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Performance-Limiting Laryngeal Disorders*

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ABSTRACT: The larynx is composed primarily of cartilage that forms a communicating channel between the pharynx and trachea. Performance-limiting upper respiratory disorders involving the larynx typically cause narrowing of the rima glottidis, resulting in audible respiratory noises, poor performance, and exercise intolerance. To treat laryngeal performance-limiting upper respiratory disorders, medical or surgical intervention is commonly required to enlarge the rima glottidis cross-sectional area and restore the horse's athleticism.

The larynx, which is composed of single cricoid, thyroid, and epiglottic cartilages and paired arytenoid cartilages, forms a communicating channel between the pharynx and trachea (Figure 1). Contraction of intrinsic laryngeal muscles produces changes in the rima glottidis diameter by abducting and adducting the corniculate processes of the arytenoid cartilages and vocal folds¹ (Figure 1). The paired cricoarytenoideus dorsalis muscles, which are innervated by the recurrent laryngeal branch of the vagus nerve, are the principal abductor muscles that widen the laryngeal opening by abducting the corniculate processes of the arytenoid cartilages and tensing the vocal folds.¹ Contraction of the single arytenoideus transversus muscle, which is innervated by the recurrent laryngeal branch of the vagus nerve, also provides arytenoid

abduction by drawing the dorsomedial margins of the arytenoid cartilages together.¹ The paired thyroarytenoideus, single arytenoideus transversus, and paired cricoarytenoideus lateralis muscles, which are innervated by the recurrent laryngeal branch of the vagus nerve, adduct the corniculate processes of the arytenoid cartilages, narrow the rima glottidis, and protect the lower airway during swallowing.¹ The paired cricothyroideus muscles, which are innervated by the external branch of the cranial laryngeal nerve, tense the vocal folds during inspiration and vocalization and narrow the rima glottidis.² The external laryngeal muscles involved in laryngeal stabilization during exercise include the thyrohyoideus muscle, which is innervated by the external branch of the cranial laryngeal nerve; the hyoepiglotticus muscle, which is innervated by the hypoglossal nerve; and the sternothyroideus muscle, which is innervated by the ventral branches of the first and second cervical nerves.³

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EPIGLOTTIC ENTRAPMENT

Epiglottic entrapment occurs when the aryepiglottic folds become abnormally positioned above the dorsal epiglottic surface and encom-

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Figure 1. Lateral view of the larynx and normal endoscopic appearance of the upper airway.

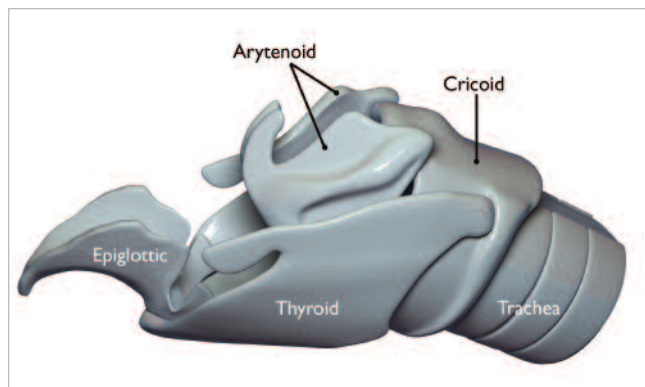


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Single cricoid, thyroid, and epiglottic cartilages and paired arytenoid cartilages form a communicating channel between the pharynx and trachea.

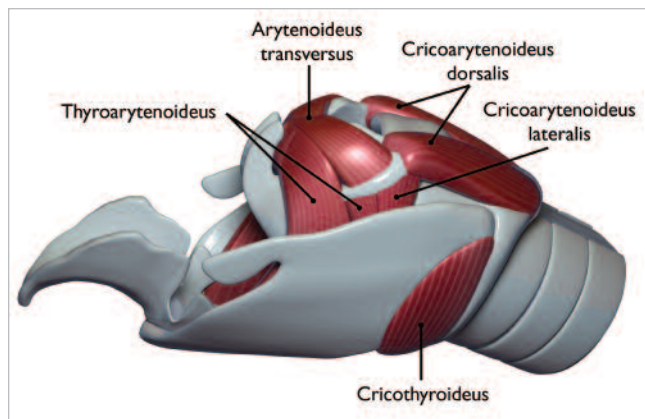


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Overlay of intrinsic laryngeal muscles that abduct and adduct the diameter of the rima glottidis via contraction.



Normal endoscopic appearance of the equine upper airway.

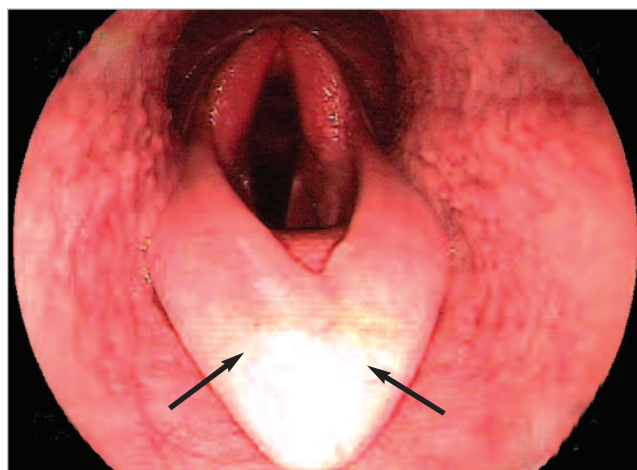


Figure 2. Epiglottic entrapment. Endoscopically, the outline of the epiglottis (arrows) can be visualized; however, the crested margins and the normal vascular pattern of the epiglottis cannot be observed.

pass the epiglottis. During expiration, turbulence is caused by air pocketing between the aryepiglottic folds and the dorsal epiglottic surface, resulting in abnormal respiratory noise and exercise intolerance in horses. Thickening and dilation of the entrapping membranes reduce the pharyngeal cross-sectional area rostral to the rima glottidis.⁴ On resting endoscopic examination, the general shape of the epiglottis is still visible; however, because the epiglottis is covered with a fold of mucosa, the distinct crested margins of the epiglottis and the dorsal epiglottic vascular pattern are obscured (Figure 2). The entrapment may be intermittent and relieved by swallowing, but most cases involve persistent entrapment. Mucosal disruption can be visualized in chronic epiglottic entrapments, ranging from minimal erosions to extensive amounts of exposed granulation tissue and proliferative pale, fibrous connective tissue around the

perimeter of the ulcer. Thoroughbreds and Standardbreds with epiglottic entrapment have a significantly shorter thyroepiglottic length (7.28 and 7.21 cm, respectively) compared with that of normal and nonentrapped horses (8.56 and 8.74 cm, respectively).^{5,6}

Surgical correction of epiglottic entrapment has been described using laser-facilitated axial division, transnasal or transoral axial division using a curved bistoury, transendoscopic electrosurgical axial division, or surgical excision through laryngotomy or pharyngotomy.^{4,7-10} The most common complications include reentrapment, which occurs in 4% to 15% of horses, and dorsal displacement of the soft palate, which occurs in 10% to

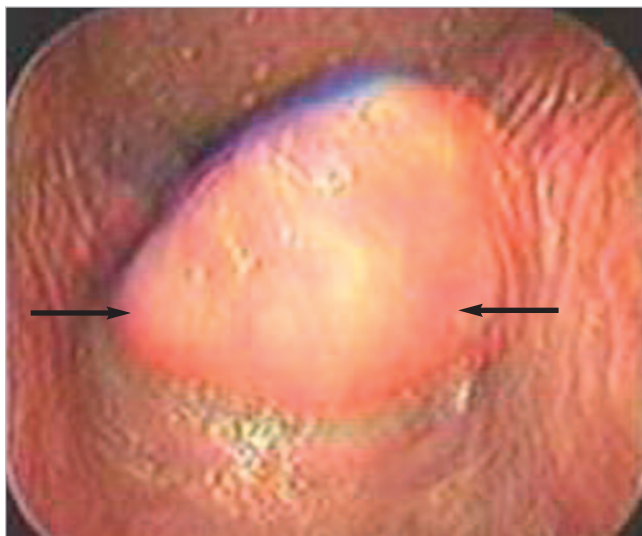


Figure 3. Epiglottic retroversion is a dynamic upper respiratory disturbance that results in occlusion of the rima glottidis by the epiglottis (arrows); therefore, it can be observed only during high-speed treadmill videoendoscopy.

15% of horses.^{7,8} Noteworthy complications associated with the axial division techniques are soft palate division and epiglottic or pharyngeal lacerations.⁷⁻⁹ Excessively thickened, ulcerated, or fibrotic-appearing entrapped membranes are usually combined with severe epiglottic hypoplasia. These horses are generally poor candidates



Figure 4. Subepiglottic cyst. A large cyst (arrow) is present ventral to the epiglottis within the subepiglottic tissue.

unknown, but local anesthesia of the genioid muscle and the hypoglossal nerves within the guttural pouch has resulted in experimentally induced epiglottic retroversion during exercise.¹² Trauma, inflammation, or loss of motor function to the hyoepiglotticus or genioid muscle may precede epiglottic retroversion.¹¹ Currently,

Subepiglottic cysts are infrequent causes of upper respiratory tract noise and exercise intolerance in horses. With subepiglottic cysts, the upper respiratory noise occurs on inspiration and expiration during exercise.

for axial aryepiglottic division; however, surgical excision of the central one-third of the aryepiglottic membrane via laryngotomy can be beneficial.⁸

EPIGLOTTIC RETROVERSION

Epiglottic retroversion is a rare inspiratory condition in which the epiglottis regresses into the rima glottidis opening during inspiration and returns to its normal position during expiration¹¹ (Figure 3). Because this is a dynamic upper respiratory disorder, videoendoscopic high-speed treadmill examination is required to confirm the diagnosis. The etiology of epiglottic retroversion is

there is no good treatment for this condition. Case reports have included the use of polytetrafluoroethylene (Teflon) paste in two horses, with a 50% success rate.¹¹

SUBEPIGLOTTIC CYSTS

Subepiglottic cysts are infrequent causes of upper respiratory tract noise and exercise intolerance in horses.¹³ With subepiglottic cysts, the upper respiratory noise occurs on inspiration and expiration during exercise. The cysts are thought to be a remnant of the thyroglossal duct but may also result secondary to inflammation or trauma.¹³ During resting endoscopy, the cyst is usu-

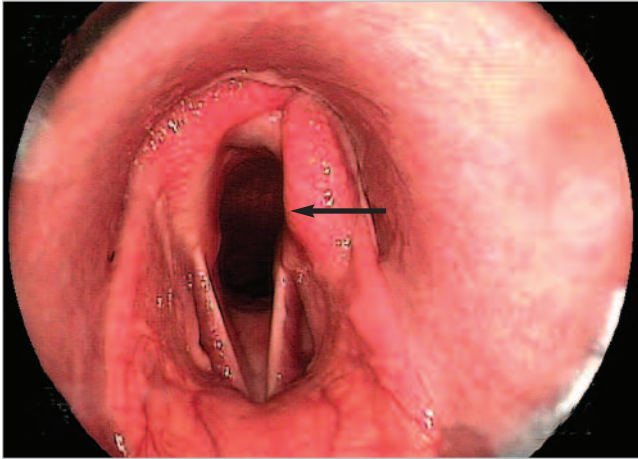


Figure 5. Recurrent laryngeal neuropathy (RLN). Grade 4 left RLN is present. The right corniculate process of the arytenoid cartilage is fully abducted, while the left corniculate process (arrow) of the arytenoid cartilage is drawn axially into the airway, resulting in a reduced rima glottidis cross-sectional area.

ally located dorsal to the soft palate within subepiglottic tissue (Figure 4). The cyst may be loosely attached and can intermittently disappear beneath the soft palate; swallowing usually replaces the cyst under the epiglottis. Radiography may be used to further define the location and size of the cyst. In some cases, a diagnosis can be difficult to make, necessitating oral digital palpation

Fifty percent to 75% of racehorses treated for laryngoplasty have improved performance after surgery, whereas 75% to 90% of nonracehorses treated for laryngoplasty perform at, or higher than, presurgery levels.

with the patient under general anesthesia to confirm the lesion. Treatment options include excision of the cyst through laryngotomy or an oral approach using either a transendoscopic laser or an electrocautery snare.¹⁴ Regardless of which treatment is pursued, the entire cystic lining must be removed to prevent cyst redevelopment. The prognosis after surgery is good, with most horses returning to athletic performance.¹⁴

EPIGLOTTITIS

Epiglottitis causes edema, reddening, and thickening of the epiglottis and aryepiglottic folds. Severe cases result in epiglottic mucosa erosion and exposure of the

epiglottic cartilage tip. Epiglottitis is diagnosed via resting endoscopy. The etiology is unknown, but clinical signs include respiratory noise and exercise intolerance or coughing in racehorses. Treatments include discontinuation of exercise and administration of topical sprays containing antimicrobials and antiinflammatories as well as systemic antimicrobials and antiinflammatories for 10 to 14 days.¹⁵ The prognosis for returning to performance is good; however, long-term complications from epiglottitis can include epiglottic deformity, intermittent or persistent dorsal displacement of the soft palate, and epiglottic entrapment.¹⁵

DORSAL EPIGLOTTIC ABSCESS

Dorsal epiglottic abscess is a rare disorder with an unknown etiology and has been reported in a small number of racing Thoroughbreds.^{16,17} Endoscopically, this disorder features smooth, round swelling along the dorsal aspect of the epiglottic cartilage. The abscess can be incised and drained transendoscopically using a laser and then debrided using bronchoesophageal grasping forceps.¹⁶ The prognosis for a dorsal epiglottis abscess is favorable.¹⁶

SUBEPIGLOTTIC GRANULOMAS

Subepiglottic granulomas are thought to originate from aryepiglottic fold ulceration along the ventral aspect of the epiglottis as a result of chronic inflammation or

infection.¹⁸ Granulomas can typically be resolved by administering topical sprays containing antimicrobials and antiinflammatories as well as systemic antimicrobials and antiinflammatories for 10 to 14 days; in addition, the patient should rest for 4 to 6 weeks.¹⁸ Transendoscopic laser excision of the granuloma may be required in cases that do not respond to medical therapy.¹⁸

RECURRENT LARYNGEAL NEUROPATHY

Recurrent laryngeal neuropathy (RLN) is an inspiratory disorder characterized by the inability to fully abduct the corniculate process of an arytenoid cartilage (usually the left side). As a result of increased negative luminal

Box 1. Subjective Arytenoid Cartilage Movement Grades for Horses

Grade 1—There is symmetric, synchronous abduction and adduction of the left and right arytenoid cartilages.

Grade 2—There is some asynchronous movement (hesitation, flutter, or abductor weakness) of the left arytenoid cartilage during any phase of respiration. Full abduction of the left arytenoid cartilage can be maintained by swallowing or nasal occlusion.

Grade 3—There is asynchronous movement (hesitation, flutter, or abductor weakness) of the left arytenoid cartilage during any phase of respiration. Full abduction of the left arytenoid cartilage cannot be induced and maintained by swallowing or nasal occlusion.

Grade 4—There is no substantial movement of the left arytenoid cartilage during any phase of respiration.

pressure that occurs during exercise, the affected arytenoid cartilage and associated vocal fold are drawn axially into the airway, causing the rima glottidis cross-sectional area to decrease¹⁹ (Figure 5). Consequently, horses with RLN develop exercise intolerance, decreased inspiratory flow, increased respiratory resistance, hypercapnia, hypoxemia, metabolic acidosis, and excessive inspiratory noise.^{19–21}

A recent study showed that 15% of horses diagnosed with RLN had worsening of laryngeal function over a median period of 12 months, indicating that RLN is a progressive disease.²² Progressive dysfunction of large myelinated left recurrent laryngeal nerve fibers prevents appropriate cricoarytenoideus dorsalis muscle contraction and results in failure to abduct the corniculate process of the arytenoid cartilage during inhalation.^{19–21,23,24} Because most of the intrinsic laryngeal musculature is innervated by the left recurrent laryngeal nerve, neurogenic atrophy of these muscles eventually occurs, resulting in loss of both abductor and adductor arytenoid function; therefore, the inspiratory and expiratory pressures become similar.^{19,25}

Recurrent laryngeal nerve damage can result from a perivascular injection intended for the jugular vein, guttural pouch mycosis, trauma from injuries or surgical procedures of the neck, strangles abscesses of the head or neck, and impingement by neoplasms of the neck or chest.¹⁸ Organophosphate toxicity, plant poisoning, lead toxicity, and central nervous system diseases have also been shown to cause RLN.¹⁸ Most RLN cases are idiopathic and involve large-breed horses, although this upper

respiratory disorder can affect any breed of horse. RLN is more common in horses older than 2 years that are training or actively performing. It has been reported that 25% of yearling Thoroughbreds have RLN that is significantly associated with decreased racing performance.²⁶

Horses with RLN have a history of an inspiratory noise characterized as a whistle or a “roar” and exercise intolerance. The noise is the result of air turbulence created as air passes over the affected vocal cord and ventricle, which act as a resonator. A four-grade endoscopic laryngeal grading system is used to describe arytenoid cartilage activity at rest²⁷ (Box 1). If there is a question about the degree of arytenoid abduction, endoscopy immediately after exercise or videoescopy during high-speed treadmill exercise should be performed. In advanced stages, especially in lean horses, it is possible to palpate cricoarytenoideus dorsalis muscle atrophy associated with the affected arytenoid cartilage.

Treatments for RLN include laryngoplasty, ventriculectomy, ventriculocordectomy, partial arytenoidectomy, and neuromuscular–pedicle grafts.^{19–21,23,24,28,29} Laryngoplasty (“tie-back”) is the placement of a suture prosthesis between the cricoid cartilage and muscular process of the affected arytenoid cartilage. This prosthesis mimics cricoarytenoideus dorsalis muscle contraction, allowing permanent abduction of the corniculate process of the arytenoid cartilage. Successful laryngoplasty returns airflow mechanics to normal during exercise.¹⁹ Using strict criteria,^b it is realistic to expect that 50% to 70% of racehorses treated with laryngoplasty will have improved performance after surgery.^{24,28} Some horses (i.e., sport horses) can tolerate RLN and work to capacity despite upper airway obstruction; therefore, the success rate is higher (75% to 90%) for horses involved in nonracing activities.^{20,24,30} Potential complications associated with laryngoplasty include seroma formation, infection, suture failure or pull-out, coughing, dysphagia, and aspiration pneumonia.

Ventriculectomy (removal of the mucosal lining of the laryngeal ventricle) or ventriculocordectomy (removal or ablation of the vocal cord and the ventricle) is usually performed in conjunction with laryngoplasty to help further reduce inspiratory noise; however, neither of these procedures performed alone improves upper respi-

^bRace records (i.e., number of starts, earnings, and racing class according to The Jockey Club and the United States Trotting Association) before and after surgery, and date of horse’s first start after surgery.

ratory airflow mechanics.³¹ Bilateral ventriculocordectomy alone effectively reduces inspiratory noise in horses with experimentally induced RLN by 90 days following surgery but does not return the upper respiratory airflow mechanics to baseline values.³² Because of these findings, bilateral ventriculocordectomy can be recommended as a surgical treatment of RLN if reduction of respiratory noise is the primary objective of surgery. It was shown that unilateral laser vocal cordectomy alone does not effectively reduce upper airway noise in horses with experimentally induced RLN and does not return the upper respiratory airflow mechanics to baseline values.³³ Because of these findings, unilateral laser vocal cordectomy cannot be recommended to treat upper airway noise in horses with RLN.³³

Laryngoplasty failure can be corrected by either repeat laryngoplasty or partial arytenoidectomy (see following Arytenoid Chondritis section), depending on the surgeon's preference.^{34,35} Occasionally, partial arytenoidectomy can be used as a primary treatment of RLN when there is a congenital cartilage malformation.³⁵

The neuromuscular–pedicle graft technique entails creating a pedicle graft involving the first cervical nerve and the omohyoideus muscle and implanting the entire graft into the affected cricoarytenoideus dorsalis muscle.²⁹ The first cervical nerve and omohyoideus muscle are used to make the graft because of their proximity to the larynx and because the first cervical nerve depolarizes during inspiration, resulting in cricoarytenoideus

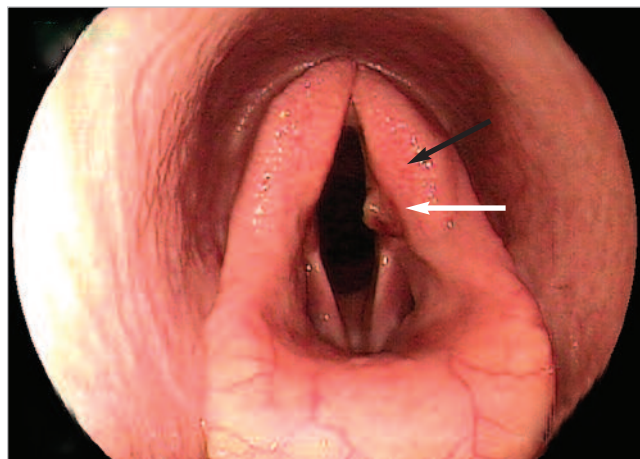


Figure 6. Arytenoid chondritis. Mild disfigurement of the left corniculate process (*black arrow*) of the arytenoid cartilage is present. In addition, granulation tissue (*white arrow*) along the medial surface of the corniculate process of the arytenoid cartilage marks the entrance to a fistula. During inspiration, this condition can cause the arytenoid cartilage to function as it does in RLN.

ARYTENOID CHONDRITIS

Arytenoid chondritis is a progressive inflammatory process involving the laminar portion of the arytenoid cartilage, resulting in a laryngeal space-occupying mass that produces an inspiratory noise and exercise intolerance.^{23,34,36,37} Characteristic resting endoscopic signs of arytenoid chondritis include a small sinus tract or granulation tissue that protrudes into the airway from the

Partial arytenoidectomy can be used to successfully manage recurrent laryngeal neuropathy, arytenoid chondritis, or failed laryngoplasty.

dorsalis muscle contraction after reinnervation.²⁹ Reinnervation is usually clinically evident approximately 4 to 6 months after surgery, although horses can take up to 12 months to show evidence of successful reinnervation.¹⁸ If no arytenoid abduction is observed 9 months after surgery, the chance of reinnervation is small.¹⁸ Because of the length of time required for reinnervation to occur, horses that are best suited for the neuromuscular–pedicle graft technique include young horses with grade 3 laryngeal hemiplegia when immediate return to performance is not necessary.²⁹ In addition, horses that have had a previous laryngoplasty are not candidates for this procedure.¹⁸

affected arytenoid cartilages³⁷ (Figure 6). The corniculate process of the arytenoid cartilage is usually distorted, resulting in decreased arytenoid cartilage abduction, axial displacement of the arytenoid cartilage, and rostral displacement of the palatopharyngeal arch.³⁷ In chronic cases of arytenoid chondritis, laryngeal radiographs usually reveal variable amounts of arytenoid, cricoid, and thyroid cartilage mineralization.^{34,36} The etiology of arytenoid chondritis is unknown, and the condition most often occurs unilaterally.¹⁸ At comparable levels of exercise, horses with arytenoid chondritis have lower inspiratory pressures and higher expiratory pressures than horses with RLN, suggesting that arytenoid

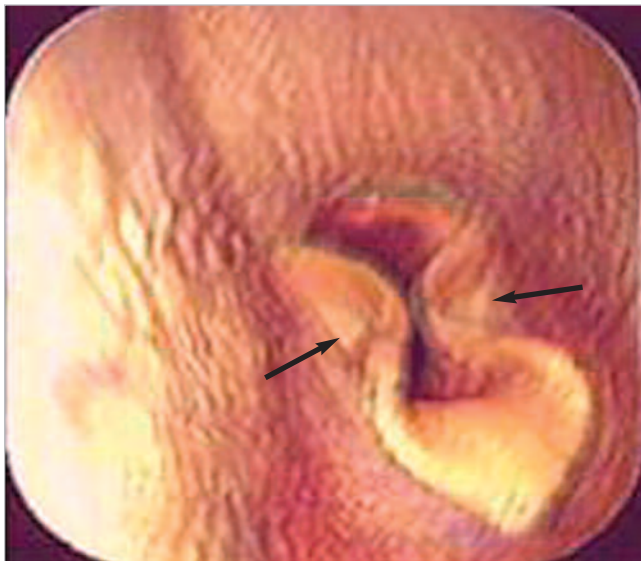


Figure 7. Axial deviation of the aryepiglottic folds. A severe case of bilateral axial deviation of the aryepiglottic folds. The membranous portions (arrows) of the aryepiglottic folds are deviated axially, resulting in a dynamic upper respiratory tract obstruction.

chondritis is more of a fixed type of airway obstruction with minimal or no dynamic collapse.²⁵

Early and mild cases of arytenoid chondritis may respond to medical management, including rest and topical and systemic antibiotics and antiinflammatories. Small granulomas that protrude into the airway can be removed using transendoscopic laser ablation.³⁷ Because laser ablation may provide only temporary resolution in performance horses, most cases of arytenoid chondritis with granuloma recurrence require surgical removal of the affected arytenoid cartilage using partial arytenoidectomy. This procedure involves removal of the corniculate process and the body of the arytenoid cartilage, leaving only the muscular process of the arytenoid cartilage intact.³⁴ The goal of a partial arytenoidectomy is to improve the airway geometry by increasing the cross-sectional area of the rima glottidis and preventing dynamic collapse of unsupported structures.³⁴ Partial arytenoidectomy improves upper airway function in horses with experimentally induced RLN; however, airflow mechanics in these horses indicate that airflow rates are submaximal during exercise.²³ Although the procedure does not completely restore the upper airway to normal, partial arytenoidectomy is a viable treatment option for failed laryngoplasty and arytenoid chondropathy.²³ Of horses that undergo unilateral partial ary-

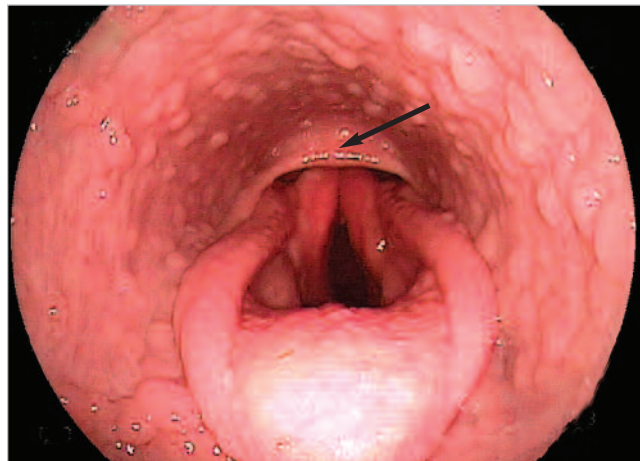


Figure 8. Rostral displacement of the palatopharyngeal arch. The caudal margin of the ostium intrapharyngeum (arrow) is displaced rostral to the corniculate processes of the arytenoid cartilages. Note the lymphoid hyperplasia, which is commonly seen in young horses.

tenoidectomy, 60% to 78% return to racing after surgery.^{34,35} Of nonracehorses that undergo the procedure, 75% return to their previous use.³⁴ Bilateral arytenoidectomy should not be performed because it has only a 22% success rate for return to expected levels of performance,³⁴ and these horses may be at more risk for developing aspiration pneumonia. Alternatively, permanent tracheostomy can be performed in horses that would require bilateral arytenoidectomy.

AXIAL DEVIATION OF THE ARYEPIGLOTTIC FOLDS

Axial deviation of the aryepiglottic folds is an inspiratory disorder that occurs during strenuous exercise; therefore, diagnosis of this upper respiratory disorder must be made using high-speed treadmill videendoscopy. During axial deviation of the aryepiglottic folds, the membranous portion of the aryepiglottic fold, which extends between the corniculate process of the arytenoid cartilage and the lateral edge of the epiglottis, deviates axially, resulting in a dynamic upper respiratory tract obstruction³⁸ (Figure 7). This condition typically occurs bilaterally; however, the right side is more commonly affected in unilateral cases.³⁸ Abnormal respiratory noise and exercise intolerance are the most common clinical manifestations. The etiology is unknown; however, immaturity or fatigue may play a role in the pathogenesis.³⁸ Transendoscopic laser excision of the collapsing tissue (typically a 2-cm-wide tri-

angle section) can be performed in standing or anesthetized horses, whereas young horses without other upper respiratory disorders may benefit from long periods of rest.³⁸ In a retrospective study of axial deviation of the aryepiglottic folds, owners and trainers subjectively thought more horses improved following surgical intervention than horses that were treated with rest alone.³⁸

ROSTRAL DISPLACEMENT OF THE PALATOPHARYNGEAL ARCH

Rostral displacement of the palatopharyngeal arch is a congenital disorder in which the caudal margin of the ostium intrapharyngeum is displaced rostral to the corniculate processes of the arytenoid cartilages (Figure 8). This deformity has been described as cricopharyngeal-laryngeal dysplasia because it can occur in conjunction with thyroid cartilage abnormalities, absence of the cricopharyngeus muscles, and a variety of intrinsic laryngeal muscle abnormalities.³⁹ A developmental abnormality of the fourth branchial arch has been proposed as the cause of the anatomic abnormalities of the thyroid cartilage and the laryngeal muscles, which can be affected unilaterally or bilaterally.⁴⁰ Endoscopically, affected horses typically appear to have right RLN, and the effects of this syndrome depend on the severity of the associated deformities.¹⁸ Surgical treatment is generally unrewarding,^{39,40} but right partial arytenoidectomy may be beneficial.¹⁸

CONCLUSION

Many different laryngeal and pharyngeal respiratory disorders restrict normal amounts of airflow through the rima glottidis, preventing adequate oxygenation during exercise. Careful physical, endoscopic, and radiographic examinations are crucial components when evaluating athletic horses with abnormal upper respiratory noise, exercise intolerance, and poor performance. Although most of the common laryngeal disorders can be well defined and understood by using resting and postexercise endoscopy, high-speed treadmill videoendoscopy may be necessary to detect subtle and vague dynamic laryngeal disorders. In addition to clinicians understanding upper respiratory airflow mechanics and physiology, an accurate diagnosis and appropriate treatment regimen are necessary to provide horses with the best chance of regaining full athletic potential.

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ARTICLE #1 CE TEST



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1. **Which intrinsic laryngeal muscle provides arytenoid abduction by drawing the dorsomedial margins of the arytenoid cartilages together?**
 - a. the cricoarytenoideus lateralis
 - b. the arytenoideus transversus
 - c. the thyroarytenoideus
 - d. the cricoarytenoideus dorsalis
2. **Which intrinsic laryngeal muscle is not innervated by the recurrent laryngeal branch of the vagus nerve?**
 - a. the cricoarytenoideus dorsalis
 - b. the arytenoideus transversus
 - c. the cricothyroideus
 - d. the thyroarytenoideus
3. **A remnant of the thyroglossal duct is thought to cause**
 - a. dorsal epiglottic abscessation.
 - b. subepiglottic granulomas.
 - c. epiglottitis.
 - d. subepiglottic cysts.
4. **Alone, which recommended treatment for RLN does not improve upper airway noise or return the upper respiratory airflow mechanics to baseline values?**
 - a. laryngoplasty
 - b. bilateral ventriculocordectomy

- c. unilateral laser vocal cordectomy
- d. none of the above

5. Laryngoplasty failure can be corrected by

- a. partial arytenoidectomy.
- b. ventriculectomy.
- c. bilateral ventriculocordectomy.
- d. unilateral laser vocal cordectomy.

6. What is the approximate success rate of partial arytenoidectomy in treating arytenoid chondritis in a racing Thoroughbred?

- a. 20% to 30%
- b. 40% to 50%
- c. 60% to 80%
- d. 85% to 95%

7. Which upper airway disturbance is thought to be caused by a developmental abnormality of the fourth branchial arch?

- a. a subepiglottic cyst
- b. axial deviation of the aryepiglottic folds
- c. epiglottic retroversion
- d. rostral displacement of the palatopharyngeal arch

8. Which nerve/muscle combination is used when performing a neuromuscular–pedicle graft to treat RLN?

- a. hypoglossal nerve/hyoepiglotticus muscle
- b. first cervical nerve/omohyoideus muscle
- c. external branch of the cranial laryngeal nerve/cricothyroideus muscle
- d. external branch of the cranial laryngeal nerve/thyrohyoideus muscle

9. Which of the following is not a complication of surgical correction of epiglottic entrapment?

- a. reentrapment
- b. dorsal displacement of the soft palate
- c. laceration of the epiglottis
- d. epiglottic retroversion

10. Which of the following disorders results in distortion of the corniculate process of the arytenoid cartilage, causing decreased arytenoid cartilage abduction, axial displacement of the arytenoid cartilage, and rostral displacement of the palatopharyngeal arch?

- a. axial deviation of the aryepiglottic folds
- b. rostral displacement of the palatopharyngeal arch
- c. arytenoid chondritis
- d. dorsal epiglottic abscessation