USE OF ULTRASOUND AND MRI IN LARYNGEAL DISEASE
Katherine S. Garrett, DVM, DACVS-LA
Rood and Riddle Equine Hospital, Lexington, KY

Key Points
- The information obtained from imaging of the laryngeal region aids in decision making in cases of laryngeal disease.
- Ultrasonography is a valuable part of a complete laryngeal examination and is an inexpensive, non-invasive procedure.
- MRI allows more complete examination of the larynx in some situations but requires general anesthesia and additional cost.

Laryngeal disease is a common cause of equine upper airway dysfunction. Although initial evaluation of the larynx is typically performed during a resting endoscopic examination, resting endoscopy has limitations. Laryngeal ultrasound and magnetic resonance imaging (MRI) can offer additional diagnostic information in cases of laryngeal disease, both from a structural and functional standpoint.

Image Acquisition

Ultrasonography of the larynx can be performed using standard ultrasound equipment suitable for musculoskeletal examinations. A 7-10 megahertz linear or microconvex transducer provides good resolution and adequate penetration. Sedation is often necessary, as it facilitates patient cooperation and relaxation to allow extension of the head permitting access to the laryngeal region. The hair can be clipped or soaked with isopropyl alcohol. The larynx is imaged from the lateral, dorsolateral, and ventral aspects. The lateral window allows evaluation of the arytenoid cartilages, thyroid cartilage, cricoid cartilage, cricoarytenoideus lateralis muscle, and vocalis muscle in longitudinal and transverse planes. By moving the ultrasound transducer to a dorsolateral window by moving slightly dorsally and angling slightly ventrally, the lateral portion of the cricoarytenoideus dorsalis muscle is imaged. From the ventral window, the basihyoid bone, vocal folds, thyroid cartilage, and cricoid cartilage are imaged.

Magnetic resonance imaging usually requires general anesthesia as the design of standing magnets does not permit positioning of the laryngeal region within the magnet for most equine patients. Positioning of the horse in dorsal recumbency is often easier than lateral recumbency. A body coil may be used, but a surface coil is preferred and will result in superior image quality. Images are obtained in the transverse, dorsal, and median planes using a combination of T1 weighted, T2 weighted, proton density weighted and short tau inversion recovery (STIR) sequences. A more complete anatomic evaluation of the entire laryngeal region is possible with MRI as compared to ultrasound.

Recurrent Laryngeal Neuropathy

The most common cause of left laryngeal hemiplegia is recurrent laryngeal neuropathy leading to dysfunction of the cricoarytenoideus dorsalis, cricoarytenoideus lateralis, vocalis, and ventricularis muscles. Ultrasonographically, in horses affected with recurrent laryngeal neuropathy, the cricoarytenoideus dorsalis, cricoarytenoideus lateralis, and vocalis muscles appear hyperechogenic as compared to the unaffected side. The ventricularis muscle is often difficult to image due to its more rostral anatomic location.
In a group of horses undergoing treadmill upper airway endoscopy, a hyperechogenic appearance of the left cricoarytenoideus lateralis muscle (as compared to the right cricoarytenoideus lateralis muscle) had a sensitivity of 90% and a specificity of 98% in predicting incomplete left arytenoid abduction, supporting its use as an adjunctive tool in the diagnosis of recurrent laryngeal neuropathy.\(^1\) This technique is particularly useful in horses with Havemeyer grade II or III resting arytenoid movement when dynamic endoscopy is not performed and treatment decisions are not clear-cut.

![Figure 1: Dorsal plane ultrasound images of the left (A) and right (B) sides of the larynx of a horse with left recurrent laryngeal neuropathy. Rostral is to the left of the images. The left cricoarytenoideus lateralis and vocalis muscles (arrows) are hyperechogenic as compared to the same muscles on the right side.](image)

**Figure 1:** Dorsal plane ultrasound images of the left (A) and right (B) sides of the larynx of a horse with left recurrent laryngeal neuropathy. Rostral is to the left of the images. The left cricoarytenoideus lateralis and vocalis muscles (arrows) are hyperechogenic as compared to the same muscles on the right side.

**Arytenoid Chondritis**

Although arytenoid chondritis is often obvious during resting upper airway endoscopy, endoscopy does not permit complete evaluation of the arytenoid cartilages. Ultrasonography allows examination of more of the arytenoid cartilage, including the interior and the lateral aspect. Normal arytenoid cartilages should have a characteristic “trumpet” shape with uniform echogenicity and smooth margins. Chondritic arytenoid cartilages are enlarged with irregular margins and abnormal echogenicity. Additional findings include peri-laryngeal or intra-cartilage abscessation, tracts extending from the luminal surface of the arytenoid cartilage, and axial mass lesions.

The diagnosis of arytenoid chondritis is not always obvious during resting endoscopy. Some horses have equivocal arytenoid cartilage thickening endoscopically in the face of dramatic change ultrasonographically, while others have large axial arytenoid masses that ultrasonographically do not involve the body of the arytenoid cartilage and consist only of the mass. The additional information about the arytenoid cartilage gained from ultrasonography can significantly impact treatment decisions (e.g. decision for arytenoidectomy versus resection of a luminal mass). Clinically, ultrasound allows monitoring of the progression of chondritis after medical therapy and resolution of any peri-laryngeal or intra-cartilage abscessation. If horses are affected bilaterally and are candidates for arytenoidectomy, ultrasound can determine which arytenoid cartilage is enlarged to a greater degree, which can be difficult to determine based on endoscopy alone.
Laryngeal Dysplasia

Anatomic malformations of the larynx have the potential to cause a wide spectrum of clinical signs. While fourth branchial arch abnormalities have classically been thought of as causing right-sided laryngeal hemiplegia and rostral displacement of the palatopharyngeal arch, they can also cause left-sided laryngeal hemiplegia or dorsal displacement of the soft palate in the absence of the classic clinical signs. Horses may be affected on either the left or the right sides, symmetrically or asymmetrically. Both ultrasonography and MRI can demonstrate the characteristic malformations including a lack of cricothyroid articulation, dorsal extension of the thyroid lamina, and varying degrees of pharyngeal muscle abnormalities. Although MRI requires general anesthesia and is considerably more expensive than is ultrasonography, it does provide a more complete depiction of the anatomic malformations than is possible with ultrasound alone.

Accurate diagnosis of laryngeal dysplasia is key, especially in cases that present with left-sided laryngeal hemiplegia or dorsal displacement of the soft palate. Knowledge of the underlying disease process is important when recommending treatment and formulating a prognosis in these cases, as surgical intervention may not lead to predictable results or resolution of the clinical signs due to the abnormal anatomy involved. Prior knowledge of the abnormal anatomy also assists with pre-operative surgical planning.

Other anatomic malformations of the larynx distinct from the classic fourth branchial arch abnormality have also been observed. As imaging of the laryngeal region continues to advance, the number of these unusual cases will likely increase.
Figure 3: Dorsal plane ultrasound images of a normal horse (A) and a horse with laryngeal dysplasia (B). Rostral is to the left of the images. The normal horse has a normal cricothyroid articulation (arrow) while the horse with laryngeal dysplasia lacks a cricothyroid articulation and a gap between the thyroid and cricoid cartilages is present (arrow). C: Dorsal plane MRI image of a horse with unilateral laryngeal dysplasia. One cricothyroid articulation is normal (arrow) and the other is absent (arrowhead). Rostral is to the top of the image.

Although many cases of laryngeal dysfunction are straightforward, others are not. Ultrasound and MRI add valuable additional information that can substantially augment the diagnostic work-up and subsequent treatment decisions. For example, abnormal left arytenoid movement is most often caused by recurrent laryngeal neuropathy, but can also be the result of laryngeal dysplasia or arytenoid chondritis. Alternatively, ultrasound can help support a diagnosis of recurrent laryngeal neuropathy. Incorporation of ultrasonography as a routine procedure and use of MRI when indicated should be considered in cases of upper airway dysfunction.

References