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Case Report

Pneumothorax, pneumomediastinum, and pneumoperitoneum during peroral endoscopic myotomy under general anesthesia-A case report

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Abstract: A 45-year-old female with esophageal achalasia was scheduled for peroral endoscopic myotomy under general anesthesia. Pneumothorax, pneumomediastinum, and pneumoperitoneum happened during the procedure. These gas-related complications happened at the same time is rare but extremely dangerous.

Keywords: POEM, gas-related complications, general anesthesia

Peroral endoscopic myotomy (POEM) is proved to be a novel and safe therapy for achalasia. Pneumomediastinum and pneumoperitoneum frequently occur after surgery as the carbon dioxide insufflation during the procedure. But pneumothorax, pneumomediastinum, and pneumoperitoneum happen together during POEM has not been reported yet, and it is extremely dangerous. It requires prompt diagnosis and immediate treatment or it may lead to respiratory failure and cardiovascular collapse. We report a case of these gas-related complications occurring intraoperatively.

Case report

A 45-year-old female with esophageal achalasia was scheduled for peroral endoscopic myotomy (POEM). This patient was 160 cm height and 56 kg weight. She had no known history of pre-existing medical conditions or allergies (ASA I). Routine laboratory investigations including blood count, coagulation and biochemical tests were within normal limits. ECG and chest radiograph was normal.

Anesthesia was induced with 3 mg midazolam, 0.2 mg fentanyl, 120 mg propofol, and 50 mg rocuronium. Intubation was performed with a 7.0 mm cuffed endotracheal tube, secured between the lips at 21 cm. Equal breathing sounds were auscultated in both lung fields. For maintenance of anesthesia, oxygen 2 L/min, sevoflurane (2.0 vol%) were administered, and propofol was continuously infused 100 mg/hr. Volume-control ventilation was maintained with a tidal volume (VT) of 500 ml, with respiration rate (RR) of 11/min. Airway pressure was maintained to 20 cmH_2O, whereas partial pressure of end-tidal carbon dioxide ($P_{ET}CO_2$) was kept to around 32 mmHg. The patient was placed into a left lateral position. After a routine injecting of raceanisodamine hydrochloride, the surgery began.

About 50 minutes later, the SpO_2 decreased to 97% for 3 minutes. While checking the airway and setting of the anesthesia machine, SpO_2 suddenly dropped to 71% and the waves of end-tidal carbon dioxide ($ETCO_2$) disappeared. Patient became cyanotic. There was no improvement in the condition of the patient. So the procedure was stopped. Patient was changed to supine position. Manual artificial ventilation was shifted immediately, but the airway pressure was too high to make any ventilation, and the breath sounds of both sides could not be heard. Vital signs were 150/109 mmHg for blood pressure, 112 beats/min for heart rate, no waves of $ETCO_2$ at that time. Because of the sudden decrease in SpO_2, the anesthesiologist decided to extubate to exclude the problems of endotracheal tube and then re-intubated. During this procedure, the endotracheal tube

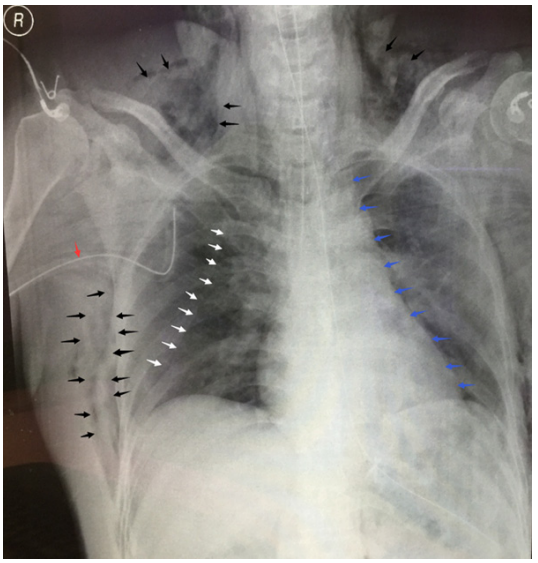

Figure 1. The postoperative bedside chest film showed subcutaneous emphysema (black arrow), pneumothorax (white arrow), pneumomediastinum (blue arrow) and pleural drain (red arrow).

was proved to be fine. Cervical, facial and upper thoracic subcutanrous emphysema and Abdominal distension was found. Chest compressions were performed at once. A 16G needle was punctured to the right second intercostal space and thoracic surgeon was called at the same time. Through chest compressions, there was no obvious hemodynamic changes and oxygen desaturation in next 30 minutes. Blood pressure and heart rates were maintained at 98-138/68-86 mmHg and 60-138 beats/min. After thoracic surgeon arrived, pneumothorax, pneumomediastinum, and pneumoperitoneum were diagnosed. A closed thoracic drainage was performed on the right chest. Mechanical ventilation was changed with a tidal volume of 450 ml, with respiration rate of 16/min. Ventilation was then improved, patient started becoming pink. Results of arterial blood gas analysis showed pH 6.94, $PaCO_2$ 90 mmHg, PaO_2 91 mmHg, HCO_3^- 19.3 mEq/L, K^+ 2.8 mmol/L and SaO_2 90%. 5% Sodium Bicarbonate was used to correct acidosis. 20 minutes later another arterial blood gas analysis showed pH 7.16, $PaCO_2$ 78 mmHg, PaO_2 86 mmHg, HCO_3^- 27.8 mEq/L, K^+ 2.8 mmol/L and SaO_2 93%. All vital signs were stable. The endoscopist finished the rest procedures; a gastrointestinal decompression tube was placed. Patient was immediately transferred to ICU after the surgery.

The patient received an intermittent positive pressure ventilation (IPPV), with VT 450 ml, RR 18, FiO_2 100%, PEEP 0 cmH_2O. Bedside chest film was shown subcutaneous emphysema, pneumothorax, and pneumomediastinum (**Figure 1**). At 6 hours after the end of the surgery, extubation was achieved after confirmation of self-respiration and consciousness recovery. Pneumomediastinum was confirmed, antibiotics and 5 L/min of oxygen were administered for treatment. The patient's symptoms were improved on post-operative day 3. A chest and upper abdominal CT scan were taken on post-operative day 15, it showed subcutaneous, pleural effussion, and little pneumomediastinum (**Figure 2**) and then transferred to general ward on post-operative day 15. She was discharged on post-operative day 25.

Discussion

Achalasia is an esophageal motor disorder characterized by sustained lower esophageal sphincter contraction and reduced esophageal peristalsis. This pathology eventually results in symptoms like dysphagia, regurgitation and occasional chest pain related to food intake. POEM appears to be a feasible endoscopic therapy for achalasia with excellent short-term clinical results and improvement in manometric outcomes [1, 2]. The most frequent complications reported until now are CO_2 retention, capnoperitoneum and mediastinal exposure [3]. Yang S et al. [4] find out that pneumomediastinum and pneumoperitoneum detected by CT occur frequently after POEM and may be regarded as normal postoperative changes.

Pneumothorax, pneumomediastinum, and pneumoperitoneum occurred at the same time during POEM is very rare and is more life threatening. The diagnosis should be considered in the presence of increased airway pressure, hemodynamic compromise, oxygen desaturation, unexplained hypoxia/hypercapnia. Subcutaneous emphysema of the neck, chest wall and face should alert the anaesthesiologist to this life threatening complication [5]. A chest x-ray and chest CT can clarify the diagnosis [6].

What causes pneumothorax and pneumomediastinum during the surgery? The possibility of mucosal damage due to endotracheal intubation while inducing anesthesia is also low since there were no difficulties in the intubation process and the 7.0 mm cuffed endotracheal tube

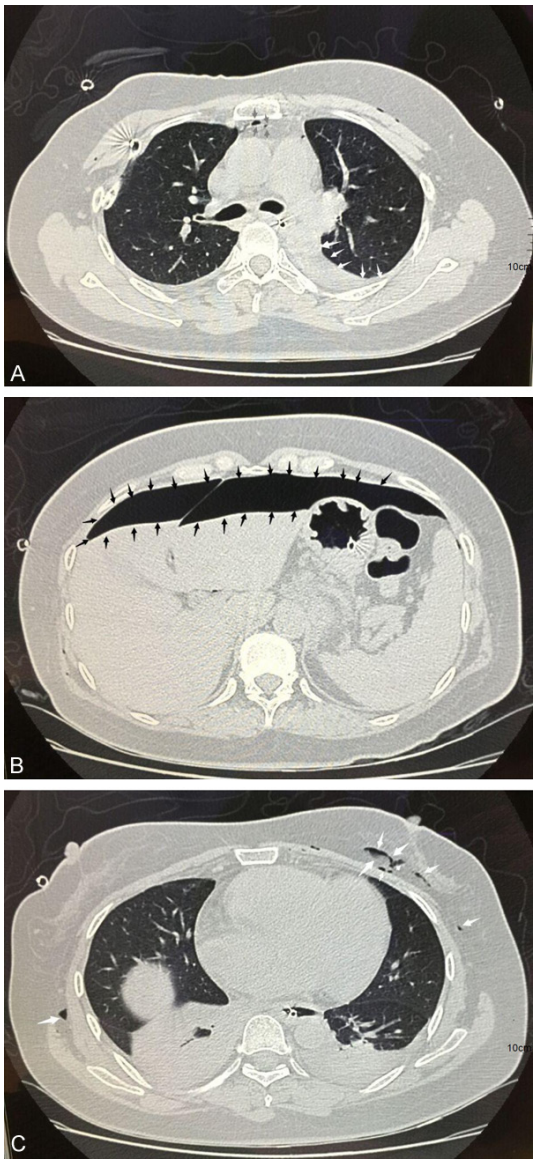

Figure 2. The post-operative chest and upper abdominal CT scan showed pleural effussion (A white arrow), and little pneumomediastinum (A grey arrow), pneumoperitoneum (B black arrow), subcutaneous emphysema (C white arrow).

forms a curve at a 21 cm length so it is difficult to have deeper intubation. And there were no excessive position changes to the neck area during surgery. We checked the breath sounds of both sides, the depth of endotracheal tube and airway pressure after changing position. Therefore, the authors believe that there is low possibility of mucosal damage due to endotracheal intubation.

POEM is an endoscopic procedure, which means carbon dioxide insufflation exists all the time. Though carbon dioxide insufflation is safe and useful in endoscopy procedures [7-9], we should still aware of the gas-related complications including subcutaneous emphysema, pneumothorax, pneumoperitoneum and mediastinal emphysema happened during the surgery. Ren Z et al. [10] found that Complications that occurred during the operation included subcutaneous emphysema (22.7%, 27/119) and pneumothorax (2.5%, 3/119). Wang X et al. [11] studied on the gas-related complications occurred during POEM reported that simple longitudinal mucosal incision, tunnel width ≤ 3 cm and sigmoid-type oesophagus are independent risk factors for gas-related complications for achalasia during POEM, but not myotomy depth and operative time.

What can help us to recognize pneumothorax, pneumomediastinum or pneumoperitoneum early during POEM? Tanaka E [12] et al. suggested that elevation of end-tidal carbon dioxide after initiating esophageal carbon dioxide insufflation should be observed in all patients and be treated by minute adjustments to the ventilation volume. In our case, $ETCO_2$ disappeared just after oxygen desaturation without an early phase raised. Airway pressure was too high to do manual artificial ventilation and the breath sounds of both sides could not be heard. After excluding airway problem, we considered tension pneumothorax and pneumomediastinum. HR and arterial BP both significantly increased with hypercapnia [13]. In our case, HR and BP increased at the early phase of the surgery, did it indicate a hypercapnia? In endoscopy procedure, raceanisodamine hydrochloride was injected to depress gastrointestinal motility while increase the HR and BP, which may compromise the diagnosis. So $ETCO_2$ and Airway pressure change is more useful.

What's the treatment of gas-related complications during the procedure? The cases with mild complications usually presented with merely a small amount of subcutaneous emphysema, which did not require any special intervention. In severe cases, however, vast gas accumulation may occur in the chest, abdominal cavity, mediastinum or under the skin. Sometimes acute respiratory and circulatory failure and even death may occur. In such a setting, emergency invasive interventions of deflation via subcutaneous puncture and closed thoracic drainage should be taken for symptom relief [14, 15]. The patient in our case received continuous chest compression before chest

tube insertion, which provided a temporary respiratory and circulatory pump and won a gold time for further treatment. After extubation, the patient was treated with bed rest, oxygen therapy and antibiotics. As to avoid hurting the extensive bowl, we abandoned inserting a IV cannula into the abdominal to release some gas. The patient's symptoms were improved at last.

In conclusion, we should be aware of that gas-related complications may occur during POEM and sometimes it is life threatened. It requires prompt diagnosis and immediate treatment.

Disclosure of conflict of interest

None.

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