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Laryngeal Hemiplegia in Horses (Roaring) – Anatomical Basis and Surgical Correction

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Introduction

In the world of equine athletes and companions, a clear and unobstructed airway is paramount for optimal performance and overall well-being. **Laryngeal hemiplegia**, commonly known as "roaring," is a significant upper airway disorder in horses that can severely impact their respiratory efficiency, particularly during exercise. This condition arises from the paralysis of the laryngeal muscles, most frequently due to damage or dysfunction of the **recurrent laryngeal nerve**. Understanding the intricate anatomy of the equine larynx and the pathology behind this condition is crucial for accurate diagnosis and effective management. This article will explore the anatomical basis of roaring, its clinical manifestations and the various surgical and non-surgical approaches to treatment.

The Equine Larynx: A Vital Airway Guardian

The **larynx**, often referred to as the "voice box," is a complex and highly specialized cartilaginous structure located at the cranial end of the trachea, just below the pharynx, in the upper part of the horse's neck. It serves as a critical gateway for air entering the lungs and plays a vital role in several physiological processes.

The larynx is a sophisticated movable framework composed of several key cartilages, muscles and soft tissue structures. Its principal cartilaginous components include:

- **Epiglottis:** A leaf-shaped cartilage positioned at the rostral aspect of the larynx, which folds back over the entrance to the trachea during swallowing to prevent aspiration.
- **Thyroid Cartilage:** The largest cartilage, forming the ventral and lateral walls of the larynx, providing a protective casing.
- **Cricoid Cartilage:** A ring-shaped cartilage forming the caudal and dorsal part of the larynx, connecting it to the trachea.
- **Arytenoid Cartilages:** Paired, pyramid-shaped cartilages located dorsally on the cricoid cartilage. These are particularly critical in roaring, as their movement is essential for airway patency. The **muscular process** of the arytenoid cartilage is the attachment point for muscles responsible for its movement.
- **Vocal Folds (Vocal Cords):** Two folds of mucous membrane that extend from the arytenoid cartilages to the thyroid cartilage. They vibrate to produce sound and are involved in airway regulation.
- **Laryngeal Ventricles (Saccules):** Small pouches or diverticula located lateral to the vocal folds, which can contribute to airway obstruction if inflamed or everted.

The coordinated movement of these structures, particularly the abduction (opening) of the arytenoid cartilages and vocal folds, is essential for unrestricted airflow, especially during the inspiratory phase of respiration.

The Recurrent Laryngeal Nerve

The vast majority of the intrinsic muscles of the larynx, responsible for its crucial functions, are innervated by the **recurrent laryngeal nerve (RLN)**. This nerve is a significant branch of the **vagus nerve (Cranial Nerve X)**, which is a major component of the parasympathetic nervous system. While the vagus nerve has a wide range of functions, its laryngeal branches are specifically dedicated to controlling the intricate movements of the larynx.

There are two recurrent laryngeal nerves: the left and the right. Their anatomical courses differ significantly, which has important implications for the prevalence of laryngeal hemiplegia:

- **Right Recurrent Laryngeal Nerve:** At the level of first rib, it originates from the vagus nerve and loops around the right subclavian artery before ascending the neck to innervate the laryngeal muscles.
- **Left Recurrent Laryngeal Nerve:** Originates from the vagus nerve near the base of the heart. Crucially, it has a much longer and more tortuous course, looping around the arch of the aorta before ascending the neck. This extended pathway, particularly its close association with the ventral aspect of the esophagus and major vessels, makes the left RLN more susceptible to injury or degeneration. Consequently, **left-sided laryngeal hemiplegia is overwhelmingly more common in horses** than right-sided or bilateral forms.

The recurrent laryngeal nerve is solely responsible for supplying all intrinsic muscles of larynx except the cricothyroideus muscle (which is innervated by the external laryngeal nerve, another branch of the vagus). It also provides sensory innervation to the laryngeal mucosa caudal to the vocal folds. The primary muscle affected in recurrent laryngeal hemiplegia is the **cricoarytenoideus dorsalis (CAD) muscle**, which is the sole abductor (opener) of the arytenoid cartilage.

Recurrent Laryngeal Hemiplegia: The "Roaring" Phenomenon

Recurrent laryngeal neuropathy or recurrent laryngeal hemiplegia is the most important cause of upper airway obstruction in horses. It is often considered an idiopathic condition. The major cause of recurrent laryngeal neuropathy is associated with length of recurrent laryngeal nerve and is more frequent in large horses. The left side of the larynx is most invariably affected as the left nerve is longer and also due to its association with the ventral aspect of oesophagus and possible mechanical injury. Hemiplegia laryngis' is the condition of damage or degeneration of the recurrent laryngeal nerve leading to the paralysis of muscles controlling arytenoid cartilages on that side. This paralysis prevents the arytenoid cartilage from fully abducting during inhalation. This is characterised with paralysis of one or both sides of the larynx with atrophy of the innervated muscles and is clinically characterised by typical inspiratory stenotic sounds - 'whistling' or 'roaring'. This can lead to impaired vocalization and breathing difficulty during exercise. The other causes include infection such as guttural pouch mycosis or equine protozoal myelopathy, trauma (including perivascular injection of irritant substances during jugular- vein injection) and toxicoses.

Diagnosis: Unmasking the Roar

Laryngeal hemiplegia in horses is diagnosed primarily through clinical signs and endoscopic examination of the larynx specifically observing the movement of arytenoid cartilages and vocal folds during respiration. Before undertaking any diagnostic techniques it is advisable to listen to the horse during exercise for ‘whistling’ or ‘roaring’ sound.

1. **Auscultation and Palpation:**
    - **Listening for the Roar:** The first step often involves listening to the horse during exercise, ideally while being ridden or lunged at a canter or gallop on both reins. The characteristic inspiratory "whistle" or "roar" is usually evident. Some horses may also grunt on forced

expiration due to the inability to adduct the vocal cords properly.

- **Laryngeal Palpation:** Experienced clinicians can palpate the larynx from the dorsal aspect, sliding fingers under the sternomandibularis muscle to compare the two sides. In cases of significant muscular atrophy, the process on the affected arytenoid cartilage may feel sharper and more prominent compared to the smooth rounding of the normal side.
- **Slap Test:** While not definitive, the "slap test" can provide supportive evidence. A quick, firm slap to the horse's flank typically elicits a reflex adduction (closure) of the contralateral arytenoid cartilage. A diminished or absent response on one side suggests neurological dysfunction.

2. **Endoscopic Examination:**
   - **Resting Endoscopy:** This is the primary diagnostic tool. A flexible endoscope is passed into the horse's nasal passages to visualize the larynx at rest. The movement of the arytenoid cartilages and vocal folds is observed during quiet respiration. Various grading systems (e.g., Grades I-IV) are used to classify the severity of arytenoid movement and asymmetry [1]. Grade IV indicates complete paralysis with no abduction.
   - **Dynamic (Treadmill or Overground) Endoscopy:** In some cases, particularly where the diagnosis is ambiguous at rest, or if the signs are intermittent and only apparent during exercise, dynamic endoscopy is performed. The horse is examined while exercising on a high-speed treadmill or with an overground endoscopy system. This allows for a complete assessment of laryngeal function under physiological stress, revealing subtle dynamic obstructions not apparent at rest.

Treatment: Restoring Airflow

Surgery is the only possible treatment for even a partial recovery of a horse. The most frequent treatment is prosthetic laryngoplasty also known as tie back surgery. Other surgical options include ventriculectomy and cordectomy, arytenoidectomy and neuromuscular pedicle graft, but these are fewer common methods.

Surgical methods

Prosthetic Laryngoplasty (Tie-back Surgery):

This is the most common surgical treatment and involves placing a suture to hold the paralysed arytenoid cartilage in an open position, effectively widening the airway.

Ventriculocordectomy:

This involves removing portions of the laryngeal saccules and vocal fold which can sometimes contribute to airway obstruction.

Arytenoidectomy:

This is typically performed when laryngoplasty fails and involves removing part of the arytenoid cartilage.

Neuromuscular Pedicle Graft:

This involves transplanting a nerve and muscle graft to improve laryngeal function.

The choice of treatment can depend on the extent of paralysis and the animal's use.Certain breeds like Thoroughbreds may have different success rates with surgery. Many of the surgical treatment involve further complications.

Non-Surgical Management:

Medications:

Medications can be used to manage inflammation and respiratory distress, but they do not address the underlying cause.

Tracheostomy:

In severe cases, a tracheostomy (creating an opening in the trachea) may be necessary to improve breathing, but this is generally a last resort.

Conclusion

Laryngeal hemiplegia is a prevalent condition in horses, particularly in large breeds and performance animals, characterized by paralysis of the muscles controlling the arytenoid cartilage of the larynx. This results in restricted airflow and an

abnormal respiratory noise, "roaring," especially during exercise. The condition can significantly affect a horse's overall performance. While various treatment options are available, mostly successful are surgical interventions like prosthetic laryngoplasty/ tie back surgery. The goal of all treatments is usually to improve, rather than fully restore, airway function. Although many horses show marked improvement after treatment, complete recovery of normal laryngeal function is uncommon. The prognosis depends on the severity of the condition, the type of treatment pursued and the performance expectations for the horse. Therefore, early detection, accurate diagnosis and a well-planned management strategy are critical for optimizing the health, comfort and utility of affected horses. Laryngeal hemiplegia is one of the major cause of lose in horse marketing.

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