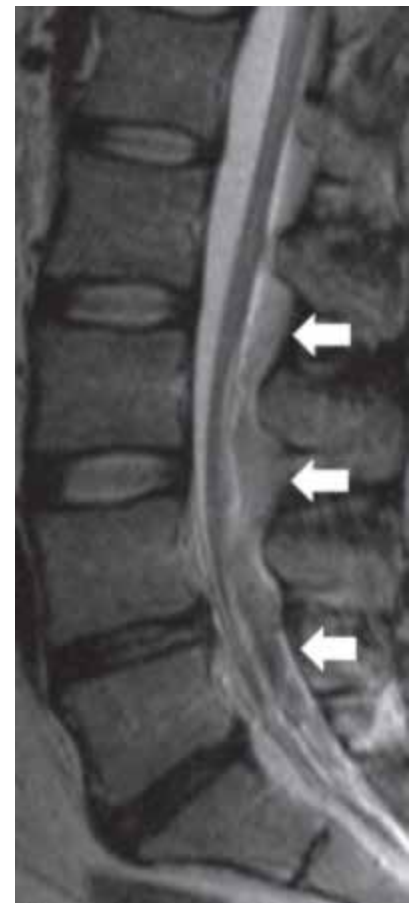
Introduction: Inadvertent dural puncture has been estimated to occur in 1-6% of elective epidural placement. (1) The incidence of post-dural puncture headaches in parturients is thought to occur in approximately 75-85% of cases in part due to their age & gender, as well as the small gauge Tuohy typically used. (1,2) Epidural blood patch has long-remained the gold standard in treatment with 90-95% effectiveness on first attempt. (3) We present a case of effective blood patch placement through a pre-existing epidural catheter initially used for labor pain.

Case: Patient was a healthy 28 year-old G2P1 parturient with unremarkable pregnancy to date. The patient was appropriately positioned with L3-L4 interspace easily identified by anatomic landmarks. The Tuohy was advanced with apparent LOR by saline at 5cm. Upon removal of the stylet, roughly 10ml of clear CSF returned. Tuohy was quickly removed followed by atraumatic placement of epidural catheter at L2-L3. Within one hour of vaginal delivery, patient complained of excruciating headache of the frontal and occipital lobes extending to her shoulders. Headache was positional in nature with post-dural puncture headache diagnosed given the preceding events. Conservative therapy with IV fluids, acetaminophen/butalbital/caffeine was initiated, however, her headache continued to worsen, now accompanied by episodes of vomiting. The decision was made to proceed with epidural blood patch given the severity of her symptoms. Twenty mL of venous blood was sterilely obtained. As the epidural catheter was still in place, it was used to administer the entire 20 ml of blood as opposed to undergoing third epidural placement. Patient tolerated the procedure well with immediate improvement of symptoms. On follow-up, she reported resolution of symptoms with no signs of infectious processes or neurological deficits.

Discussion: Administration of a blood patch through a pre-existing epidural catheter has rarely been reported in literature. This has largely been attributed to logistical factors due to removal of catheter soon after delivery and typical placement of epidural blood patch 24 hours after symptom onset. Concern arises in sterility of the procedure as the catheter has been exposed to an unsterile environment, however, the proper use of chlorhexidine/betadine nearly obviates this risk. Further studies are needed to elucidate complications that may occur with this technique but it remains a viable option as a non-invasive and novel approach.

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Abstract #: S-54**A case of uterine and bladder rupture during trial of labor after Cesarean section**

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Sheryl Nagle, MD - University of Maryland Medical Center

Although noted in sporadic case reports, simultaneous uterine and bladder rupture is a rare, serious, but poorly characterized consequence of labor after a prior Cesarean section.

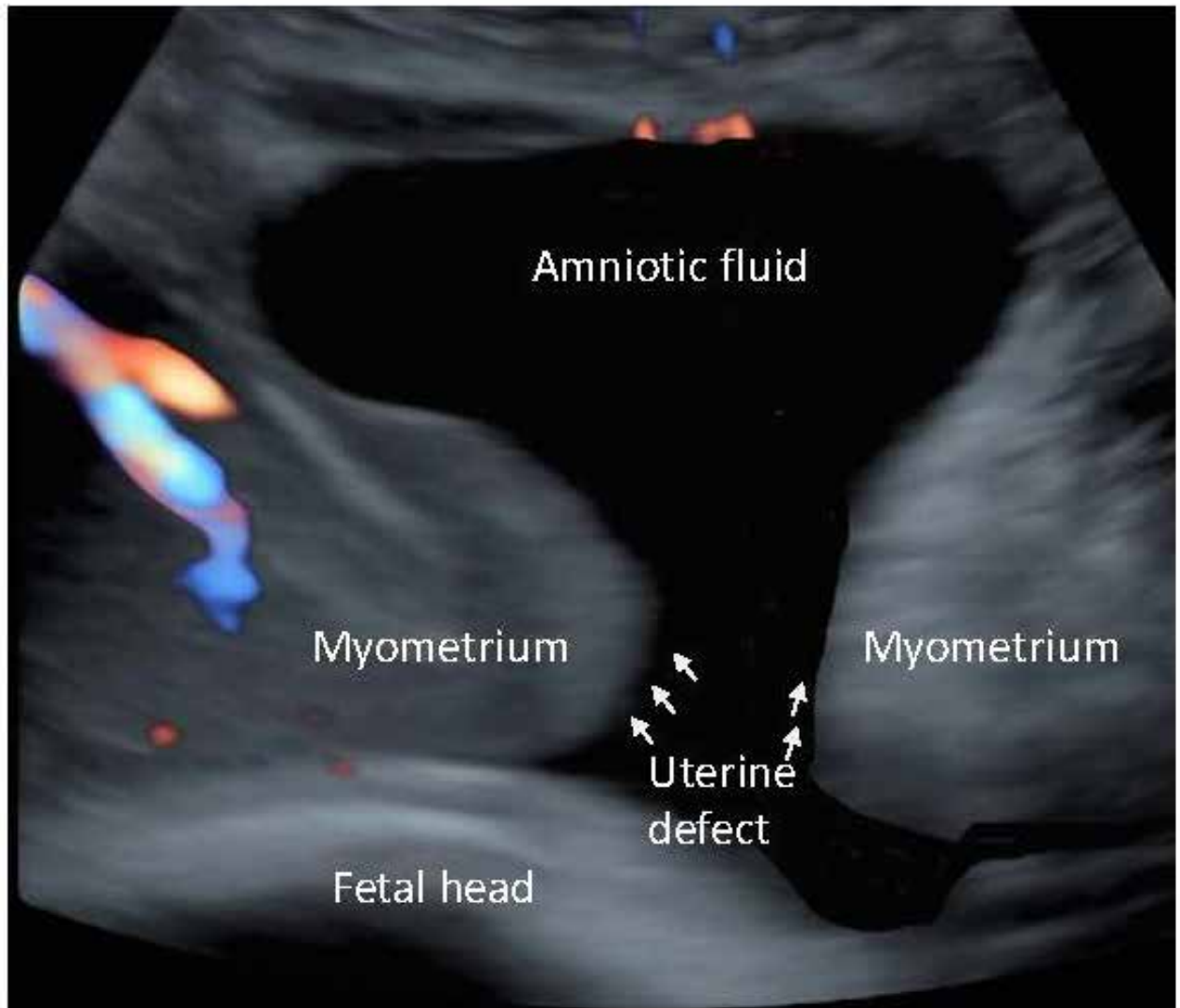
A 37yo G10P4054 at 37weeks gestation with hypertension, asthma, anemia, and fibroids presented for trial of labor after C-section. Sixteen years prior, she had a C-section for non-reassuring fetal status followed by a successful vaginal birth one year ago. She arrived in early labor and requested neuraxial analgesia. Analgesia was induced by a combined spinal epidural with 25mcg intrathecal fentanyl and a Programmed Intermittent Epidural bolus of 0.0625% bupivacaine + 2mcg/ml fentanyl with relief of labor pain. Labor was augmented with oxytocin and a urinary catheter was placed to decompress the bladder.

Six hours later, the patient reported worsening abdominal and back pain as well as right shoulder pain. A team assessment was made with the patient, nurse, anesthesiologist, and obstetrician. Exams revealed mild maternal tachycardia, 5cm cervical dilation, and intact T8-S1 analgesic levels. External fetal monitoring showed increased contraction frequency and prolonged fetal heart rate decelerations. Ultrasound showed uterine wall defect. The team moved the patient to the OR for C-section for non-reassuring fetal status.

Her epidural was augmented for surgical anesthesia with 3% Chloroprocaine to avoid risks of general anesthesia. On entry into the peritoneum, a fetal shoulder was noted in the abdomen with rupture and extension of the prior hysterotomy. The figure of the intrapartum ultrasound illustrates the uterine wall defect. After rapid delivery of the fetus, a large defect in the dome and posterior bladder was identified as well. Due to progressive hypotension and ongoing blood loss, additional IV access was obtained, and resuscitation was initiated with 3 liters Lactated ringers and 3 units red blood cells. Uterine atony complicated the procedure. Urologic and other obstetric teams were called for assistance with complex uterine closure and bladder repair. Two doses of 0.25mg carboprost intramyometrium, 60 units oxytocin, and 1g tranexamic acid assisted with hemostasis.

The patient and her infant recovered well and discharged home on post-operative day 6. Her urinary catheter was successfully removed 3 weeks later in urology clinic.

With an incidence of less than 0.5%, uterine rupture is a rare complication of labor after prior C-section. Associated bladder rupture is even more uncommon. We hope to share our experience to illustrate its presentation as well as stress the need to counsel patients on the potential risks. With collaborative patient assessment and shared decision-making, the team effort led to early recognition of a rare life-threatening obstetric complication. Furthermore, open communication contributed to rapid care coordination for this patient resulting in delivery of her infant 20 minutes from the decision with Apgar scores of 8 and 9.



Abstract #: S-55

Mountain or Molehill? Superficial Back Mass and Neuraxial Anesthesia

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Co-Authors: Corinne Weinstein, M.D. - University of Illinois Hospital & Health Sciences System

Introduction: Midline posterior masses in the thoracolumbar region carry a broad differential with potentially serious clinical implications² and are of particular importance in obstetric anesthesia. Consideration of inherent risks and proper patient evaluation are crucial in developing a safe and effective anesthetic plan¹. We describe a case where evaluation of one such unexpected mass with history, physical, and bedside ultrasound resulted in the safe and successful placement of an epidural catheter.

Case Presentation: AB was a 19 yo G2P1 with no significant past medical history who presented in active labor with advanced cervical dilation to the L&D unit. The patient requested neuraxial analgesia for labor pain control shortly after admission. Upon positioning for lumbar epidural placement, scoliosis was noted in addition to a large, 5 cm circular subcutaneous mass left of midline extending from T11-L1. The patient was aware of the mass but had not undergone any workup and had not endorsed the mass to providers. She denied associated pain, bowel, bladder, and lower extremity neurologic deficits upon further questioning. Physical exam additionally revealed a mobile, nontender mass without erythema or skin markings suggestive of a diagnosis of Neurofibromatosis. Ultrasound examination demonstrated a hypoechoic center with clear hyperechoic margins, and surrounding spinal bony landmarks were identified without irregularities. There was no deep extension of the mass appreciated beyond subcutaneous tissue. Decision was made to attempt midline lumbar epidural placement below the involved area at the L4-5 interspace with ultrasound assistance for localization. A traditional epidural technique was utilized using an 18 g Touhy needle, and an epidural catheter was easily threaded into the epidural space. Placement was completed without complication. Patient reported subjective decrease in pain scores following the test dose and initial bolus of epidural medications. The patient's labor progressed quickly following epidural medication administration, and a healthy baby was delivered 30 minutes after placement.

Discussion: Understanding the presentations and differential diagnoses of posterior superficial masses is crucial in developing anesthetic plans for parturients. Etiologies and clinical consequences of such masses must be considered before administration of neuraxial anesthesia. This case demonstrates the importance of a thorough history and physical exam as well as the usefulness of bedside ultrasound in discerning the etiology of a superficial posterior mass.

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Abstract #: S-56

A Case of Cardiovascular Collapse During Caesarian Delivery

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Introduction: Peripartum cardiovascular collapse is a rare emergency in obstetric anesthesia, thought to affect approximately one in 20000 women. The following case is a presentation of cardiovascular collapse following neuraxial anesthesia for cesarean delivery.

Case Presentation: Patient is a 36-year-old G6P3 at 32 4/7 weeks gestation with pregnancy complicated by twin gestation, chronic hypertension, and history of preeclampsia. After admission for fetal decelerations on NST monitoring, she continued to have decelerations with increasing frequency, depth, and duration. On hospital day 8, obstetric team determined an urgent cesarean delivery was necessary. In the operating room, patient had sinus tachycardia to 160s with normotension. She endorsed anxiety regarding fetal outcomes. She was placed in the lateral decubitus position due to fetal decelerations when upright and epidural catheter was placed without incident. She was turned supine with left uterine displacement. After negative test dose, epidural lidocaine with epinephrine was administered and patient developed an appropriate sensory level bilaterally. Tachycardia persisted, though she remained normotensive. The patient then endorsed feeling "funny," but denied nausea, lightheadedness. Minutes later, she became unresponsive. Patient was given boluses of phenylephrine and ephedrine for hypotension. Despite this, her pulse became unpalpable; EKG showed PEA. ACLS with chest compressions was performed. Within two minutes of loss of consciousness, obstetric team made uterine incision and both infants were delivered within five minutes. She regained consciousness at delivery of infants and remained awake, calm, and comfortable for the remainder of the case. Patient was monitored in the ICU postoperatively. Cardiac evaluation with ECHO revealed reduced LVEF and findings consistent with stress cardiomyopathy. She was discharged postoperative day 5. Six week follow up ECHO showed improved but persistent findings of cardiomyopathy. Stress cardiac MR performed at postop week 14 showed full resolution of cardiac abnormalities. Cause of cardiovascular collapse was determined to be most likely stress cardiomyopathy (SCM).

Discussion: SCM is a type of cardiomyopathy with an unknown incidence and poorly understood etiology. It is more common in women and older patients. Pregnant patients are also at risk. A 2015 meta-analysis found that in parturients, the following had a higher association with SCM: advanced maternal age, multiple gestations, preterm birth, and cesarean delivery. Our patient had all of these risk factors as well as preceding emotional stress. Stress CM should be considered in obstetric patients with acute cardiovascular collapse, especially those with the aforementioned risk factors.

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Abstract #: S-57

Emergency Caesarean section in undetected Pseudobatters syndrome

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Introduction: Placental function and maternal homeostasis determine the electrolyte equilibrium achieved between maternal and fetal circulations.

We describe a case of undetected pseudobatters syndrome during an emergency caesarean-section. This contributed to fetal metabolic acidosis, dyselectrolytemia, needing prolonged neonatal intensive care for intraventricular haemorrhage.

Case report: A 29 year old pregnant woman known to have depression, bulimia nervosa, diet controlled diabetes & bipolar disorder was admitted on labour ward for preterm labour & projectile vomiting. She had a category 1 caesarean-section for fetal bradycardia. On application of BP cuff, severe carpopedal-spasm was noticed by the anaesthetist. A venous blood gas was performed prior to induction showed severe metabolic alkalosis (Ph 7.65), hyponatremia (Na:122), Hypokalaemia (K:2.7), hypochloremia (Cl: 75) and hypocalcemia (Ca:0.97). Patient had a rapid sequence induction for anaesthesia with Propofol & Suxamethonium. Calcium gluconate 10% 10ml was administered to correct hypocalcemia. CVP was inserted for further electrolyte replacement. Patient maintained sinus rhythm, remained haemodynamically stable and didn't need any cardiovascular support during the procedure. She was successfully extubated at the end of the procedure. A morphine PCA was prescribed for pain relief and electrolytes were corrected over period of 4 days. Baby's blood gas analysis showed metabolic alkalosis, hyponatremia (Na:118), hypokalaemia (K:2), hypocalcemia & hypochloremia, had grade 3 intraventricular haemorrhage needing 9 days of NICU for ventilation & electrolyte correction.

Discussion: Placental transfer of ionic exchange influences neonatal outcome. Bulimia nervosa & self induced vomiting may have been contributory to the metabolic alkalosis & electrolyte abnormalities as seen in this case. Presence of severe hypokalemic metabolic alkalosis associated with hyponatraemia & hypochloreaemia suggests a likely presentation of Pseudo batters syndrome. The changes in the pH of fetal cerebrospinal fluid (CSF) are known to correlate with maternal arterial pH changes. Elevation in fetal CSF pH may cause contraction of cerebral vasculature in the fetus predisposing to intracranial bleeding as seen in this case. Early detection & treatment of maternal acid-base imbalance and dyselectrolytemia is essential part of management of a pregnant patient.

Conclusion: Early detection & treatment of maternal dyselectrolytaemia and metabolic imbalance would prevent fetal complications & improve fetal outcome.

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Abstract #: S-58

ARE LABOR EPIDURALS ALWAYS ELECTIVE? A CASE REPORT OF A POST-ICTAL ECLAMPTIC PATIENT WITH AN INTRAUTERINE FETAL DEMISE

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Presenting Author's Institution: Northwestern University Feinberg School of Medicine

Co-Authors: Jack M. Peace, MD - Northwestern University Feinberg School of Medicine

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Introduction: Labor epidurals are often considered an elective procedure for labor analgesia. As with all elective, non-emergency procedures, epidurals require informed consent. However, are there circumstances in which labor epidurals are medically indicated? We present the anesthetic management of a post-ictal pregnant eclamptic female requiring induction of labor for intrauterine fetal demise (IUFD).

Case: A healthy 19-year-old G1P0 female at 28 weeks gestation presented following 3 witnessed seizures. Upon arrival, she was postictal and minimally responsive. Lack of cardiac activity on fetal ultrasound confirmed an IUFD and laboratory studies were concerning for eclampsia with HELLP syndrome. A magnesium bolus for seizure prophylaxis was initiated. CT brain imaging was concerning for posterior reversible encephalopathy syndrome. The obstetricians decided to proceed with induction for IUFD. While she continued to be minimally responsive and confused, her platelet level was declining (~70K/ μ L) and there was concern that the window of opportunity for a labor epidural would be lost. She was deemed a poor candidate for patient-driven alternatives, such as a narcotic PCA or nitrous oxide. As she was unable to provide informed consent, analgesic options were discussed with the patient's power of attorney (POA), her mother. Consent was obtained and an epidural catheter was placed for labor analgesia. She had an uneventful delivery and subsequent hospital course; she was discharged postpartum day 2.

Discussion: Informed consent requires a discussion regarding the procedure, its risks, benefits and reasonable alternatives; autonomy in decision making and an evaluation of understanding; and allows patient questions.¹ Normally, despite the pain and anxiety imparted during labor, women maintain the ability to understand and recall information, thus their capacity to consent to labor epidural analgesia is not impaired.² In instances where the patient is not competent and unable to consent, a surrogate decision maker can provide consent, making decisions based on what the patient would reasonably want under the circumstances. Considering the emotional impact of an unanesthetized IUFD induction and lack of alternative analgesic options, labor epidural analgesia could be considered medically indicated. Studies have shown that epidural analgesia is associated with decreased risk of postpartum depression, even after a live delivery.³ Ultimately, our decision to proceed was based on weighing the risks, benefits, and urgency of various options at hand, in consultation with multiple providers, the patient's family, and surrogate decision maker. As every scenario is unique, it is vital to consider the clinical context and communicate with the POA to help determine patients' wishes if needed.

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Abstract #: S-59

Loeys-Dietz Syndrome – Misadventures in Dural Ectasia

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Introduction: Loeys-Dietz Syndrome (LDS) is an autosomal dominant genetic disorder caused by a defect in the transforming growth factor-beta pathway - predisposing affected parturients to widespread arterial aneurysms/dissections, dural ectasia and complications including uterine rupture and death. In our patient, severe scoliosis and known dural ectasia complicated neuraxial analgesia (NA), leading to intrathecal catheter (ITC) placement, but also proved protective in the setting of iatrogenic ITC overdose.

Case Report: A 36yo G7P4024 diagnosed with LDS presented for IOL secondary to LDS with aortic root dilation (3.8cm) at 37.6wk EGA. Other clinical LDS stigmata included a bifid uvula, scoliosis, and dural ectasia. She had 4 vaginal deliveries prior to diagnosis all with uncomplicated NA, and requested NA at approximately 2cm dilation for this delivery. NA was complicated by inadvertent dural puncture with a 17G Weiss needle followed by ITC placement. The ITC was initiated using 20mcg fentanyl with 1.25mg bupivacaine, and maintained with 4mg/h ropivacaine. About 8h following the ITC placement, she requested a bolus for breakthrough pain. Despite adequate warning signs/labels, the ITC was bloused with 4ml 0.5% bupivacaine resulting in a bilateral T2 level, maternal hypotension, and fetal bradycardia. The patient underwent a stat cesarean section with resultant neonatal Apgars of 8 and 9. Maternal intubation was not required as she remained conscious and showed no signs/symptoms of respiratory distress. In the PACU, she was given preservative-free (PF) 0.2mg morphine intrathecally, as well as 10ml of PF saline. The catheter was left in place overnight, with an additional 10ml of PF saline given prior to ITC removal. She began to complain of a spinal headache (HA) shortly after delivery, but was not felt to be a great candidate for an epidural blood patch (EBP). Her HA was treated with cosyntropin, IV/oral analgesics, and caffeine prior to resolution 8 days later.

Discussion: LDS can pose significant problems as several organ systems are affected, and there can be wide variation in the severity of clinical features. Our patient's history of dural ectasia both contributed to her ITC placement and likely protected her against a subsequent total spinal. Unfortunately, this also contributed to making her a poor candidate for EBP which can lead to unique challenges should the HA persist or have associated neurological symptoms. Hemodynamic changes associated with NA can have detrimental effects on preexisting vascular abnormalities with fluctuations in wall tension predisposing patients to aneurysm rupture. While general anesthesia wasn't necessary for this patient - cervical spine instability and other airway anomalies, can lead to airway difficulty. As noted above, human error can complicate even well-designed anesthetic plans. Many clinical and systemic lessons were learned from this patient.

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Abstract #: S-60

Anesthetic Management of the Parturient with Moyamoya Syndrome: A Case Report and Review of the Literature

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Introduction: Moyamoya disease (MMD) is a disease of the internal carotid arteries (ICA) with stenosis and/or complete occlusion, leading to compensatory proliferation of fine blood vessels, resembling a "puff of smoke" on contrast imaging.¹ This disease can affect one or both ICA's and typically presents in childhood with ischemic strokes and can also present in adulthood with intracerebral hemorrhage.² Patients with MMD are highly susceptible to changes in cerebral perfusion pressure (CPP) and arterial blood gas tensions.^{1,2} The parturient with MMD is at high risk for neurological sequelae given her physiologic changes of labor, including hypoxapnea, increased ICP with vaginal delivery, and hypertension secondary to pain.³ We present a case of a successful caesarian delivery in a parturient with MMD.

Case Description: This is a G3P1102 28 year old female at 38weeks 2 days gestation, presenting from an outside facility for c-section with concern for IUGR. Medical history was notable for MMD complicated by TIA three years prior status post bilateral pial syangiosis, and syncope in this pregnancy. Pre-op MRI showed patent collaterals around occluded right and left ICA's with no acute infarcts. The choice was made to proceed with c-section under epidural anesthesia. An epidural was placed using dexmedetomidine for anxiolysis, and a dermatomal level near T4 was achieved by dosing 2% lidocaine. MAPs were maintained between 69-74mmHg using a phenylephrine infusion, and end-tidal CO₂ was maintained at 30mmHg. The case was uncomplicated and the patient was asymptomatic throughout.

Discussion: MMD is incredibly rare with an incidence in the US of 0.086 per 100,000 persons.³ The typical surgical palliation for MMD can mitigate symptoms by reducing cerebral ischemia. However, due to the progressive nature of this disease, even patients who have had a revascularization procedure are still at considerable risk of peripartum morbidity.^{1,3} Maintenance of adequate CPP should be the primary goal of the anesthesiologist. Regional anesthesia allows for an interactive patient, and avoids hypertension that may accompany a general anesthetic¹. We ultimately chose an epidural technique due to the ability to establish gradual dermatomal anesthesia with less hemodynamic instability than subarachnoid block, though spinal and CSE anesthetics have been reported in the literature¹.

Conclusion: The priorities in managing a parturient with MMD aim to maintain normotension and normocapnea, an aim that can be safely accomplished using regional anesthesia.

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Abstract #: S-61**Anesthetic Management of a Parturient with Recurrent Acute Myeloid Leukemia****Presenting Author:** Leziga T. Obiyo, MD, MPH**Presenting Author's Institution:** Loyola University Medical Center**Co-Authors:** Nakia Hunter, MD - Loyola University Medical Center

Introduction: Cancer is diagnosed in 0.07-0.1% of pregnancies, yet a leading cause of maternal death¹. Acute myeloid leukemia (AML) accounts for approximately two-thirds of leukemia cases in pregnancy. Women diagnosed with AML during pregnancy should be treated promptly, as this aggressive malignancy may be associated with life-threatening complications to both mother and fetus.² When diagnosed between 24-32 weeks' gestation, chemotherapy and delivery preparation requires a multidisciplinary team approach with special consideration of the risk-benefit ratio³. We present a rare case of a parturient presenting for induction of labor for pancytopenia due to recurrent AML.

Case: A 30-year-old G2P1 female at 32.1 weeks' gestation presented to L&D for induction of labor to initiate chemotherapy for AML. She was initially diagnosed with AML post-pregnancy status post chemotherapy, which was in remission until the second trimester of her second pregnancy. The patient presented with a sore throat, dyspnea, and productive cough. On exam, she was afebrile, hypoxemic (SpO₂ 88%) with diminished breath sounds and an enlarged left tonsil. Her oxygenation improved with 3L of supplemental oxygen via nasal cannula. Labs were significant for severe pancytopenia (Hgb 6.4 g/dL, platelets 7 K/UL and WBC 1 K/UL), rhinovirus, parainfluenza and a positive screen for five alloantibodies. Appropriately screened blood products were available prior to induction to maintain transfusion goals of Hgb > 7 g/dL and platelets > 30 K/UL. The patient was transfused 3 units (U) of packed red blood cells (PRBCs) and 4 units (U) of platelets with an appropriate response. Labor was induced via standard obstetric practice. Tranexamic acid 1G was given prophylactically at 8 cm cervical dilation. The patient did not qualify for neuraxial analgesia and declined systemic opioids. She had an uncomplicated vaginal delivery, only requiring 2U PRBCs and 1U platelets postpartum. On postpartum day 2, she was transferred to the Hematology/Oncology service for further management of her AML.

Discussion: The anesthetic management of a parturient with AML can be challenging. Neuraxial anesthesia should be avoided in the presence of significant thrombocytopenia and neutropenia as this increases the risk of spinal-epidural hematoma and infection. Additionally, neuraxial procedures may introduce malignant cells into the CNS, which may worsen disease outcomes². Alternative methods of labor analgesia should be offered, while cesarean delivery will require general anesthesia.

There is an increased risk for both hemorrhage and thrombosis in parturients with AML. Management often requires advanced preparation of blood products, thromboprophylaxis, and antifibrinolytics. Each anesthetic plan should balance the aggressiveness of AML to the risks and benefits to both mother and fetus.

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Abstract #: S-62

Subdural Hematoma after Spinal Anesthesia for Cesarean Delivery

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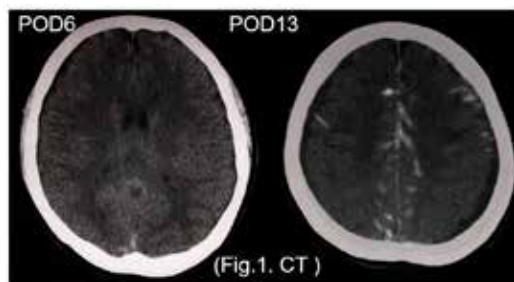
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A 37-year-old G1P0 presented at 38+4weeks-of-gestation, for elective cesarean delivery due to breech presentation and uterine myoma. Past medical history was unremarkable and routine blood tests, including coagulation status were normal. Spinal anesthesia was administered at the L3-4 level, with a 27-gauge pencil point needle obtaining clear cerebrospinal fluid flow on the first pass and anesthesia was induced with 11mg 0.5% hyperbaric bupivacaine. For postoperative analgesia, an epidural catheter was placed at Th11/12 with no evidence of dural puncture, a healthy infant weighing 2950g was delivered, with Apgar scores of 9 and 10. After the operation, continuous epidural infusion was started 6mL/h of 0.1%ropivacaine with 2mcg/mL fentanyl for the post-operative pain until POD 2. On the POD1 she started to ambulate and took care of the baby and her recovery was fine until on POD3, when she complained of nuchal pain and headache. Physical examination including other cranial nerve symptoms showed no deficits, and it was interpreted as a PDPH. On the safe side, we planned diagnostic imaging for exclusion of other intracranial pathology. On POD6 she had a diagnosis of intracranial subdural hematoma with head CT(fig1) and MRI(fig2). The patient declined autologous epidural blood patch, and treatment for the next 3 days consisted of acetaminophen and bed rest in the supine position until the headache improved. On the POD13 we confirmed no exacerbation with second CT and she was discharged and followed neuroimaging found no abnormal changes(fig2).

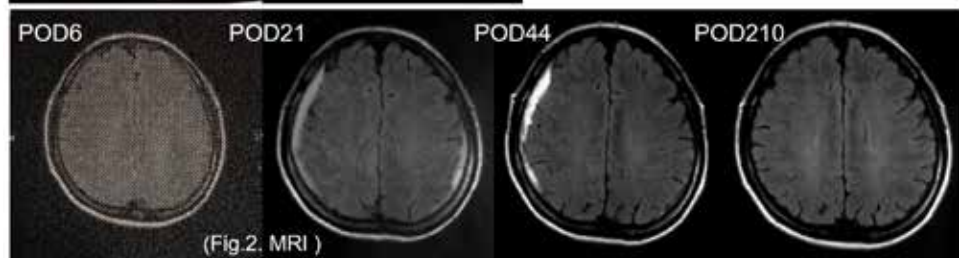
Discussion: PDPH is a relatively common complication of neuraxial anesthesia, whereas acute intracranial subdural hematoma is a rare occurrence. One recent review showed as high as 1 of 320 PDPH cases.¹⁾ As in this case, there is another report with 27-gauge Whitacre needle and subdural hematoma.²⁾ One report resulted in a diagnosis 3 weeks postpartum, and had a nearly fatal neurologic outcome.³⁾ Failure to make an early diagnosis can occur given the similar symptoms of PDPH and intracranial hematoma. The diagnosis can be confirmed by neuroimaging, which should be considered to facilitate early recognition of intracranial lesions and to start an effective treatment.

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(Fig.1. CT)



(Fig.2. MRI)

Abstract #: S-63**Successful Prevention of Autonomic Hyperreflexia in a Paraplegic Parturient****Presenting Author:** Victoria Olatunji, MD**Presenting Author's Institution:** Ohio State University Wexner Medical Center**Co-Authors:** Blair H. Hayes, MD - Ohio State University Wexner Medical Center

Pedro Pineda, M.D. - The Ohio State University Wexner Medical Center

A 25 y.o. G1P0 with a PMH of T9 paraplegia, cHTN, morbid obesity (BMI 48), and no prior hx of autonomic hyperreflexia (AH or autonomic dysreflexia), presented at 39w1d for a scheduled IOL. Paraplegia was from a GSW at T10/11, 10 years ago. Months after her GSW, imaging showed severe atrophy of the spinal cord from T8/9 to T11/12, with no other abnormalities. Clinically, the patient had loss of movement and sensation from T9 down, but she was able to sense fetal movement. Per OB, the patient had no contraindication to a vaginal delivery so she was scheduled for an IOL with an assisted second stage. An obstetric anesthesiology consult recommended an early epidural for L&D to decrease her risk of AH in the setting of paraplegia. The primary reason for the epidural was to blunt the afferent pain fibers which could theoretically trigger AH. Therefore, baseline sensation level to pinprick was marked prior to her epidural placement and the insensate level increased bilaterally with epidural dosing, which confirmed a functional epidural. The patient underwent an uneventful and hemodynamically stable forceps assisted vaginal delivery of a male infant. Max BP was 160/74 and she did not show signs or symptoms of AH. Postpartum, she was treated for suspected endometriosis and UTI, and she was discharged on PPD2 with follow up scheduled.

AH is acute hypertension secondary to unmodulated sympathetic reflexes in response to “noxious visceral or somatic stimulation” below the spinal cord injury (SCI) (1). Parturients at highest risk of AH are those with prior AH episodes, and/or with injury at level T6 or above (2, 3). Since the location of the sympathetic chain is variable, parturients like ours, with injury level below T6, are still at risk for AH. Approximately 88% of the time, symptoms of AH include headache and sweating above the lesion, and without immediate treatment, cerebral hemorrhage, cardiac arrest, seizure and death may occur (1).

Early neuraxial anesthesia is recommended to prevent AH by inhibiting afferent noxious stimuli from reaching the spinal cord (3). For patients at high risk for AH, maintaining neuraxial anesthesia for 24-48 hours postpartum may further prevent AH, as it is not uncommon for parturients to develop AH in the postpartum period (3).

Meticulous confirmation of epidural function is important, yet challenging in insensate patients. Baseline sensation level before epidural placement was used for our patient. Other methods include confirming loss of DTR in the LEs and/or the abdominal wall, and monitoring for increase in skin temperature (3, 4).

This case highlights the importance of placing an early epidural in parturients with SCI to prevent AH, and the different ways of confirming the function of epidurals in patients with baseline sensation impairments.

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Abstract #: S-64**The Ethical and Anesthetic Considerations For a Parturient with Grade III Malignant Astrocytoma****Presenting Author:** Kroh Monique, MD**Presenting Author's Institution:** University of Louisville School of Medicine**Co-Authors:** Daisy Sangroula, MD - University of Louisville School of Medicine

Anaplastic astrocytoma is a rare malignant brain tumor, that develops from star-shaped brain cells known as astrocytes. Astrocytomas are classified by their grade-- grade I and grade II astrocytomas grow slowly and are benign; while grade III and grade IV astrocytomas grow faster and are highly malignant. Grade III tumors are aggressive, often invade neighboring tissues and carries a poor prognosis. The mainstay of treatment for Grade III astrocytomas remains surgical resection with radiation and chemotherapy. Studies have not shown a difference in incidence of brain tumors between pregnant and non-pregnant women; however, it has been hypothesized that faster development of symptoms and progression of disease in pregnant women is suspected secondary to pregnancy hormones that facilitate the growth of these tumors. We report a 27-year-old gravida 5 para 2 at 27 weeks with a past medical history of anaplastic astrocytoma stage III status post resection, who presented with worsening headache, confusion and altered mental status. On physical exam, the patient was uncooperative, only oriented to self and did not follow commands. A magnetic resonance imaging of the brain revealed reoccurrence of the disease with significant cerebral edema. Decision regarding type of delivery was not straightforward and required multiple discussions between obstetricians, maternal fetal medicine, neurosurgery, oncology, palliative medicine, and anesthesia. This case highlights the ethical concerns of a mother with deteriorating neurologic status who presents with terminal brain cancer, the implications of neuraxial anesthesia in the setting of elevated intracranial pressure, as well as the importance of a multidisciplinary approach.

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Abstract #: S-65**Post-partum hemorrhage success story: Patient gets 58 units of product and walks out of the hospital with her newborn in only 6 days.**

Presenting Author: Montana Osler, M.S.

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Mellany Stanislaus, MD - The Ohio State University Wexner Medical Center

An otherwise healthy 32-year-old G1P0 parturient underwent cesarean for failure-to-progress at 41w3d. After delivery, bleeding was noted from an extension of the hysterotomy. Surgeons corrected this and achieved hemostasis and good uterine tone. After closure, a large amount of blood and clot was expressed vaginally and patient became pale, diaphoretic and hypotensive. Quantitative blood loss exceeded 3500mL and Massive Transfusion Protocol (MTP) was initiated. Invasive lines, monitors and ETT were placed. In attempt to preserve fertility, Interventional Radiology was consulted. CTA pelvis showed active extravasation and she underwent successful uterine artery embolization. She was subsequently transferred to the ICU and extubated. However, 10 hours later, she became hemodynamically unstable and reported increasing pain. Uterine bleeding was noted from the Bakri device. At that time, decision was made to return to the OR for emergent laparotomy and hysterectomy. In totality, she required 27U PRBCs, 25U FFP and 6U platelets. She was discharged to home HD#6.

Post-partum hemorrhage (PPH) is a leading cause of maternal morbidity and mortality in both resource-poor areas and high-resource countries. In contrast to worldwide trends, maternal mortality has been increasing in the United States and 11.2% of those deaths are attributed to PPH (1). Population data report that PPH affects approximately 5% of deliveries. However, when blood loss is assessed quantitatively, the incidence jumps to 10% of deliveries resulting in PPH (2). Given the rising rates of maternal mortality in the United States, and the substantial amount that can be attributed to PPH, efforts need to be made to improve recognition time and treatment.

Our case illustrates evidence-based strategies to improve outcomes in mothers with PPH. First, prompt recognition of bleeding along with quantification of bleeding is essential for timely interventions. Studies show healthcare providers underestimate blood loss when based solely on subjective measures (3). Our institution uses an artificial intelligence application in the OR, which allows for a more objective and accurate blood loss estimation, giving providers real time data to promptly decide on targeted interventions. Second, an MTP used alongside a PPH hemorrhage protocol can greatly improve maternal mortality and morbidity. This was seen in a large institutional study over 14 years where despite increasing incidence of PPH, measures of morbidity and mortality actually decreased after initiating these protocols (4). Alongside strong interdisciplinary collaboration and communication, implementation of PPH protocols and quantification of blood loss can improve maternal morbidity and mortality as seen in this case.

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Abstract #: S-66

Successful management of a ruptured intra cranial hemorrhage in a parturient patient with embolization, followed by resection of Arterio Venous malformation (AVM) and delivery of baby by C-section

Presenting Author: Rakhi pal

Presenting Author's Institution: University Hospitals and case Western Reserve Medical Center

35 y/o 30 weeks pregnant with a history of prior miscarriages presented with headache; found to have large right temporoparietal intracranial hemorrhage (ICH) with intraventricular hemorrhage IVH (ICH grade 4). Patient underwent Right craniectomy and resection of temporal brain arteriovenous malformation; intracerebral hemorrhage clot evacuation. The fetus was delivered by C section at 34 week.

CT demonstrated a large intraparenchymal hemorrhage with moderate intraventricular extension with significant midline shift. She was brought emergently to the operating room where a hemicraniectomy was immediately performed with partial clot evacuation. One day later she was brought to endovascular suite for embolization, which was coordinated with neuro radiologists, obstetricians as well as anesthesiologists to ensure the safety of both the mother and fetus. During the procedure, various measures were taken to minimize exposure of the fetus to ionizing radiation. The obstetrics team was monitoring the fetus during the entire procedure and was ready to intervene should any fetal distress occur. Next day craniotomy was performed for left parieto-occipital AVM resection followed by postoperative angiography confirming successful resection. She also required placement of a VP shunt for persistent hydrocephalus.

During the entire course of hospital stay, obstetric team was following her and growth of fetus. Patient received antenatal corticosteroids for fetal maturation and magnesium for fetal neuroprotection. Fetal monitoring was planned for with non-stress test (NSTs) daily. Since rehabilitation center won't accept pregnant patient, hence decision was made to deliver baby by c section under general anesthesia. Since there was not a maternal/fetal indication to deliver at that time, our goal was to prolong the pregnancy as long as maternal/fetal status allowed.

Discussion: In pregnant mothers with ruptured AVM is associated with associated maternal and fetal mortality due to increased risk of re-hemorrhage; decision to operate after ICH during pregnancy should be based upon neurosurgical principles, whereas the method of delivery should be based upon obstetrical considerations. Management of a ruptured brain AVM during pregnancy requires a multidisciplinary approach with close cooperation among the neurosurgeon, obstetrician, and anesthesiologist for the neurosurgical intervention and the timing and mode of delivery along with fetal monitoring.

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Arteriovenous malformations of the cerebral circulation that rupture in pregnancy. J Obstet Gynaecol 2003,

Abstract #: S-67**Hole in One: Use of Intubating LMA in an Emergency Cesarean Delivery****Presenting Author:** Priyanka Patel, DO**Presenting Author's Institution:** Allegheny Health Network**Co-Authors:** Erica Coffin, MD - Allegheny Health Network

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Mark Stypula, MD - Allegheny Health Network

Difficult intubation for emergency cesarean delivery is associated with increased mortality and morbidity (1). It is well-known that as pregnancy progresses, the parturient airway becomes more challenging, and there have been multiple published articles discussing the management of difficult airways (2). A retrospective study recently illustrated that laryngeal mask airway (LMA) is the most common airway rescue device utilized during a difficult airway in obstetric anesthesia. This study looked at the utility of the LMA and the subsequent consequences of its use (3). Here, we demonstrate the successful use of an intubating LMA during a difficult airway in an emergency cesarean section.

A 19 year old G1P0 at 30 weeks and 6 days was admitted for pre-eclampsia with severe features. A decrease in fetal heart rate was noted in triage and the patient was brought to the operating room for emergency cesarean delivery under general anesthesia. Rapid-sequence induction was initiated. Two attempts at video laryngoscopy failed due to poor visualization of airway structures. The surgery was started under straightforward bag-mask ventilation. An LMA was then placed without difficulty and ventilation was determined to be effective. The standard LMA was then successfully swapped for a Fastrach intubating LMA. A 6.5mm endotracheal tube (ETT) was placed through the intubating LMA. The ETT position was confirmed and placement was secured. The patient was extubated uneventfully after the procedure and remained stable throughout the rest of her admission.

Here, we demonstrate the use of an intubating LMA in a can ventilate, cannot intubate situation. Previously, a case report described a similar situation in which a ProSeal LMA was utilized and an oral gastric tube was passed to aspirate stomach contents (4). Successful aspiration of gastric contents with a standard LMA has also been reported in the literature (3). The use of a more advanced LMA mitigates the risk of aspiration by allowing placement of an ETT.

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Abstract #: S-68

Perioperative Management of a Parturient with Symptomatic Type 1 von Willebrand Disease and an Allergy to DDAVP

Presenting Author: Sabrina Petrillo

Presenting Author's Institution: New York Presbyterian - River Vale, New Jersey

Co-Authors: Jennifer Wagner - New York Presbyterian

Type 1 von Willebrand disease (vWD1) is the most common inherited coagulopathy and results in a mild to moderate qualitative deficiency of von Willebrand factor (vWF). The preferred initial treatment of bleeding in these patients is administration of desmopressin (DDAVP), which works by causing the release of endogenous vWF from endothelial cells.¹ Allergies to DDAVP are rare but have been reported.² Replacement products, such as vWF/factor VIII (vWF/FVIII) complex, are used in patients who do not respond to DDAVP. We report the case of a patient with vWD1 and DDAVP allergy, and the safe perioperative use of VWF/FVIII complex prior to neuraxial anesthesia and cesarean section (CS).

The patient is a 28-year-old G1P0 with a history of gestational diabetes, chronic hypertension, and vWD1. She was diagnosed with vWD1 after she experienced excessive bleeding following a dental procedure at age 16. At that time she received DDAVP to which she responded well but resulted in an allergic reaction. At 34 weeks gestation she was diagnosed with preeclampsia with severe features which required urgent delivery. She elected to be delivered by CS. Hematology was consulted pre-operatively and recommended administration of vWF/FVIII complex 50u/kg prior to surgery and neuraxial anesthesia. However, our small, community hospital did not have vWF/FVIII complex available in the blood bank. Coordination with a larger affiliated hospital took place to deliver the drug within the next few hours. Approximately 2 hours prior to neuraxial anesthesia placement, the patient received vWF/FVIII complex 50U/kg. Estimated blood loss during the CS was 800mL. She did not have any further bleeding or embolic complications and did not require additional dosing of VWF/FVIII complex for the rest of her hospital stay. The patient had an uneventful hospital course and was discharged on postpartum day three.

Pregnant women with vWD1 are at an increased risk for postpartum hemorrhage despite an increase in both vWF and factor XIII during pregnancy, and treatment options should be planned during pregnancy.³ This patient had prenatal care and a hematology consult early in pregnancy. A plan was already in place for the time of delivery, but the patient presented much sooner than expected. This patient's case demonstrated the importance of multidisciplinary coordination and planning for obtaining necessary blood products for an unanticipated and urgent delivery.

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Abstract #: S-69

Epidural Catheter Placement for Pain Management in a Parturient with Spontaneous Intracranial Hypotension

Presenting Author: Sabrina Petrillo

Presenting Author's Institution: New York Presbyterian - River Vale, New Jersey

Co-Authors: Marisa McSwain - New York Presbyterian

Spontaneous intracranial hypotension (SIH) is a condition secondary to low cerebral spinal fluid (CSF) pressure believed to be caused by micro-dural tears resulting in spontaneous CSF leakage.¹ It is characterized by a postural headache which is more severe in the upright position and relieved when lying supine. Other characteristics include nausea, vomiting, photophobia, dizziness, neck pain, and visual disturbances.¹ We report a case of a patient with a history of SIH requiring pain management and the safe use of an epidural catheter for labor and delivery.

The patient is a 29-year-old G1P0 at 39.3 weeks gestation with no surgical history and no significant medical history other than headaches and neck pain requiring emergency room (ER) visits since 2017. During the ER visits no imaging was done, she was given pain medication and sent home. Since then she has been consulted by otolaryngologists, neurologists and cardiologists whose workups were all negative. The patient's symptoms persisted throughout her pregnancy along with new onset nausea and vomiting. At 33 weeks gestation, the patient was ultimately diagnosed with dural tears and CSF leakage. An anesthesia consult was done one week later with the plan to evaluate the patient's symptoms upon arrival to the hospital, determining whether to proceed with neuraxial or intravenous analgesia. When the patient presented to labor and delivery, she was asymptomatic and requesting labor pain management. An epidural catheter was placed uneventfully, providing analgesia for the next 12 hours until delivery of a healthy baby via spontaneous vaginal delivery. She did not have any further complications and remained asymptomatic for the rest of her hospital stay. The patient had an uneventful hospital course and was discharged on postpartum day two with daily evaluations from anesthesia providers.

Pregnant women commonly present with headaches, nausea and vomiting making the diagnosis of SIH uncommon, hence providing for very few cases studies pertaining to obstetric management with such a condition.² This patient had prenatal care and several consults throughout the pregnancy. Conservative management was considered using intravenous analgesics and antiemetics with the option of an epidural blood patch if the patient's symptoms worsened. This case demonstrated the importance of multidisciplinary coordination and plan for pain management in a rare and evolving condition. Although SIH can be considered a problematic and difficult to diagnose disease process it is not one that requires exclusion of neuraxial analgesia.

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Abstract #: S-70**Assessing the Clinical Usefulness of TEG 6S in a Parturient with Significant Thrombocytopenia****Presenting Author:** Phillips E. Louisa, MD**Presenting Author's Institution:** Emory University**Co-Authors:** Johnson M. Erica, MD - Emory University

Thrombocytopenia occurs in 7-10% of parturients¹. Although thrombocytopenia is a relative contraindication to neuraxial anesthesia, some authors have proposed different minimum platelet counts for different etiologies of thrombocytopenia². We present a patient with significant thrombocytopenia of unclear etiology with a difficult airway in need of urgent Caesarean in which thromboelastography (TEG 6s) helped to guide clinical management.

A 40yr, non-English speaking G7P6006 at 38.2wks with history of gestational diabetes and ITP was admitted with diagnosis of HELLP syndrome. Admission blood pressure was 150s/90mmHg, AST/ALT (235/110), and platelets were 24K. Her exact etiology of thrombocytopenia was unclear secondary to her known history of steroid responsive ITP. Hematology was consulted, and proposed to challenge the patient's response to a platelet transfusion to better identify her cause of thrombocytopenia. As the baby was breech on presentation, an urgent caesarean section was planned and there was no time to follow-up labs or attempt steroids. We did perform serial TEG tests that were all consistent with normal platelet function and clotting ability. Of note, the patient's airway appeared challenging on exam, and after a detailed discussion with patient via in-person interpreter, decision was made to proceed with spinal anesthesia given difficult airway and risk of postpartum hemorrhage (PPH). Atraumatic spinal performed and the patient underwent c-section, which was complicated by PPH (QBL 1042mL) requiring 2ndline uterotonic agents (oxytocin, carboprost, and misoprostol). Frequent neurochecks done overnight. Her post-op platelet count improved to 69K and trended to 140K on PPD 3. She was discharged on PPD 3 and was asymptomatic at subsequent visits.

Thromboelastography has been described as guiding clinical management in thrombocytopenic parturients in several case reports³. In conclusion, our patient most likely had a combined source of her thrombocytopenia to include ITP and new-onset of preeclampsia with severe features. Our patient had a known history of ITP with platelets as low as 16K 10 months prior, yet she also had hypertension, mildly elevated LFTs and gestational diabetes that predisposed her to preeclampsia. Given the urgent nature of her delivery, our on-unit TEG 6s was reassuring and helpful in guiding our clinical decision to perform neuraxial anesthesia.

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Abstract #: S-71**Severe hypoxic respiratory distress in an ESRD patient refusing HD, on magnesium for treatment of post delivery pre-eclampsia after IUFD**

Presenting Author: Alexi Pollet, DO

Presenting Author's Institution: Rush University Medical Center

Co-Authors: Michael Holland, MD - Rush University Medical Center

Pregnancy in patients with ESRD is rare as most females reaching ESRD are anovulatory(1). The ANZDATA registry published data on pregnancies occurring in dialysis patients with rates of 3.3 per 1000 person/year from 1996-2008(2).

Pregnancy in ESRD is associated with increased morbidity and mortality. A Canadian and US Cohort Comparison suggests a dose response between dialysis intensity and pregnancy outcomes(3).

Pre-eclampsia in ESRD patients is difficult to diagnose. Physicians must distinguish between cHTN, volume overload, and preE. Volume status is hard to assess in pregnancy.

Case: 36F (HTN, SLE, HFrEF, MR, ESRD on HD 6x/wk) G7P4024 at 28w6d with IUFD presented for IOL. Prior to IOL, nephrology dialyzed pt. She was induced and had SVD. Post delivery, she developed HTN. She was diagnosed with PreE with severe features, superimposed on cHTN. HELLP labs were normal except for Cr. Pt was treated with PO meds escalating to Labetolol IV. Mag was started (4mg bolus, rate of 1g/hr). She was seen by nephrology, however refused dialysis. Pt had intermittent SOB overnight, but decompensated the next morning, sPO2 50% on 15L with pink frothy discharge. A code blue was called. K+ was verified at 3.9 per nursing. She was intubated with 50mg Propofol, 120mg Succ. Pt then became bradycardic and went into PEA. ACLS was started. She received epi x3, calcium, and bicarb. Her rhythm converted to v-tach. She was defibrillated x1. ROSC was achieved. US, FAST scan, pelvic exam, and CT head: unremarkable. CXR: pulmonary edema. ECHO: EF of 45%. Pt had HD for electrolyte and volume removal.

Discussion: This pt was diagnosed with preE with severe features postpartum, for which ACOG recommends seizure prophylaxis with mag(4). However, women with renal insufficiency should receive a standard loading dose of 4-6mg, without maintenance if serum Cr is ≥ 2.5 . She also refused dialysis post-partum and was volume overloaded prior to intubation.

CV changes post-partum include an increase in CO and SV. We would expect to see a rise in BP as a direct result of increased preload. By definition, this pt did have preE with severe features, but the new onset pulmonary edema could have been due to normal post-partum changes and dialysis refusal.

It is unclear if her eventual cardiac arrest was secondary to prolonged hypoxemia, hyperK, or mag toxicity.

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Abstract #: S-72**Preoperative Multidisciplinary Management of a Parturient with Placenta Percreta****Presenting Author:** Lauren Rego-Cherian**Presenting Author's Institution:** University of Kansas Medical Center**Co-Authors:** Grace Shih, MD - University of Kansas Health System

Introduction: Placenta accreta spectrum affects 1:270 pregnancies in the United States, which includes the most feared, placenta accreta (PA)¹. This case details the multidisciplinary expectant and delivery management following ACOG guidelines of a patient with PA, with consideration of our facility's maternal hemorrhage protocol².

Case: A 27-year-old G3P1102 presented at 19w2d with vaginal bleeding. On exam, the patient was in no distress with stable vital signs. MRI demonstrated PA invading the cervix and bladder wall (Figure 1). She was admitted for bed rest, daily CBC, fetal monitoring, betamethasone, and maintenance of two 18G peripheral IVs. A multidisciplinary team met to discuss resuscitative and backup surgical methods, including uterine balloon placement, hysterectomy, and aortic cross-clamping. At 25w3d, the patient went into preterm labor, prompting an urgent caesarean section (CS).

Ancillary support staff and blood bank were mobilized, including activation of massive transfusion blood products (MTP) prior to incision.

Upon arrival to the main operative suite, standard ASA monitors were applied and pre-oxygenation initiated. She underwent a general anesthetic with rapid-sequence induction and direct laryngoscopy. Central venous access was obtained via a MAC catheter and attached to a Belmont rapid-infuser. A radial arterial line was placed. Additional vasopressors were available. She underwent cystoscopy, ureteral stent placement, then caesarean delivery, after which she received a dose of methergine and 1g of TXA. The placenta and uterus were left in-situ, and as planned, interventional radiology performed a uterine artery embolization. Estimated blood loss was 750cc, requiring only crystalloid for resuscitation.

The patient was extubated post-operatively, monitored in the ICU until post-op day two, and discharged without incident on post-op day seven. She did return four weeks later with vaginal bleeding, requiring an urgent hysterectomy.

Discussion: A well-delineated plan with both surgical and anesthetic contingencies, if given the luxury of time, can provide a safer background for high-risk obstetric operations.

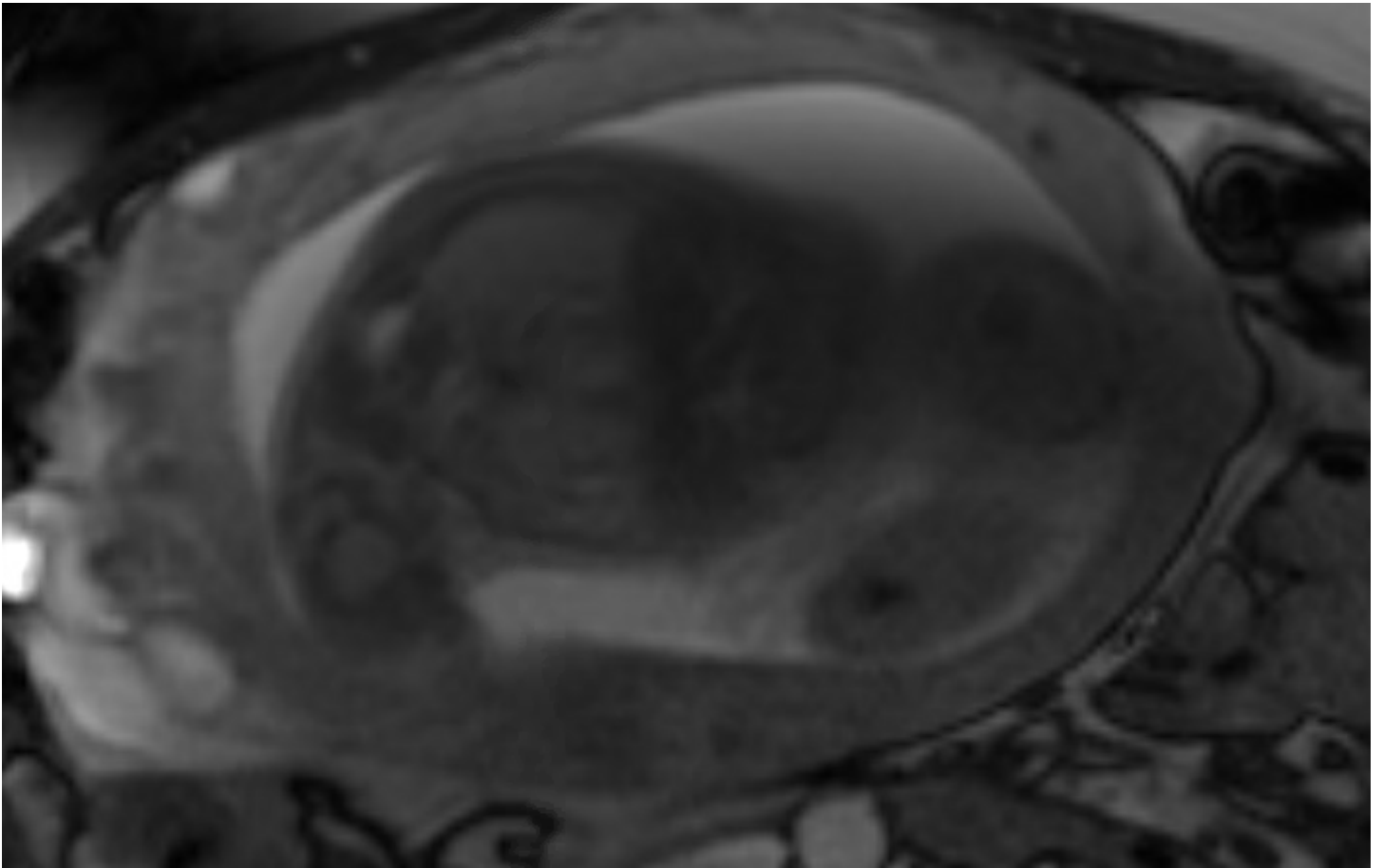
A general anesthetic was chosen due to concern for coagulopathy in the setting of MTP that could predispose to epidural hematoma as well as maternal comfort during invasive line placement. Due to the age of the neonate, the chance of skin-to-skin was thought to be unlikely.

Uniquely, MTP was initiated prior to incision, providing a potential buffer for hemorrhage. The maternal hemorrhage protocol included a warm operative suite and early administration of TXA and uterotonics. Due to the extent of invasion, instead of hysterectomy, the operative team decided to leave the placenta in-situ to allow for reabsorption.

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Abstract #: S-72



Abstract #: S-73

Managing the Extremes of Obesity: One Patient, Two Cesareans, Triple-digit BMI

Presenting Author: Joseph L. Reno, MD

Presenting Author's Institution: Ohio State University Wexner Medical Center - Columbus, Ohio

Co-Authors: John Coffman, MD - Ohio State University Wexner Medical Center

Anesthetic implications for parturients with Class 3 obesity (body mass index, BMI ≥ 40 kg/m²) are well known, but to what degree they overlap versus differ for women with BMI ≥ 100 remains poorly elucidated in the literature.

Case: A 20 year old G1P0 underwent two cesarean deliveries, 18 months apart. Her BMI was 102 and then 116 for the respective deliveries. Her comorbidities included OSA without CPAP compliance, chronic hypertension, and anticoagulation for PE during pregnancy. Ahead of the scheduled cesarean deliveries, multi-team coordination arranged non-standard operative case duration, locations, equipment, and staffing. While we did use an ultrasound for intravenous and arterial line placement, it was not required for the neuraxial procedures. Side pannus retraction with tape enabled palpation of spinous processes, so a midline landmark approach was used. For the first case, the neuraxial catheter was placed in the operating room on the table. In the second delivery, the neuraxial catheter was placed in a procedure room, and then the patient was taken to a non-obstetric operating room with a reinforced operating table. In both cases, despite fastidious technique, inadvertent dural puncture occurred; this was handled with intrathecal catheters each time, advanced 7cm and 6cm, respectively. Post-dural puncture headache did not occur either time. Loss of resistance depth increased from 13 to 15 cm between deliveries. Conflicting data from the literature on intrathecal dosing in obesity led us to choose gradual titration via catheter. In both cases, 8 staff members were required to position the patient on the operating table in a 45° sitting position. In that initial position, the catheter was dosed (hyperbaric bupivacaine 12mg, fentanyl 15mcg, morphine 100mcg, in 0.25mL increments over 15 minutes) to achieve a T4 level. Between deliveries her weight increased, but identical doses achieved the same level. After achieving a T4 level, she was reclined to a 30° semi-recumbent, operative position. The position mandated a vertical skin incision and classical hysterotomy but optimized her restricted ventilation compared to flat supine. Supplemental oxygen was used, but non-invasive positive pressure was not required. After delivering, she was monitored closely for 24 hours before being transferred to the postpartum unit.

Discussion: These cases highlight unique implications for those with BMIs at the extremely high end of Class 3 obesity. Considerations include neuraxial technique, depth, dosing, positioning (during neuraxial placement and cesarean section), common comorbidity management, postpartum monitoring, and the additional resources required for nearly every therapeutic effort.

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Abstract #: S-74

Between a Rock and a Hard Place: Management of a Pregnant Patient with a Ruptured Arteriovenous Malformation

Presenting Author: Kyle J. Riley, MD

Presenting Author's Institution: Massachusetts General Hospital Department of Anesthesia, Critical Care and Pain Medicine

Co-Authors: Lisa Leffert

Elisa C. Walsh, MD - Massachusetts General Hospital Department of Anesthesia, Critical Care and Pain Medicine

Arteriovenous malformations (AVMs) can be located anywhere along the vessels of the central nervous system (1). It is uncertain if pregnancy increases their size or likelihood of bleeding. AVM rupture can have morbid consequences for both the mother and the fetus.

Case Description: A 32-year-old G7P2042 at 38 weeks gestation with a known left cerebellar arteriovenous malformation (AVM) status post coiling and embolization was transferred from an outside hospital in the setting of severe headache and nausea. On presentation, she was alert and oriented without neurologic deficit. MRI showed a new left cerebellar intraparenchymal hemorrhage (2.9 x 3.1 x 2.4 cm). Her fetal heart rate tracing was reassuring.

Discussion: An interdisciplinary meeting was held with Obstetrics, OB Anesthesiology, Neurology, and Neurosurgery teams to determine the optimal patient management. The risks and benefits of neurosurgical intervention versus delivery of the fetus were discussed. For treatment of the AVM, the next step was diagnostic angiogram (potentially exposing the fetus to fluoroscopy and intravenous dye), followed by neurosurgical intervention as needed. Although this evaluation was not deemed to be urgent, the neurosurgeons thought it was vital that it be done in a controlled setting, without the presence of the fetus. At 38 weeks gestation, delivery was deemed to be low-risk for the fetus although proceeding with delivery in the setting of a recent maternal intracranial hemorrhage was associated with its own inherent risks.

Ultimately the interdisciplinary group decided to proceed with delivery of the fetus, followed by neurosurgical evaluation of the mother. The following day, the mother underwent cesarean delivery under general anesthesia. Vaginal delivery was avoided due to concern that uterine contractions and Valsalva during labor would lead to repeated transient increases in venous pressure, cardiac output, and CSF pressure potentially disrupting the AVM (2). Similarly, changes in lumbar CSF pressure related to neuraxial anesthesia had the potential to alter the transmural pressure within the vascular lesion and disrupt the fragile AVM. As such, a general anesthetic employing the basic tenants of neurosurgical anesthesia was used resulting in the successful delivery of a vigorous baby. This case highlights the importance of a multidisciplinary team approach to assess the risks and benefits of intervention for both the mother and the fetus in the setting of a ruptured AVM.

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Abstract #: S-75

Pregnant patient with intracranial hypertension secondary to brain abscesses undergoing an emergency cesarean section: A Case Report

Presenting Author: Carolina Rincón

Presenting Author's Institution: McGill University Fellow - Montreal

Co-Authors:

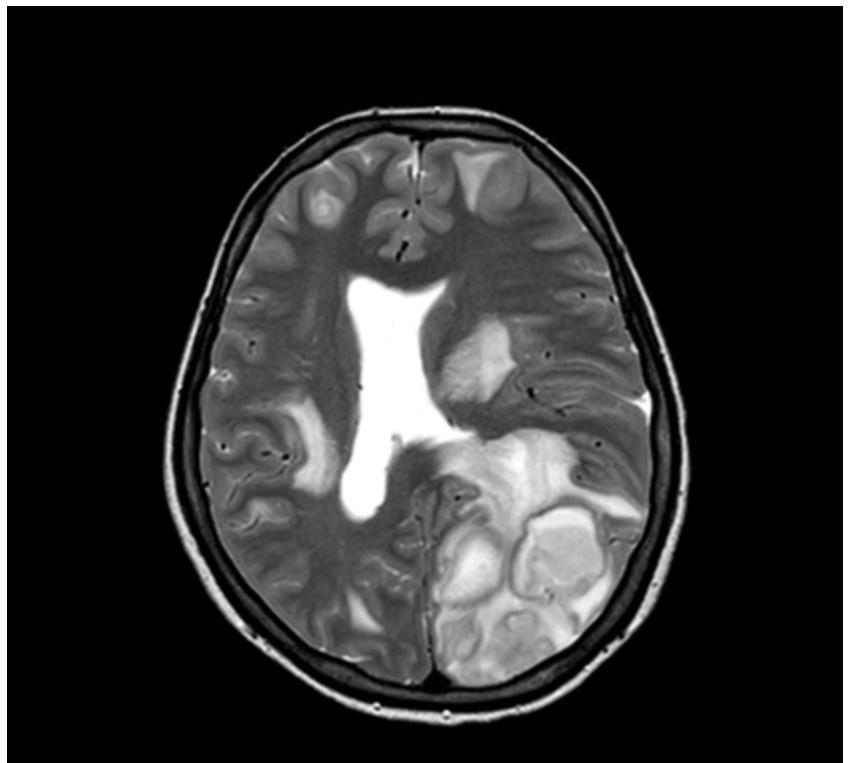
Introduction: An intracerebral abscess is a rare, life threatening infection that is extremely rare in pregnancy and presents several management dilemmas (1).

Case: A 35 year old, G2P1, 25 week pregnant, previously healthy woman was admitted for IV antibiotic for a presumed pneumonia. During the admission she developed visual disturbances and altered mental status. MRI demonstrated increased intracranial pressure (ICP) due to brain abscesses. Rapid deterioration resulted in ICU transfer. Hypertonic saline, mannitol and dexamethasone provided no improvement. After multidisciplinary consultation it was decided to deliver the baby by cesarean. She was transferred to the OR, and an arterial line was placed. Anesthesia was induced with propofol 120mg, succinylcholine 100mg, lidocaine 100mg and fentanyl 200mcg. Hyperventilation, hypertonic saline, mannitol and furosemide were used to manage intracranial pressure. Anesthesia was maintained with a propofol infusion for neuroprotection. The patient remained hemodynamically stable and a live 840g baby, with Apgar 6-7-7, was delivered. The patient was transferred to the neurosurgical OR for an uneventful left decompressive craniectomy and drainage of intracerebral abscess. The patient recovered with only mild right hemianopsia. The neonate enjoyed an uncomplicated course in the neonatal ICU and was discharged at 40 weeks of age.

Discussion: Brain abscess is a life threatening infection that is extremely rare during pregnancy (1). It has been associated with head trauma, preeclampsia, mechanical cardiac valves, dental abscesses and thrombophilia (3). Bacterial invasion can be through contiguous spread, hematogenous spread from pulmonary or cardiac infections or unknown mechanisms (2). Early detection and diagnosis can be challenging, as the symptoms can be unspecific. Management requires consultation between multiple specialties, as possible management strategies include: delivery before decompression, decompression followed by delivery at a later date or conservative treatment with antibiotics and progression of pregnancy. Due to the severe clinical status of this patient it was decided that death was imminent and a rapid delivery was chosen. The route of delivery is also an important factor to consider as both labor and cesarean delivery have implications on neurologic and neonatal function (3). Anesthesia for both labor and cesarean section must take into consideration the possibility of raised ICP, and appropriate measures for reduction should be taken.

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Abstract #: S-76**A Case of Postpartum PRES in the Setting of Immunosuppressive Therapy****Presenting Author:** Pauline Ripchik, MD**Presenting Author's Institution:** Northwestern Memorial Hospital, Feinberg School of Medicine**Co-Authors:** Jennifer M. Banayan - Northwestern University Feinberg School of Medicine
Emery H. McCrory, MD - Northwestern University

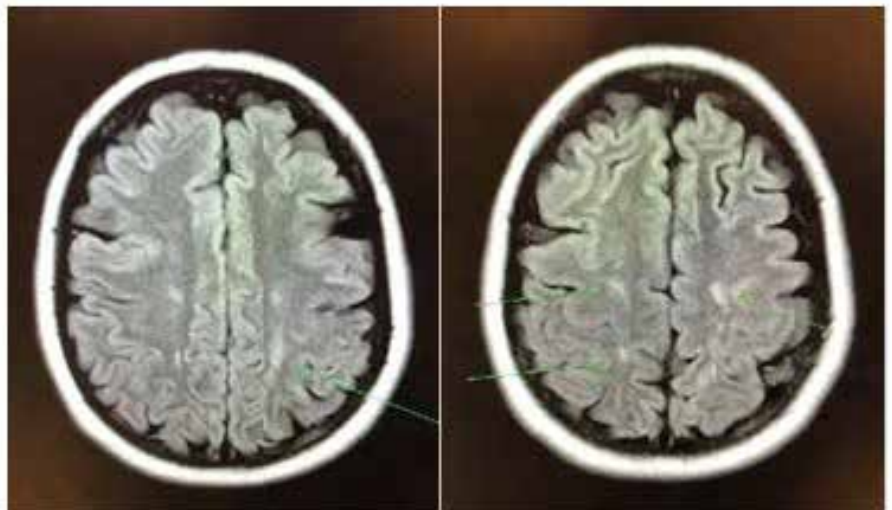
Introduction: Posterior reversible encephalopathy syndrome (PRES) is a rare disease that has been seen in parturients and can even occur in the postpartum period. The pathophysiology of PRES remains unclear; however, it is known that sudden hypertension and immunosuppressive therapy are risk factors in the onset of the white matter edema that defines PRES. Here, we describe the anesthetic management of a parturient's postpartum course complicated by PRES.

Case: A 30-year-old, G1P0 female with a past medical history notable for Crohn's disease on adalimumab presented at 38w3d in labor with breech fetal positioning. She was taken to the operating room for cesarean delivery and a spinal anesthetic was administered containing Bupivacaine 0.75% (12 mg), Fentanyl (15 mcg), and Morphine (150 mcg). Her mean arterial pressure precipitously dropped, uncovering fetal decelerations, which prompted an emergent delivery. The hypotension was treated with phenylephrine (200 mcg) leading to reflex bradycardia (HR 40s) with persistent hypotension, which was then treated with glycopyrrolate and ephedrine. A few minutes later, the patient had blood pressure of 184/111 and heart rate of 140. At this time, the patient complained of a throbbing headache and blurry vision. She was treated with esmolol (100 mg) in divided doses. Finally, her hemodynamics returned to baseline and her symptoms resolved. Five minutes later, she developed tonic-clonic seizure-like activity lasting approximately 60 seconds, which dissipated on its own. A magnesium bolus of 4 grams was infused. The patient remained hemodynamically and neurologically stable during transfer to the CT scanner, which showed no acute findings of intracranial hemorrhage, but, a head and neck CT angiogram revealed bilateral carotid artery dissection and left vertebral artery dissections with multifocal cervical dissections. She was started on aspirin in the intensive care unit.

Discussion: While the pathophysiology of PRES remains unclear, it is hypothesized that acute hypertension causes cerebral autoregulation malfunction and endothelial dysfunction leading to focal vasogenic edema in the posterior regions of the brain. Hypertensive disorders of pregnancy, connective tissue disorders, autoimmune disorders, and immunosuppressive drugs have all been identified as etiologies of PRES (1). With this patient's hypertensive episode, seizure, and neuroimaging confirming PRES, the diagnosis of eclampsia was made. In addition, our patient was being treated with adalimumab injections weekly for her Crohn's disease since 2013. There have been a few cases reports of TNF α antagonist-associated PRES. With several studies showing that adalimumab decreases arterial wall stiffness, it can be postulated that arterial wall remodeling can disrupt cerebral autoregulation and endothelial function and increase susceptibility to development of PRES.

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Abstract #: S-77

Failed Uterine Artery Embolization x2 Resulting in Hysterectomy

Presenting Author: Lance Roberts, MD

Presenting Author's Institution: Ochsner Clinic Foundation

Co-Authors: Liane Germond, MD - Ochsner Clinic Foundation

Introduction: Uterine arteriovenous malformation is a rare cause of post-partum hemorrhage (1-2%) that may lead to increased morbidity and mortality (2). Management depends on the severity of the hemorrhage, age of the patient, and the desire for future fertility(1). There are multiple treatment strategies with embolization being highly successful in women who desire continued fertility. Unfortunately, we discuss a unique case that failed multiple UAEs resulting in a hysterectomy.

Case report: A 36 y/o G2P0 at 40 weeks EGA presented for a primary c section due to active labor with a breech fetus. A postpartum hemorrhage ensued during the procedure with resulting EBL of 1680mL. Her hemoglobin dropped from 12 to 10, but she was otherwise asymptomatic and discharged on POD#3. POD#4, the pt returned to the ED with heavy vaginal bleeding. Multiple clots were evacuated and EBL in the ED was 1600mL. She was transfused 2U PRBCs, placed on a methergine series, and admitted for observation. On POD#6, the pt had another bleed, prompting her to be taken to the OR for a D&C and Bakri balloon placement. She was also given methergine and hemabate (Hgb 5.9). She was transfused 2U PRBCs and taken to IR for uterine artery embolization for continued bleeding. The radiology report noted active bleeding from the right uterine artery, but bilateral embolization was completed to stasis. She was discharged home 3 days later. On POD #17, the pt again presented to the ED with heavy vaginal bleeding, EBL of 400mL. A CTA confirmed endometrial bleeding. She continued to bleed after her scan and became hypotensive (80/30) with this episode. She was given cytotec, transfused another 2U PRBCs, and taken emergently to IR for a second UAE. Her right uterine artery was found to be completely embolized, so a left embolization was performed again. The pt remained in the hospital for 3 days when a final bleeding episode took place (EBL 950mL). She was given misoprostol, methergine, and estrogen with no cessation of her bleeding. An emergent hysterectomy was then performed and the pt was discharged 4 days later with no additional sequelae.

Discussion: Embolization of the uterus is possible due to the highly vascular bed along with multiple anastomoses, resulting in the treatment of certain vessels while still preserving function of the uterus. Possible explanations for the failed attempts in our patient include residual extra-uterine fine feeders such as an ovarian-uterine anastomotic connection or retained products of conception (POC) (2). Although bleeding from an AVM is rare, it needs to remain in the differential for women of childbearing age.

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Abstract #: S-78

Hairy Cell Leukemia unmasked with pregnancy; Improves post-partum

Presenting Author: Lance Roberts, MD

Presenting Author's Institution: Ochsner Clinic Foundation

Co-Authors: Adrienne Ray, MD - Ochsner Clinic Foundation

Introduction: Hairy cell leukemia is a rare diagnosis in pregnancy with very few case reports documented. HCL typically presents in males within the sixth decade and is associated with pancytopenia and splenomegaly (1). We discuss a case of a parturient who presented with unknown etiology of thrombocytopenia associated with megaloblastic anemia, and preeclampsia leading to a subsequent diagnosis of HCL.

Case Report: A 39yo G1 was admitted at 25w2d for preeclampsia with severe features and IUGR. She was started on magnesium and given steroids and IV antihypertensives. Her pregnancy was complicated by thrombocytopenia and megaloblastic anemia. Her initial prenatal labs showed anemia and thrombocytopenia (plt 117). Throughout the course of her pregnancy her platelets trended down to the 50s. Upon presentation her platelets were 56, which was stable for the last 2months. During this time period, she remained anemic with an increasing MCV (max 112). Heme/Onc was consulted, and the initial evaluation ruled out folate and B12 deficiencies. A bone marrow biopsy was performed during her admission. However, before results were obtained, she continued to have severe range bp's that necessitated delivery via classic c-section at 25 5/7wks. Her c/s was performed under spinal anesthetic after receiving 1U platelets for a platelet count of 51. Postoperatively, her hypertension continued to be an issue and her medications were adjusted appropriately. She was discharged on POD6 in stable condition. A few weeks after biopsy, results confirmed that the patient had hairy cell leukemia. Since delivery her anemia and thrombocytopenia have progressively improved. Most recent labs include Hgb of 9.3 and plt 128. With the improvement of her CBC, she currently does not warrant treatment.

Discussion: Studies recommend that alternative causes of thrombocytopenia other than pregnancy or its complications should be considered in patients with platelet counts less than $100 \times 10^9 /L$ (2). Because of the epidemiology of hairy cell leukemia, the diagnosis is extremely rare in pregnant women. However, this should be included in the differential for a patient with thrombocytopenia in the setting of megaloblastic anemia. The treatment options are limited in the parturient and are often postponed till after delivery. Interestingly, our patient's Hgb and platelets normalized without treatment in the postpartum period. Therefore, we hypothesize that her pregnancy unmasked her underlying, latent hairy cell leukemia leading to early identification and close follow-up.

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Abstract #: S-79

Anesthetic Management of a Parturient with Severe Mitral Stenosis and Severe Pulmonary Hypertension

Presenting Author: Samantha Rubright

Presenting Author's Institution: Northwestern University McGaw Medical Center - Chicago, Illinois

Co-Authors: Jennifer M. Banayan - Northwestern University Feinberg School of Medicine

Paul Scott, MD - Northwestern University, Feinberg School of Medicine

Introduction: Mitral stenosis (MS) is only prevalent in 0.02-0.2% of the population in developed countries, but is the most common valvular abnormality in pregnancy.² The pathophysiology of MS causes elevated left atrial pressures which ultimately results in pulmonary hypertension. Pregnancy exaggerates these effects by increased cardiac output, blood volume and heart rate. Hemodynamic goals of patients with MS is focused on maintaining a slower heart rate to allow for diastolic filling and avoiding sudden changes in systemic and pulmonary pressures.

Case: A 40-year-old G4P0121 female with a complex medical history including multiple valve repairs for spontaneous endocarditis. Her last repair included an annuloplasty that resulted in MS. She had one prior preterm delivery, after which she was advised not to get pregnant again. Once pregnant, she was advised to terminate the pregnancy, but refused. At 33 weeks gestation, she presented with severe dyspnea on exertion and an echocardiogram showed bowing of the right ventricle concerning for decompensated right heart failure. Her right ventricular systolic pressure had increased to 101 mmHg and mean mitral valve gradient to 23 mmHg. An arterial line was placed for hemodynamic monitoring, and she was rate controlled with metoprolol and diuresed with furosemide. The patient began to have painful contractions and non-reassuring fetal heart tones, so the decision was made to proceed with urgent caesarean delivery (CD).

In the operating room the patient was prepped, draped and rapid sequence induction was performed with etomidate, succinylcholine, and esmolol. After intubation, general anesthesia was maintained with sevoflurane and midazolam. Her blood pressure and heart rate were maintained with phenylephrine and esmolol infusions. During CD, the patient was monitored via transesophageal echocardiogram and a swan-ganz catheter was floated via an introducer in the right internal jugular vein. At the end of the case, the patient was extubated and transferred to the intensive care unit.

Discussion: Parturients with moderate MS are considered high-risk, and those with severe MS are advised against pregnancy until surgically optimized.¹ Our patient chose to proceed with her pregnancy despite her critically severe mitral valve gradients and daily symptoms of lower extremity edema and dyspnea at rest. Traditionally parturients with MS were delivered via CD for fear of prolonged valsalva leading to excessive cardiac stress, but increasingly studies have shown outcomes are improved with vaginal delivery.² Unfortunately the fetal heart tones necessitated an emergent CD with general anesthesia because of the patient's recent enoxaparin use. This case emphasizes that parturients with critically severe mitral stenosis and pulmonary hypertension can safely proceed with CD under general anesthesia.

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Abstract #: S-80

Complicated Management for Postpartum Hemorrhage in a Parturient with Immune Thrombocytopenic Purpura

Presenting Author: Neeti Sadana, MD

Presenting Author's Institution: Tufts Medical Center - Boston, Massachusetts

Co-Authors: Michael Welljams-Dorof, MD - Tufts Medical Center

Case: We present the case of a 42-year-old G2P1 parturient with an in vitro fertilization (IVF) pregnancy at 36 3/7 weeks gestation complicated by a history of immune thrombocytopenic purpura. The patient was known to our high-risk obstetric anesthesia service as well as hematology service as part of an antepartum consultation. The hematology team said she is not a candidate for intravenous immunoglobulin (IVIG), but should begin an oral steroid dose at 38 weeks gestation, one week prior to her induction of labor. In the morning, when the patient arrived in labor with spontaneous rupture of membranes, she had a platelet count of 64,000 platelets per microliter of blood. During her entire pregnancy her platelets ranged from 60,000-70,000 platelets per microliter, and she was aware that her epidural placement would depend on day of procedure platelet count as well as the anesthesiologist's level of comfort. On the morning of her placement, she had a count of 62,000. Her epidural placement was by an attending obstetric anesthesiologist, with one attempt, and no complications. She became comfortable appropriately. Post-delivery, the anesthesia team was called emergently for brisk postpartum hemorrhage. The patient was given oxytocin, methylergonovine, prostaglandin (carboprost), tranexamic acid, hydrocortisone, one round of platelets, and recombinant factor VIIa. It was only after factor VIIa was given that her bleeding stopped and the obstetric team was able to place a Bakri balloon. The patient had no further bleeding episodes. The postpartum plan was to remove the epidural once the Bakri balloon was removed the next morning. But, the epidural became inadvertently dislodged and was removed prematurely. Luckily the platelet count was 74,000 platelets per microliter within 1 hour of the dislodgement. The patient had neurological checks every 4 hours postpartum day 1 and then at each 8 hour shift through postpartum day 2. The patient was seen by hematology on postpartum day 1 with no further recommendations. The patient had no complications and was discharged home postpartum day 3.

This case highlights the novel treatment of postpartum hemorrhage in a patient with known ITP with medical management utilizing drugs not routinely used in patients with ITP.

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Abstract #: S-81

Labor Neuraxial Analgesia – To Be? Or Not To Be? With an Iliopsoas Abscess

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Introduction: Iliopsoas abscesses are an uncommon phenomenon with an incidence of about 0.4 cases per 100,000 population/year. An iliopsoas abscess can be primary or secondary depending on the presence or absence of an underlying disease. Primary iliopsoas abscesses can occur in immunocompromised patients, while secondary causes often result from hematogenous spread such as in Crohn's disease. Iliopsoas abscess formation is described in literature as a rare complication of epidural anesthesia¹. However, there has been no discussion of the reverse. We present a case where a patient arrived in labor with an active iliopsoas abscess requiring a prudent decision for neuraxial labor analgesia.

Case Presentation: Our patient is a 28yo G2P0 at 33+5 w/ pmh of Crohn's disease s/p cecal resection and ileostomy creation (2013) and takedown (2014). She was previously admitted at 29+3 with abnormal vitals and low back pain. During the admission a MRI showed a 9.8x5.9cm right iliacus and quadratus lumborum abscess with extension into the right paraspinal psoas muscles. A multidisciplinary discussion involving GI, Surgery, OB, ID, and IR resulted in drain placement by IR into the abscess. Cultures grew GPR and GNR, and the patient was discharged on Ertapenem, Vancomycin, and Metronidazole via PICC line. The patient presented 1 mo later to the OB ED in active labor. VS: T:36.7; P:67; BP:107/71. Labs: WBC:13.3; Hgb: 9.0; Plt:420. The patient's drain was in place, and she was still receiving antibiotics. The patient expressed a desire for an epidural. As the abscess was in close proximity to the desired placement of an epidural catheter, we decided not to proceed with neuraxial placement. The patient received IV pain medications for labor and was consented for GA for cesarean delivery if required. She delivered that day without complications and was discharged on POD#2.

Discussion: Psoas abscesses and epidural abscesses are interrelated infections. 10-30% of epidural abscesses result from direct extension of local infection, and a psoas abscess could be a potential source. Even though the patient did not display the standard contraindications to neuraxial placement such as sepsis and active infection overlying the spine, neuraxial placement in this patient could have potentially lead to tract formation and eventually sepsis². These outcomes have yet to be described in literature but should be considered as a potential concern.

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Abstract #: S-82**Stage IV primary mediastinal B cell lymphoma requiring urgent chemotherapy during pregnancy****Presenting Author:** Elizabeth Ozery, MD**Presenting Author's Institution:** Stanford University**Co-Authors:** Gillian Abir, MBChB, FRCA - Stanford University School of Medicine

Sapna Satyanarayan-Victor, MD, MPH - Stanford University

Introduction: Hematologic malignancies complicate 0.02% of all pregnancies. Primary mediastinal B cell lymphoma (PMBCL) is very rare, occurring in 2-3% of patients with Non-Hodgkin lymphoma (1). Chemotherapy is often initiated after delivery due to concern for adverse fetal outcomes. We describe a pregnant patient with stage IV PMBCL requiring urgent chemotherapy at 27 weeks gestation.

Case Report: A healthy 30 year-old patient, G2P1, at 27 weeks gestation presented with new onset vomiting, anorexia, and acute back pain. Labs were notable for elevated bilirubin (2.9 mg/dL) and transaminitis (AST 98, ALT 158 u/L). An 8x7x7 cm pancreatic mass extending to the duodenum was identified on an MRI scan. A transhepatic biliary drain was placed due to complete obstruction. A thoracic MRI scan revealed a 13x8x10 cm mediastinal mass with lung compression and rightward midline shift, suspected to be the primary tumor (Figure 1). Stage IV PMBCL was diagnosed and chemotherapy was initiated to reduce tumor burden, but it was modified to omit suspected teratogenic agents. The course was complicated by neutropenic fever and coagulopathy (INR 1.9).

Cesarean delivery was scheduled at 34 weeks gestation. Neuraxial anesthesia was planned after correction of the coagulopathy with vitamin K and fresh frozen plasma, and with evidence of a normal thromboelastogram. Venous-arterial extracorporeal membrane oxygenation (ECMO) sheaths were placed preoperatively, plus two 16 gauge intravenous lines and an arterial line. A combined spinal-epidural (CSE) technique was placed (intrathecal dosing: bupivacaine 8 mg, fentanyl 15 mcg and morphine 150 mcg), and a bilateral T5 level was achieved with incremental dosing of 20 mL lidocaine 2% (with epinephrine 1:200,000). A healthy neonate was delivered, weighing 2.6 kg, with Apgar scores of 8 and 9, at 1 and 5 minutes of life. The patient was admitted to oncology. Definitive chemotherapy was initiated on postoperative day 5. However, the post-delivery course was complicated by hemorrhagic shock secondary to a gastrointestinal bleed requiring massive transfusion and coil embolization. The patient also had ongoing neutropenic fever.

Discussion: PMBCL responds best to initial chemotherapy, which could not be delayed due to complete biliary obstruction. Modified, but known to be less effective, chemotherapy was initiated to reduce tumor burden while optimizing neonatal outcome by limiting teratogenic exposure and extending the duration of pregnancy.

The patient had a positive delivery outcome, despite a complex oncologic course, with careful multidisciplinary planning. Given the potential for catastrophic cardiovascular collapse from compression of the mediastinal mass on the heart or airways, particularly with general anesthesia, ECMO cannula were preemptively placed. A carefully dosed neuraxial block allowed surgical anesthesia while minimizing hemodynamic compromise.

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Abstract #: S-82



Figure 1. Thoracic MRI image showing 13x8x10 cm mediastinal mass

Abstract #: S-83

Perinatal ECHO- Implementing Statewide Maternal Hemorrhage Bundles Through Tele-Learning

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Background: The rate of maternal mortality in the USA continues to rise and is marked by racial/ethnic inequities. Evidenced based interventions to improve maternal care often take years for dissemination and implementation. The Alliance for Innovation on Maternal Health (AIM) has produced evidence based "safety bundles" for health care providers with the goal of eliminating preventable maternal mortality and severe morbidity in the US.[1] New Mexico is a large rural state with small birthing centers scattered throughout sparsely populated areas. Urban hospitals may have greater resources for implementing the multi-step bundles than smaller rural birthing hospitals. The New Mexico Perinatal Collaborative (NMPC), a multi-stakeholder coalition of healthcare professionals and community organizations, aimed to disseminate the AIM Obstetric Hemorrhage Bundle interventions through a novel "ECHO" tele-mentoring program to birthing centers throughout New Mexico. The Improving Perinatal Health (IPH) ECHO is a didactic and case-based learning program used to disseminate and support the implementation of the AIM bundle components to participants across the state by live, twice monthly, video conferencing.

Implementation: The NMPC assembled a team of representatives from Obstetrics & Gynecology, Anesthesiology, Nursing, The NM Hospital Association and the Department of Health along with education specialists from Project ECHO[2] to develop a yearlong curriculum based on the AIM OB Hemorrhage bundle and a focus on reducing health inequities. 16 of 29 birthing hospitals from across the state formally enrolled in the NMPC's AIM program, and both participate in the IPH ECHO and contribute data. A total of 25 of the 29 birthing hospitals participated in some of the IPH ECHO sessions. Each session starts with a didactic lecture covering one bundle element followed by a case presentation by a participating hospital with discussion. Each participant joins by video or phone and actively participates in discussions. Barriers to implementation are discussed openly and problem solving and learning from others' experiences is a large portion of sessions.

Discussion: Between April 2019 and February 2020, the Improving Perinatal Health TeleECHO program has conducted 18 educational sessions focusing on the AIM OB Hemorrhage Bundle. Continuing Medical Education and Continuing Nursing Credit is granted to the attendees. Post session feedback continually demonstrates consistently positive evaluations. Following completion of the Hemorrhage Bundle, additional AIM Bundles will be discussed using the same interface. The Improving Perinatal Health ECHO program is a novel way to disseminate maternal safety bundles and has the potential to form effective learning communities in other large rural states with the goal of improving health equity in reducing maternal harm and death.

Abstract #: S-84

A Parturient With Severe Pulmonary Hypertension Requiring Early Cesarean Delivery

Presenting Author: Parth Shah, M.D., M.B.S.

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Co-Authors: Nadir Sharawi - UAMS

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Case Study: This is the case of a 28 year-old female, G3P1 at 33 weeks 0 days, with past medical history of obesity with a body mass index of 41, hypertension, intravenous drug use, recurrent episodes of endocarditis status post bioprosthetic mitral valve replacement, a previous caesarean section, who was admitted for worsening cardiac status including new onset syncope, now on Lasix and Sildenafil, shortness of breath, hypoxia, hypotension, and tachycardia, severe pulmonary hypertension at 100 mmHg, severe tricuspid regurgitation, and moderate pulmonary insufficiency with hyperdynamic ejection fraction of 75%. With her worsening cardiac profile, and overall decompensation the decision was made that she required an early cesarean delivery

A multi-specialty approach was taken formulating the plan for this patient. Obstetric Gynecology, Cardiology, Obstetric and Cardiac Anesthesiology, and Cardiothoracic surgery designed a patient centered plan coordinating timing, anesthetic and surgical technique, pain-control, and post-operative care. Intraoperatively, a neuraxial technique with a pre-procedure arterial line and central venous line placement was chosen. A multi-channel infusion pump was set up with Norepinephrine, Vasopressin, Milrinone, Oxytocin, and plasma-lyte as a carrier fluid. A Dural puncture epidural was placed without intrathecal drug administration and slowly hand bloused 12.5 ml of 2% lidocaine to obtain a T5 dermatome level. Milrinone was initiated at the start of the procedure. The patient was also given nitric oxide at 20 ppm by nasal canulae. After the patient was properly anesthetized, an uncomplicated caesarean section proceeded without complication. The newborn had APGARs of 1 and 8 and 1 and 5 minutes respectively. The epidural was bloused with 3 mg of morphine and 150 mcg of fentanyl, and 5 mls of 0.25% bupivacaine prior to removal intraoperatively. The patient was safely transferred to the surgical ICU on vasopressin and norepinephrine infusions and nitric oxide at 20 ppm. She was successfully weaned off all vasopressors and transferred to the floor on POD 1, and discharged from the hospital on POD 13.

Discussion: A multi-disciplinary approach lead to the overall success of the caesarean delivery. We had multiple modalities of intraoperative monitoring including pulse oximetry, both invasive and noninvasive blood pressure monitoring, temperature monitoring, EKG monitoring, end tidal CO₂, as well as trans-thoracic echocardiography. This allowed us to effectively guide fluid and vasopressor management to prevent hypotension, hypothermia, hypercapnia, and tachycardia which would have exacerbated her baseline pathophysiology.

Abstract #: S-85**Intrathecal baclofen pump in a patient with spastic paralysis & contractures from cerebral palsy for c-section.****Presenting Author:** Brooke Towne**Presenting Author's Institution:** UCSD**Co-Authors:** Alison a'Court - UCSD

Anne E. Shapiro - UCSD

Lawrence Weinstein, MD - UCSD

Intrathecal pain pumps are a challenge in obstetric patients. Literature in this patient population is sparse. We report a case of a 29 year-old G1P0 with a history of HTN, spastic cerebral palsy, contractures and an intrathecal baclofen pump (IBP) undergoing c-section.

This patient's IBP placement was complicated by CSF leaks resulting in post dural puncture headaches (PDPH). CSF leaks following the placement of intrathecal devices are not uncommon [3] however, our patient did not experience any relief from various medical therapies or epidural blood patches, ultimately requiring multiple surgical revisions of the intrathecal catheter. Her IBP was also complicated by episodes of baclofen withdrawal. As this pregnancy progressed she required higher doses of intrathecal baclofen for worsening spasticity. She was admitted at 36 weeks for elevated blood pressures and the decision was made to proceed with delivery given continued severe range blood pressures despite intravenous antihypertensives and concern for pre-eclampsia. Per the OB team, she was not a candidate for vaginal delivery due to her spasticity and contractures and she therefore underwent c-section.

Although neuraxial anesthesia in the setting of an intrathecal pump is not contraindicated, care must be taken to ensure the exact location of the catheter is known and avoided. Our patient's IBP was at L3-L4 and the catheter tip continued to T7, allowing for neuraxial placement as has been described [1,2]. However, our patient's history of recurrent CSF leaks and multiple surgical revisions of her device raised concern for anatomical destruction of the epidural space and risk for patchy surgical block. There was also concern for PDPH and/or baclofen withdrawal, problems she had previously encountered. Given these risks, in addition to the possibility of damage to the device itself, the risk of neuraxial anesthesia outweighed those of GA in this specific patient. C-section was performed for this patient under GA without incident.

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Abstract #: S-86

Pregnant Patient with Metastatic Colon Cancer, E. Coli Sepsis and New Right Sided Cardiac Mass

Presenting Author: Francesca Ianovich, MD

Presenting Author's Institution: UCSD

Co-Authors: Anne E. Shapiro - UCSD

Lawrence Weinstein, MD - UCSD

A 26 y/o G2P1 with a history significant for metastatic colon cancer presented at 34 weeks gestation with tachycardia, dysuria, right flank pain, and proteinuria. She was afebrile and vital signs were normal with the exception of significant tachycardia in the 140-220 range. The patient was admitted for presumed pyelonephritis, and a cardiology consult was called to work up the tachycardia. An echocardiogram demonstrated a mobile mass originating in the right atrium and prolapsing in and out of the right ventricle, concerning for a vegetation, Chiari network, metastatic disease or thrombus. Despite a normal white count and lack of fever, the patient's blood culture was positive for E. coli and a diagnosis of sepsis with possible endocarditis was made. Her access port for chemotherapy was removed and cultured but nothing grew. Intravenous antibiotics were administered and a heparin infusion started for clot and embolic prophylaxis in the setting of the mobile right atrial mass. At 37 weeks labor was induced. The heparin was stopped four hours prior to first administration of pitocin, and a PTT was checked several hours thereafter. Fourteen hours after the heparin was discontinued, the PTT was 24 seconds and a labor epidural was placed uneventfully. Approximately 12 hours post-epidural the patient delivered vaginally. The obstetricians' plan was to start therapeutic enoxaparin 8 hours post-delivery and continue anticoagulation for 3 months, following up with cardiology as an outpatient.

Anticoagulation on labor and delivery presents a challenge for the obstetric anesthesiologist. While obstetricians have the best interest of patients in mind they often forget the complexities of blood thinning agents in conjunction with neuraxial anesthesia. The timing of when an anticoagulant is held prior to placement of neuraxial anesthesia is not the only consideration. One must also consider when to restart anticoagulants after a neuraxial anesthetic has been performed. The recommendations vary with each anticoagulant, and it is paramount to stay up to date and communicate with obstetric providers to ensure safe practice when anticoagulation is needed. In this case, one can be swept away by the myriad medical issues and her complicated hospital course. However, therapeutic enoxaparin should not be started until 24 hours following neuraxial anesthesia. This patient received enoxaparin only 20 hours after epidural placement, which was too soon according to most recent guidelines. Fortunately there were no immediate or delayed bleeding nor neurologic sequelae.

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Abstract #: S-87

Obstetrics management in a twin pregnancy complicated by antepartum ST-elevation myocardial infarction.

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Peripartum acute myocardial infarction (AMI) is a rare event that presents the obstetrics anesthesiologist with a multitude of challenging scenarios necessary to help coordinate a smooth and safe delivery. Peripartum outcomes plausibly are worse due to hemodynamic changes as well as hemostatic considerations leading to increased incidence secondary to an increase in maternal age. AMI prior to delivery might require continuation of dual antiplatelet therapy (DAPT) after stent placement which may increase bleeding risk. Bridging therapy in obstetrics is poorly studied. We hereby present a case report describing the management of twin pregnancy with drug-eluting stent placement after ST-elevation myocardial infarction together with DAPT 11 weeks prior to scheduled delivery.

37-year-old multiparous female at 23 weeks of gestation with dichorionic diamniotic twins who presented with anterolateral ST-elevation myocardial infarction with severe hypokinesis of the entire anterior, anteroseptal and anterolateral wall with an ejection fraction (EF) of 40-45%. Cardiac angiography revealed single vessel disease, with 90% occlusion of the proximal left anterior descending artery which led to a drug-eluting stent placement. Patient was subsequently started on aspirin, clopidogrel and beta-blocker. Her course was complicated by a new diagnosis of severe mitral valve regurgitation together with EF 50-55% post stent placement. After a multidisciplinary maternal critical care conference, her clopidogrel was discontinued 5 days prior to the scheduled cesarean section. Bridging therapy was accomplished with IV cangrelor for 3 days prior cesarean section and stopped 3 hours prior to incision. Thromboelastography and anticoagulation labs were drawn to ensure the safest anesthetic option. After normal results and in-depth discussion with the couple, a combined spinal epidural anesthesia was attempted. Inadvertent dural puncture occurred with a 17G Tuohy needle and a decision was made to place an intrathecal catheter, which was removed immediately in recovery after uneventful cesarean delivery as the patient remained hemostatic. Later on in recovery, she developed postpartum hemorrhage, requiring blood transfusion. Clopidogrel was restarted 6 hours post-surgery once she became hemodynamically stable and hemostatic, as per multidisciplinary team suggestion. The patient also had a single episode of seizure-like activity in recovery with CT head showing small pneumocephalus with no other abnormalities, which started resolving in repeat CT head.

Peripartum AMI presents various considerations that need to be planned and managed in a multidisciplinary setting. Coronary artery dissection and thrombotic events are more prevalent in pregnant patients, the latter being believed to be the cause involved in this case. Proper stent selection and management of anticoagulation near delivery should be discussed with the multidisciplinary team to balance thrombosis and bleeding risk.

Abstract #: S-88

Epidural Anesthesia for Cesarean Delivery in a Patient With Achondroplasia

Presenting Author: Andrew Karlin, MD

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Co-Authors: Anne Shapiro, DO - University of California, San Diego

Lawrence Weinstein, MD - UCSD

The patient is a 26 year-old female, G1P0, presenting for a planned Cesarean delivery at 39 weeks gestation. The indication for elective primary c-section is maternal achondroplastic dwarfism, which carries a high probability of cephalopelvic disproportion. Aside from achondroplasia, her medical history is notable only for anemia of pregnancy. The patient denies other medical problems, including scoliosis, back pain, and back surgery.

The patient was seen by the anesthesia team, at which time she expressed a strong desire to be awake for the delivery. Physical exam was remarkable for short stature secondary to achondroplasia (height 4 feet, 3 inches, weight 44 kg), clear lungs, normal heart sounds, and a reassuring airway exam. Importantly, examination of the lumbar spine revealed easy palpation of the spinous processes and no obvious scoliosis.

The vast majority of planned c-sections are performed with spinal or combined spinal-epidural anesthesia due to its relative safety versus general anesthesia in the pregnant population. Neuraxial anesthesia can be more complicated for patients of extremely short stature, as "standard" doses might result in an unpredictably high block, with associated sequelae of profound hypotension and possible respiratory compromise. Therefore, the titratable technique of lumbar epidural was selected as primary anesthetic. The plan was discussed with the patient, and she was counseled about the possibilities of technique failure, exaggerated block height, and potential need for general anesthesia.

The patient was brought to the operating room and an epidural was placed at the L3-L4 interspace via loss of resistance to saline technique. Following a negative test dose (2 cc lidocaine 2% with epinephrine 5 mcg/cc), fentanyl 50 mcg was given via the epidural, which was then intermittently dosed with lidocaine 2%, 2 cc at a time. Sensory checks with ice were performed every 2 minutes. After only an additional 6 cc of local anesthetic, exam showed a T-4 level bilaterally and the patient had profound motor block of the lower extremities. The case proceeded uneventfully and no further epidural dosing was needed during the 50 minute surgery. At the conclusion, epidural morphine 1 mg was given for post-operative analgesia.

The case demonstrates successful application of epidural anesthesia in a patient with very short stature secondary to achondroplasia. It reinforces the importance of recognizing situations in which neuraxial drug spread may be exaggerated and adjusting standard practice accordingly.

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Abstract #: S-89

Anesthetic Management of a Patient with Apical Variant Hypertrophic Cardiomyopathy for Induction of Labor

Presenting Author: Jennifer Yoo, MD

Presenting Author's Institution: UCSD

Co-Authors: Anne Shapiro, DO - University of California, San Diego

Lawrence Weinstein, MD - UCSD

The patient is a 37-year-old G1P0 female who presented to Labor and Delivery for induction of labor at 39-weeks. Her medical history is significant for syncope while swimming 4 years prior to admission. At the time, workup revealed the presence of apical variant hypertrophic cardiomyopathy, a rare genetic disease that causes thickening of the left ventricular apex. Apical hypertrophic cardiomyopathy differs from hypertrophic obstructive cardiomyopathy in that ventricular thickening tends to be limited to the apex rather than the interventricular septum. Apical variant hypertrophic cardiomyopathy does not typically involve dynamic left ventricular outflow obstruction and may have a more benign prognosis, however, a significant percentage of patients with may present with symptoms such as chest pain, palpitations, dyspnea, or syncope. Symptomatic patients are at risk for arrhythmias, including atrial fibrillation and ventricular tachycardia. Following the diagnosis, the patient had an AICD implanted and was started on a beta-blocker for rate control.

On admission, the patient had an echocardiogram that confirmed left ventricular apical hypertrophy and a severely dilated left atrium, but did not demonstrate evidence of dynamic left ventricle outflow tract obstruction. Cardiology deemed her a good candidate for vaginal delivery and the anesthesia team was consulted for pain management options. It was agreed that an early, slowly titrated, epidural would be optimal to avoid tachycardia secondary to labor pain or sudden blood pressure changes related to rapid sympathetic blockade. The patient was admitted and placed on telemetry monitoring because of concern for arrhythmia.

Following induction of labor, the patient received a lumbar epidural that was slowly loaded with bupivacaine 0.125%. Vital signs were stable throughout the labor course and no arrhythmias were noted. Initial pain control was adequate but the patient reported unilateral pain about three hours later. The sensory block was asymmetric and the catheter was withdrawn 1.5 cm before giving a bolus, which did not help. Ultimately, the catheter was replaced with a fentanyl-only CSE with good relief. The patient had an uneventful vaginal delivery 9 hours after initial epidural placement.

On postpartum day 3, the patient developed chest pressure and shortness of breath with desaturation to 88% when supine. Chest X-ray showed pulmonary edema and echocardiogram demonstrated normal LV function, dilated left atrium, and pulmonary hypertension. She was diagnosed with diastolic heart failure secondary to impaired passive filling in the setting of hypertrophic cardiomyopathy. The patient was treated with supplemental oxygen and diuresis. She responded well to treatment and was discharged home on postpartum day 7.

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Abstract #: S-90

Epidural Labor Analgesia in a Parturient with Herpes Zoster Outbreak

Presenting Author: Korey Johnson

Presenting Author's Institution: UCSD

Co-Authors: Anne Shapiro, DO - University of California, San Diego

Lawrence Weinstein, MD - UCSD

The literature for case reports of epidural labor analgesia in patients with herpes Zoster with skin lesions is lacking. Epidural placement in this patient population may have a potentially elevated risk of introducing the virus into the central nervous system, raising concern for central nervous system infection. It follows that potential viral transfer would be more likely in the setting of active viremia or if the needle placement is close to active herpetic lesions. We could not identify any case reports describing this outcome. There are, however, several case reports describing the use of epidural analgesia in the setting of acute herpes zoster. This case describes the labor analgesia management of a parturient with recently treated shingles with vesicular skin lesions.

The patient is a 37-year-old G4P1 female at 39-weeks gestation who presented in active labor. Past medical history is remarkable for anemia of pregnancy, GERD, and a recent outbreak of herpes zoster with continued presence of crusted over vesicles on the right flank and back. As of the day of admission, she had completed a seven-day course of valacyclovir and was afebrile. The anesthesia team was consulted for possible labor epidural placement.

On exam, the patient had healing vesicular lesions on the right flank and across her right lower back to the midline, in a pattern corresponding to the L-1 or L-2 nerve root distribution. There were no actively oozing lesions and no evidence of superimposed bacterial infection. The skin below the L-2 spinous process was intact and completely clear of lesions, and the spinous processes at L4-L5 were easily palpated.

The patient was counseled about the limited data regarding the safety of epidural placement in the setting of a recent shingles outbreak and that she might be at an elevated risk of an infectious complication. She demonstrated appropriate understanding and wished to proceed with epidural analgesia.

The low lumbar area was prepped and draped such that there were no lesions within the work area. An epidural was placed at the L-4-L5 interspace on one attempt via loss of resistance technique. Following a negative aspiration and test dose, the catheter was loaded with bupivacaine 0.25% 8 cc and a PCEA infusion was started. The patient's pain score decreased from 9/10 to 0/10 within 15 minutes and she remained pain free until uneventful vaginal delivery about three hours later. There were no immediate or delayed infectious or neurological complications.

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Abstract #: S-91**Lost in Translation: A Case of Delayed Recognition of Postpartum Hemorrhage****Presenting Author:** Anne Whitehouse, MD**Presenting Author's Institution:** University of North Carolina**Co-Authors:** Jeremy Gue, MD - University of North Carolina Hospitals

Kimberley Nichols, MD - University of North Carolina

A 43 year old female G4P1021 with no significant past medical history presented to labor and delivery for induction of labor secondary to advanced maternal age and concern for low-lying placenta. Patient's native language was Mandarin, and a preoperative assessment was completed by the obstetric anesthesia team prior to epidural placement. Informed consent was obtained via phone interpreter services. Labor epidural was placed without complications with subsequent delivery of a healthy male infant. The obstetricians, however, were unable to deliver the placenta due to an avulsed cord. D&C was performed uneventfully to the satisfaction of the obstetricians. Despite surgical intervention, the patient continued to require vasopressor support and fluid resuscitation. Additional uterotonic agents, uterine massage, and placement of Bakri balloon were utilized in attempt to abate hemorrhage. A significant amount of time was devoted to communicating with the patient via her L&D nurse (who spoke Mandarin) and an iPad interpreter, and bleeding was continuously reassessed. During these events, the patient's clinical picture deteriorated, and communication became increasingly difficult. It was perceived by the nurse and interpreter that the patient was now speaking a different Chinese dialect. No clear source of bleeding was identified. Ultimately, the patient suffered PEA arrest due to severe hypotension secondary to delayed hemorrhage recognition. ROSC was achieved after 2 rounds of ACLS and MTP initiation. She was taken to Interventional Radiology Suite for bilateral uterine artery embolization. However, there was concern for continued bleeding. An emergency ex-lap revealed large subcapsular liver hemorrhage, likely from chest compressions. Additional embolization of other internal iliac branches were required. The next day, the patient was successfully extubated and transferred out of the ICU.

Postpartum hemorrhage remains a significant challenge for maternal morbidity and mortality. This case highlights the language barrier as a potentially preventable cause. The team made their best efforts to communicate with the patient in her native language, however it proved a challenging distraction from the ongoing unrecognized hemorrhage. Although cardiac arrest in peripartum patients is rare, providers must be familiar with unique maternal considerations. If ongoing hemorrhage occurs after ROSC, liver injury from chest compressions should be considered on the differential.

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Abstract #: S-92**Intraoperative code from pulmonary hypertensive crisis and successful rescue with extracorporeal membrane oxygenation during repeat cesarean**

Presenting Author: Amy Willett, MD

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Co-Authors: Jessica R. Ansari, MD - Stanford University

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Introduction: Pulmonary arterial hypertension (PAH) confers significant maternal risk in pregnancy with high mortality of 16-23% despite advanced therapies at tertiary care centers¹. We describe a case in which a patient with severe idiopathic PAH underwent uneventful primary cesarean but experienced a pulmonary hypertensive crisis and arrest 3 minutes after fetal delivery during repeat cesarean.

Case description: 34-year-old patient with chronic hypertension, obesity (BMI 38), and PAH first diagnosed 3 years prior in the setting of syncope, dyspnea, and NYHA 4 symptoms. Initial echocardiogram showed severely reduced right ventricular (RV) systolic function and RVSP 91mmHg. With pulmonary vasodilators including treprostinil and sildenafil, she improved to NYHA 2 status.

During this pregnancy, she presented to care at 26 weeks gestation with an unanticipated but desired pregnancy and stable NYHA 2 symptoms. Medical therapy included subcutaneous treprostinil, enoxaparin, and sildenafil. Repeat cesarean was recommended at 32-34 weeks; however, this was declined by the patient until 36+0 weeks.

Intraoperative Course: Treprostinil infusion was continued, and inhaled nitric oxide was started. Radial arterial and pulmonary catheters were placed. An epidural was placed for slow titration of 2% lidocaine to a T4 sensory level. Small bilateral femoral arterial and venous cannulae were inserted in case of need for ECMO.

At incision, the patient had BP 127/70, PAP 42/16, CVP 3. Vitals remained stable throughout uterine incision and fetal delivery. Immediately following delivery of placenta, PAP rose to 124/55 with a concomitant drop in arterial BP to 59/33. The patient became unresponsive and asystolic. Immediate ACLS ensued. TEE demonstrated severe RV dilation and absent LV systolic function. During several rounds of CPR with epinephrine, vasopressin, calcium, and amiodarone therapy, surgeons upsized her femoral cannulae to allow transition to full flow veno-arterial ECMO with stabilized hemodynamics. Several hours after abdominal closure, exploratory laparotomy and hysterectomy were performed due to continued transfusion requirement.

Postoperative Course: The patient was decannulated from ECMO on POD 7; TEE at that time showed normal biventricular function. On POD 8 she was extubated, on POD 10 weaned off milrinone and inhaled NO, and on POD 18 the patient was discharged home. At 3 months postpartum, patient reported that she felt back to her pre-pregnancy baseline.

Discussion: Our patient's acute rise in PAP may have resulted from multiple processes including rapid autotransfusion, acute prostaglandin withdrawal after placental delivery, or an embolic event. The case illustrates that PAH remains extremely high risk for pregnancy even after an uncomplicated prior delivery. Our case is also remarkable in the patient's recovery to baseline functional status despite a code and prolonged VA-ECMO requirement.

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Abstract #: S-93

Emergent Preterm Cesarean Delivery Followed by Left Lower Lobectomy for Pulmonary Hemorrhage

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A 24-year-old G2P1 (82 kg, 160 cm) with one prior cesarean delivery and a childhood lung mass presented at 31 weeks gestation with hemoptysis. She had absent left-sided breath sounds on exam and a 16 cm cystic mass in the left lower lobe on CT. Both mother and fetus were stable initially. On the third day, the hemoptysis increased and her clinical status deteriorated with worsening anemia and preeclampsia. Urgency to control the hemorrhage prompted a shared multi-disciplinary decision to perform left lower lobectomy immediately following the cesarean delivery.

Proper placement of a 35F left-sided double lumen tube (DLT) was precluded due to airway bleeding and poor visualization via the bronchoscope and inability to use auscultation for confirmation due to absent left-sided breath sounds. Left-sided DLT was placed almost blindly and cesarean delivery was started. APGAR score was 2/5/6. A dose of Carboprost was required in addition to oxytocin with blood loss of 1.2 L. However, after closure of the cesarean incision and right internal jugular central line placement, the oxygen saturation dropped and peak pressures rose significantly without evidence of pneumothorax. Ventilation was arduous and the DLT was exchanged for an ETT to allow effective suctioning of the airway. Lung isolation by advancement of the ETT in the right main stem was attempted, but the seal was inadequate. Optimal ventilation was only possible in left lateral position with the hemorrhaging lung in the dependent location. In the setting of insufficient lung isolation, this position allowed right lung protection but was not conducive for left thoracotomy. Definitive surgical control of the hemorrhage was necessary; therefore, the femoral vessels were cannulated for potential need of cardiopulmonary bypass (CPB) as ventilation was inadequate. Subsequently, after serial airway suctioning in the left lateral position, airway visualization improved and a bronchial blocker was successfully placed through an 8.0 ETT. Lung isolation was achieved and left lower lobectomy proceeded uneventfully with cumulative blood loss of 3.5L. Patient was successfully extubated on POD 3 and discharged on POD 8.

This case posed many challenges: multidisciplinary care, preterm delivery with pre-eclampsia, general anesthesia for cesarean with an ongoing pulmonary hemorrhage, absolute need for lung isolation, potential for catastrophic airway hemorrhage and losing the airway, significant blood loss with two major concomitant procedures, and potential full dose anticoagulation for CPB after cesarean delivery if optimal lung isolation could not be achieved. The DLT did not allow for effective suctioning of the airway. Extracorporeal life support should be considered in difficult ventilation scenario.

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Abstract #: S-94

Understanding the Physiology of Surgically Corrected Congenital Double Outlet Right Ventricle for the Parturient

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INTRODUCTION: Double outlet right ventricle(DORV) is a congenital heart defect(CHD)where the great vessels both emerge from the right ventricle with a mandatory VSD for blood mixing. The incidence of DORV is estimated to be 1-1.5% of all CHD (1:10,000 live births). Surgical intervention is usually performed early in life due to the hypoxic perfusion created by this defect. Although collective data exists regarding maternal outcomes in patients with CHD, little is known about outcomes or management strategies specifically relating to pregnancy with surgically corrected DORV. In order to devise safe and effective plans for delivery, providers must understand the physiological implications of DORV.

CASE: Our patient is a 22yo obese(BMI 35) G1PO at 38wks GA for induction of labor for symptomatic DORV. The PMH included surgical correction of DORV at 1 yo (Rastelli procedure) and was asymptomatic with normal exercise tolerance prior to pregnancy. At 37wks the patient developed DOE and peripheral edema. Pediatric echocardiogram demonstrated corrected great vessels, mild RV HTN with dilatation, mild tricuspid regurgitation and pulmonary stenosis with a small membranous VSD. EKG showed RBBB and PVCs. A multidisciplinary team was assembled with MFM, anesthesiology and cardiology services for delivery planning. Goals were designed to maintain euvoemia and preload, increase or maintain right ventricular contractility, prevent hypoxemia which might increase pulmonary HTN, limit Valsalva which could allow left to right shunt with VSD, and utilize neuraxial analgesia for patient comfort and blunt sympathetic surges. Pt was admitted for pre-delivery fluid optimization and during induction of labor a DPE technique was utilized. The patient vaginally delivered a healthy newborn without complications.

Discussion: DORV is a very rare CHD and little is known about patients with this pathology, but the corrected defect is often associated with right heart dysfunction and pulmonary stenosis which may decompensate in the setting of pregnancy. When otherwise asymptomatic patients have signs and symptoms of decompensation, it is important for providers to understand the corrected anatomy and functionality of the heart to devise appropriate delivery plans. Residual VSD or scarring of the nodal system may increase chances of left to right shunt and arrhythmia during delivery. Anesthetic goals should be targeted toward maintaining preload (maintaining SVR) and right heart contractility, preventing any pulmonary HTN or rapid increased in afterload (Valsalva) if a residual VSD exists. Although our patient did not demonstrate aortic insufficiency, this also has been associated with DORV. Our case demonstrates how proper multidisciplinary planning of an extremely rare congenital heart disease can lead to a good outcome for mother and baby.

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Abstract #: S-95**Anesthetic management of Cesarean section in a patient with Glanzmann's thrombasthenia: A case report.**

Presenting Author: Xiaolu Linda Zhang

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Glanzmann's thrombasthenia (GT) is a rare autosomal recessive disorder characterized by the qualitative or quantitative abnormalities of platelet receptor GPIIb/IIIa required for platelet aggregation. Patients with GT typically present with purpura, petechiae or abnormal bruising often during childhood. Gingival bleeding and epistaxis are common as well. Many patients require frequent treatment with anti-fibrinolytics and platelet transfusion or recombinant activated FVIIa. Pregnant GT patients are at considerable risk for antepartum and postpartum hemorrhage. Here we present a case where a 34-year-old patient with GT and Hepatitis C underwent Cesarean section due to oligohydramnios at 37 weeks of gestation. Anesthetic and coagulation management perioperatively is discussed. Multidisciplinary approach and interdepartmental cooperation among obstetricians, hematologists, anesthesia and neonatologist played an important role in the aggressive prophylactic management of postpartum hemorrhage.

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Abstract #: S-96

Late Postpartum Eclampsia Complicated with Posterior Reversible Encephalopathy Syndrome and Acute Kidney Injury: A Case Report.

Presenting Author: Xiaolu Linda Zhang

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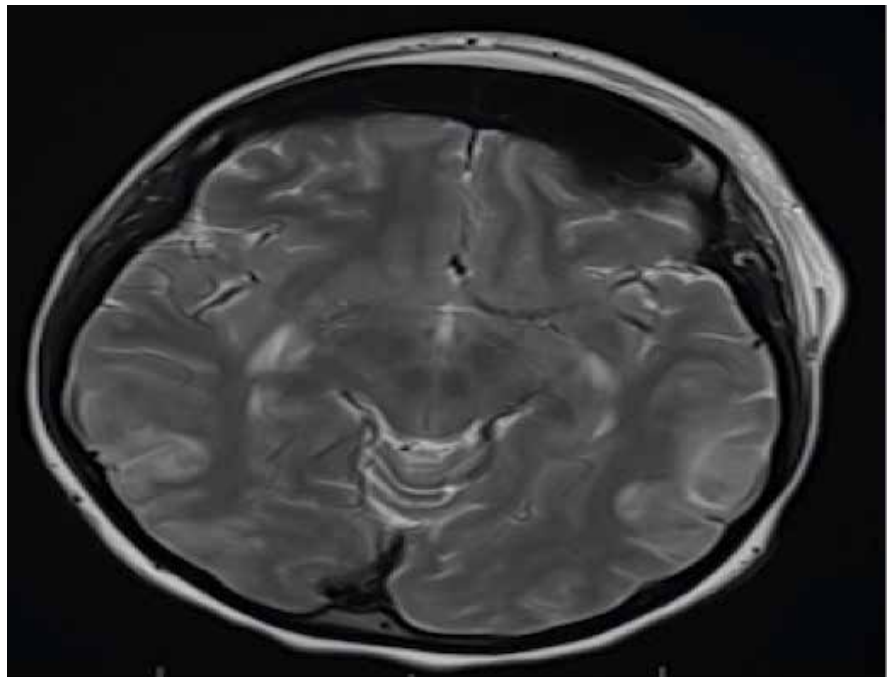
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Posterior reversible encephalopathy syndrome (PRES) is a rare entity characterized by a rapid onset of headache, vomiting, visual disturbances, seizures and unconsciousness with characteristic magnetic resonance imaging. It is often associated with acute hypertension. Pre-eclampsia and eclampsia are the most common causes of PRES in obstetric patients. Late postpartum eclampsia complicated by PRES has been reported before in the literature. Here, we present a unique case of a 23-year-old patient who developed late postpartum eclampsia complicated by PRES and acute kidney injury requiring renal replacement therapy, which is the first such case report in the literature. It is thus recommended to continue antihypertensive medications in patients with hypertensive history till 6 weeks postpartum as the occurrence of late postpartum eclampsia is high. These medications should be titrated slowly to avoid reactive hypertensive episode, which might trigger PRES and acute kidney injury.

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Abstract #: S-97**Remifentanil Analgesia in a Parturient with Neurofibromatosis type 1****Presenting Author:** Alix Zuleta-Alarcon, MD**Presenting Author's Institution:** The Ohio State University - Columbus, Ohio**Co-Authors:** Teri Gray, MD - The Ohio State University

Joseph L. Reno, MD - Ohio State University Wexner Medical Center

A 27-year-old G3P0020 with PMH of neurofibromatosis type 1 (NF1) presented for induction of labor at 35w1d indicated by preeclampsia with severe features (severe range blood pressures requiring labetalol and magnesium). Induction was performed with misoprostol and oxytocin; intermittent variable decelerations resulted in IUPC and FSE monitors.

An epidural was requested by the patient. Her surgical history included resection of multiple cutaneous lesions on arms and legs, with biopsy-proven neurofibromas. Subsequent brain MRI revealed periventricular lesions. She had not had spine imaging. She reported increased number and size of lesions throughout pregnancy. Physical exam revealed multiple lesions on her back (figure 1). She had no focal neurologic deficits.

The risk and benefits of epidural placement in absence of spine imaging were discussed. The patient was offered and agreed to remifentanil labor analgesia. Excellent pain control was achieved with remifentanil PCA delivering 10 mcg boluses with 2-minute lockout and no continuous infusion. She had an uncomplicated vaginal delivery of a 2020g infant, APGARS 7 and 9.

Neurofibromatosis is a tumor syndrome with an incidence of 1 in 2,500-3,000 live births (1). NF1 classically includes café-au-lait lesions, multiple benign tumors of central and peripheral nervous system, hydrocephalus, seizures, and hypertension. NF1 also predisposes to renal artery stenosis, pheochromocytoma, cerebral aneurysm, and other vascular disorders (2).

Recent population studies found that NF1 patients account for 0.008% of pregnancy related admissions in the United States. NF1 delivering mothers experience greater gestational hypertension, preeclampsia, IUGR, cerebrovascular disease, preterm labor, and cesarean delivery (2). Pregnancy is also associated with enlargement of existing masses and growth of new neurofibromas in >45% of patients (1, 3). Considering that spinal tumors are reported in 40% of patients with NF1, special neuroradiological evaluation is recommended prior to neuraxial procedures (4).

Epidural anesthesia is the most effective method for analgesia during labor. However, CNS lesions require careful consideration before neuraxial anesthesia. Our patient's periventricular lesion and potential for CNS neurofibroma growth during pregnancy were major concerns. Tumor seeding or injury during placement, as well as unpredictable dosing and spread of the epidural analgesia led us to favor non-neuraxial analgesia. A neuraxial procedure could affect her CNS prognosis in unknown ways, too. This case of successful remifentanil labor analgesia in a parturient with NF1 highlights the importance of personalized management of pregnancy in women with NF1 and the benefit of early anesthesia consult.

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Abstract #: S-98

An Interesting Case of Postpartum Hypoxemia in a Preeclamptic: The Presenting Sign of Malignancy?

Presenting Author: Kara Joseph, MD

Presenting Author's Institution: Northwestern University Feinberg School of Medicine

Co-Authors: Nicole Higgins, MD - Northwestern University Feinberg School of Medicine

Introduction: The risk of venous thromboembolism (VTE) is four times greater in pregnant versus non-pregnant women.¹ Diagnosis of pulmonary embolism (PE) can be challenging during pregnancy, as symptoms are often mistaken for those of a normal pregnancy.² The risk of VTE increases through each semester, peaking one to three weeks postpartum, then declines until 12 weeks when the risk is equivalent to the nonpregnant state.¹ Awareness of this risk is imperative, especially when a patient has unexplainable peripartum hypoxemia. We present a case of PE, which led to the diagnosis of a rare malignancy.

Case Presentation: A 33-year old G1P0 presented at 40w1d gestation with preeclampsia with severe-range blood pressures. She was started on magnesium and labor was induced. She received multiple doses of antihypertensives for blood pressure control. A combined spinal epidural was placed for analgesia, and patient had an uncomplicated vaginal delivery. On postpartum day two, she had acute shortness of breath with hypoxemia and tachycardia. Computed tomography angiography revealed acute bilateral lobar emboli and a large retroperitoneal tumor arising from the right adrenal gland measuring 13 centimeters (cm). The tumor extended into the inferior vena cava (IVC) and the right atrium. Transthoracic echocardiography confirmed a 4.2 cm right atrial mass, which entered the ventricle during diastole. Endocrine evaluation ruled out pheochromocytoma but elucidated hypercortisolism and hyperandrogenemia, which raised suspicion for an adrenal cortical carcinoma (ACC). Two weeks later, she underwent adrenalectomy and removal of tumor burden from the IVC and right atrium while on cardiopulmonary bypass. Pathology confirmed the diagnosis of ACC. She had an uncomplicated recovery and was discharged with therapeutic enoxaparin for pulmonary emboli, hydrocortisone for secondary adrenal insufficiency, and plans for chemotherapy and radiation.

Discussion: Our patient had several risk factors predisposing her to PE, including the hypercoagulable state of pregnancy and decreased venous outflow in the pelvis from a gravid uterus. This venous stasis was worsened by her tumor, which nearly occluded the lumen of the intrahepatic IVC. In retrospect, our patient noted worsening bilateral lower extremity edema, fatigue, and dyspnea throughout her pregnancy. Though this symptomology is typical of pregnancy, our patient's symptoms were likely due to her hypercortisolism, malignancy, and tumor mass effect. ACC is rare, with an incidence of 1.5-2 cases per million person-years.³ It is more common in women and typically presents with Cushing syndrome; less frequently, the tumor is found incidentally.³ Fortunately, given high concern for PE, this patient's diagnosis was prompt and potentially lifesaving.

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Abstract #: S-98

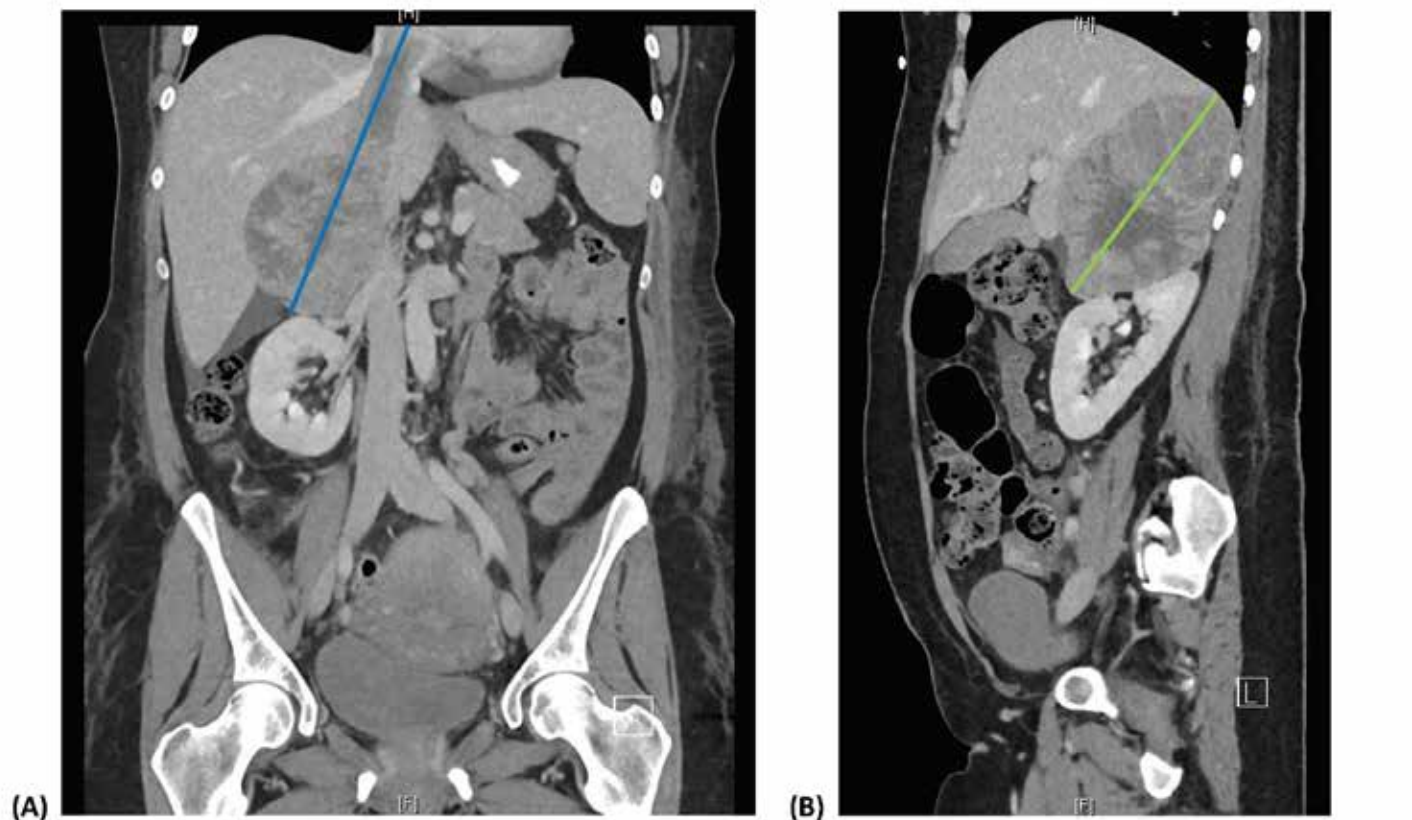


Figure 1: (A) Coronal computed tomography showing tumor above the right kidney extending into the patient's inferior vena cava (blue line). (B) Tumor in saggital view shown in greatest dimmension, more than 13 centimeters (green line).