

Hear Big Donna Roar:

Treating Laryngeal Hemiplegia via Arytenoidectomy

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Class of 2022 Clinicopathologic Conference

August 6, 2021

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### ***Introduction:***

Recurrent laryngeal neuropathy (RLN) is a common pathology warranting treatment in high performance horses and is caused by damage to the recurrent laryngeal nerve. Injury to the recurrent laryngeal nerve results in atrophy of the lateral cricoarytenoid muscle, the muscle responsible for abduction of the arytenoid cartilages. Further, the lateral cricoarytenoid muscle affords inward rotation of the arytenoid on the cricoid cartilage, closing the laryngeal airway during deglutition, vocalization, and expiration <sup>1</sup>. RLN results in a full or partial collapse of the arytenoid cartilages into the trachea which clinically is characterized by varying multitudes of exercise intolerance and abnormal respiratory noise referred to as roaring.

### ***History and Presentation:***

An approximately 6-year-old Tennessee Walker Horse mare presented to MSU-CVM Equine Services in anticipation of a partial left arytenoidectomy surgery. She is an athlete who performs often in gaited gallop competitions. Her most recent visit, was a recheck from previous tie back surgery completed 18 months prior. Tie back surgery and recovery were uneventful. As per client, classic roaring/respiratory noises were heard via exercising a year post tie back surgery. Her physical exam upon presentation, was uneventful. She was bright, alert, and responsive and weighed 1020lbs (463.64kg) with a body condition score of a 5 out of 9 (with 5 being considered ideal). All vitals were within normal limits with a rectal temperature of 99.5F, a pulse of 32 beats per minute, a respiratory rate of 22 breaths per minute, and oral mucus membranes were moist and pink with a capillary refill time of less than 2 seconds, indicating adequate hydration. Cardiothoracic auscultation was within normal limits, with no crackles, wheezes, arrhythmias, or murmurs detected. Diffuse bronchovesicular sounds were appreciated. She tested positive for menace response and palpebral reflex. The mare had normal

gastrointestinal motility in all 4 quadrants and all 4 limbs were negative for digital pulses. Both nares were patent, and her coat was clean and smooth and free of abrasions. Upon gentle exercise in the MSU-CVM clinic no roaring or respiratory noises were appreciated. As per client, loud airway noises, such as roaring, have been appreciated under strenuous exercise drills and competition.

***Diagnostic Approach and Considerations:***

Diagnosing laryngeal hemiplegia or roaring requires a multimodal approach and begins with the history of noise making or classical roaring during physical exercise and exercise intolerance for some. Diagnostics utilized to diagnose it include exercise tolerance tests, laryngoscopy via endoscope, and ultrasonography.

Laryngeal hemiplegia is graded on a scale of 1 to 4 via standing endoscopy. “High-speed treadmill endoscopy or over ground dynamic respiratory examination may be necessary to diagnose cases that are questionable on standing endoscopy and can be used to ensure that no other concurrent upper airway problems are contributing to the exercise intolerance or respiratory noise”<sup>5</sup>. Laryngeal ultrasound may be utilized to further evaluate the density of laryngeal muscle fibers to determine if they are correctly innervated<sup>5</sup>. The Havemeyer grading system is the system of choice in grading laryngeal function while at rest. The grading system is performed by full visualization of the arytenoid cartilages via endoscopy. Grade 1 is characterized by synchronous arytenoid cartilage movements and both symmetrical and full arytenoid cartilage abduction which can be achieved and maintained<sup>4</sup>. Grade 2 is characterized by arytenoid cartilage movements that are asynchronous and/or the larynx is asymmetric at times, but full arytenoid cartilage abduction can still be achieved and maintained<sup>4</sup>. Grade 3 is characterized by arytenoid cartilage movements that are asynchronous and/or asymmetric and

full arytenoid cartilage abduction cannot be achieved or maintained<sup>4</sup>. Grade 4 is characterized by complete immobility of the arytenoid cartilage and vocal fold<sup>4</sup>.

In this case endoscopy was diagnostic instrument of choice. A laryngeal endoscopy or upper airway scoping was performed at rest by lubricating the endoscope and inserting it gently and slowly through the left nare while remaining medial to the the ventral meatus and in just rostral to the arytenoid cartilages. This permitted full visualization on the arytenoid cartilages bilaterally. A grade 4 out of 4 left laryngeal hemiplegia was diagnosed.

***Pathophysiology:***

RLN is an equine degenerative disorder of the recurrent laryngeal nerves effecting (particularly) tall breeds such as Thoroughbreds and Drafts. The disease is characterized by preferential degeneration of the left recurrent laryngeal nerves over the right and causes paresis or, in more severe cases, paralysis of the left intrinsic laryngeal muscles which prevent arytenoid movement<sup>2</sup>. Arytenoid movement is vital for enabling unimpeded inspiratory airflow which is why laryngeal nerve paralysis is. Recurrent laryngeal performance limiting in horses performing at their peak exertion such as in racehorses<sup>2</sup>. The mechanisms that lead to the varying severity of degeneration of the left recurrent laryngeal in horses is still largely unknown but numerous risk factors identified include the following: increased horse height (it is still unclear whether height itself is the principal risk factor or simply a covariate for nerve length), male, heritability, mechanical stress, ischemic nerve damage, pressure damage, infectious etiologies, vitamin deficiencies, and/or toxic insults<sup>2</sup>.

***Treatment:***

Treatment choice is dependent on case grade, breed, age and the horse use/job. Currently, four treatment options exist and include the following: prosthetic laryngoplasty (a "tie-back surgery"), ventriculectomy and cordectomy, arytenoidectomy, and neuromuscular pedicle graft <sup>6</sup>. All procedures as per clinician choice may be performed under general or conscious sedation. The tie back is the most common and the first treatment of choice for RLN. The paralyzed cartilage or cartilages is/are essentially "tied back" with suture through an open abducted position through an incision in the throat latch region <sup>5</sup>. The suture will act as a "prosthetic" for the paralyzed muscle <sup>5</sup>. The tie back historically has a high failure rate of 1 to three times risk for failure <sup>5</sup>. Daily physiology of eating, swallowing and breathing increase tension on the sutures which lead to high failure rates. The Ventriculectomy/Cordectomy requires the removal of both the ventricle and vocal cord, widening the airway. This procedure may or may not be performed alone or along with a prosthetic laryngoplasty. The arytenoidectomy involves the unilateral removal of the paralyzed arytenoid cartilage. This permits a full clearance or widen opened to the trachea. The partial arytenoidectomy is the treatment of choice for a failed tie back. This procedure requires direct access via laryngotomy and visualization of the arytenoid cartilages via endoscope. Procedures such as the Ventriculectomy/Cordectomy and arytenoidectomy, which require laryngotomy incisions are often left open to heal by second intention. When no incision is necessary, such as when the laser technique is implemented alongside with the endoscope, access to the arytenoid cartilages is made through the nasal cavity. The Neuromuscular Pedicle Graft re-innervates the muscles controlling abduction of the arytenoid cartilages. The first cervical nerve is taken from one of the bluntly dissected neck muscles and a branch of that nerve is placed in the muscle that innervates the arytenoid cartilage <sup>6</sup>. Young horses with grade 3 hemiplegia are considered the best candidates for this surgery as previous tie back surgeries

leave too much nerve damage and grade 4 laryngeal hemiplegia historically do not respond as well as grade 3 Laryngeal hemiplegia<sup>6</sup>. Re-innervation from neuromuscular pedicle grafts are expected to take 6-12 months for return to function<sup>6</sup>. Given the patients clinical signs of roaring under extreme exercise and previous failed tie back, a partial left arytenoidectomy surgery was warranted and was the best option for treatment.

***Surgery Details:***

A partial left arytenoidectomy surgery was performed. The mare was sedated via intravascularly in right jugular vein via jugular catheter with 15mg Detomidine and 15mg Butorphanol to facilitate the partial left arytenoidectomy. Hair was clipped, and the surgical site prepared with a surgical scrub consisting of ten minutes of 4% chlorohexidine which was wiped off with alcohol via submerged 4x4 gauze. Lidocaine was placed subcutaneously over the right Jugular vein to anesthetize the skin for jugular catheter placement. A catheter was placed (right Jugular vein) and sutured in place. Additionally, a local block was performed to anesthetize the first cervical plexus. The cricoid cartilage was manually palpated to identify and ideal entrance into the larynx via incision utilizing a #10 blade. Muscle bellies of the sternohyoid muscle were identified via ultrasound and the 6.5cm vertical incision was made. The laryngotomy involved a blunt dissection into the trachea. Access to the arytenoid cartilages was made via laryngotomy and visualization was appreciated via scope. Allis tissue forceps were placed posterior to the left arytenoid cartilage and clamped shut. Metzenbaum scissors were utilized to remove the entire left arytenoid cartilage. A hand bur was rotated within the left saccule space and all remaining cartilage was extracted via rongeur. The skin layer was sutured closed partially utilizing 2-0 Monofilament, leaving ~2.5 cm open at the anterior aspect of the initial incision. The remaining open surgical site is expected to heal by second intention and act as a drain. The incision site was

further utilized to access arytenoidectomy surgical site post-surgery for topical pharmaceutical application.

***Post-Operative Management:***

Postoperative care varies depending on surgery performed and may include antibiotic therapy, anti-inflammatories and throat spray. Sutures or staples may need to be removed if an incision was made. Stall rest and time to return to work will vary depending on your surgeon's preference, the surgery performed, and the grade of laryngeal hemiplegia. Recheck evaluations may be required as per surgeon request depending on the procedure performed or complications met.

The mare was managed in the MSU-CVM Equine hospital for a total of six days.. Post operatively, she was managed with the following pharmaceuticals: Ceftriaxone (6.6mg/kg) for 30mls once intramuscularly pre-surgery on 11/17/2020 as an antimicrobial targeted towards gram positive bacteria to reduce risk of infection occurring at the surgical site, Banamine (1.1mg/kg) for 10mls intravenously every 12 hours to decreased pain and inflammation (and switched to orally administration 11/18). She was given this medication beginning 11/17/2020 and ending 11/21/2020 (and continue three days post discharge), Upramoxil (30mg/kg) for 2 scoops twice a day via oral syringe, began 11/17/2020 and ended 11/21/2020 as a broad-spectrum antibiotic used to decrease bacterial infection, Vetera EWT + WNV Vaccine, left neck 11/18/2020 for prevention of disease caused by Eastern and Western equine encephalomyelitis, tetanus, and viremia caused by West Nile virus, Wheat Throat Flush for 10mls twice a day inserted through the throat latch incision and applied directly to arytenoid surgical site via catheter and flushed with 30cc air, began 11/18/2020 and ended 11/21/2020 (and continue until bottle was empty post discharge) given as is a broad-spectrum antibiotic to decrease risk of

bacterial colonization and infection, Salt supplementation via 30cc via syringe mixed with molasses given three times a day to ensure adequate hydration and voluntary water intake. Surgical site maintenance included surgical site cleansing twice daily with warm water and cotton begun immediately post-surgery until date of discharge. Petroleum jelly was then applied both above and below the incision (not in the incision) to inhibit blood accumulation and bacterial colonization. Other considerations, post operatively, included exercise restrictions with strict stall Rest for four weeks, no riding or out on pasture, and halter walks for 10-minute intervals twice a day. Other recommendations included monitor water, feed, and fecal output. Water intake is important to maintain adequate hydration and daily maintenance is 25-30 liters per day. Salt blocks or adding salt to feed was recommended to help stimulate the need to drink. An adequate amount of fecal output is between 8-10 piles of moist looking piles per day. The recommendation was made to contact a veterinarian immediately if there was any observable change in the consistency or number of manure piles, as this could be a sign of abnormal motility or colonic impaction. A recheck appointment was made three weeks post-surgery to evaluate healing and properly adjust home care where warranted.

### **Case Outcome and Prognosis:**

Prognosis depends on the horse's required level of performance and the surgical treatment performed<sup>6</sup>. "Overall success rates range from 50-90%; racehorses and those with a higher demand for airflow have slightly lower success rates while show horses, draft horses, and pleasure horses tend to have higher success rates because the overall demand on the airway is lower as compared to a racehorse"<sup>6</sup>. Arytenoidectomy surgeries are not simplistic surgeries. Consult with an American College of Veterinary Surgeons board-certified equine surgeon will determine the best course of treatment for equids.



The mare returned to the MSU-CVM Equine Department for a post-operative reevaluation 30 days later, where laryngeal hemiplegia was noted to be resolved via a partial left arytenoidectomy. Upon presentation on her post-surgical reevaluation, she continued to be bright, alert, and responsive, weighing 1236lbs with a body condition score of a 5 out of 9. Her vitals were within normal limits with a rectal temperature of 99.5F, a pulse of 40 beats per minute, a respiratory rate of 12 breaths per minute, and oral mucus membranes were moist and pink with a capillary refill time of less than 2 seconds indicating adequate hydration. Cardiothoracic auscultation was within normal limits, with no crackles, wheezes, arrhythmias, or murmurs detected. Diffuse bronchovesicular sounds were appreciated. She tested positive for menace response and palpebral reflex. Normal gastrointestinal motility in all 4 quadrants was appreciated and all 4 limbs were negative for digital pulses. Bilaterally nares were patent and free of discharge, and her coat was clean and smooth and free of abrasions. To more intensely evaluate the surgery site the patient was administered 5 mg Detomidine and 5mg butorphanol intravenously to facilitate examination. An upper Airway endoscopy was performed, and visualization of the surgical site was observed and permitted confirmation of resolved laryngeal hemiplegia clinical signs of trachea obstruction. The surgery site was free of discharge, exuberant granulation tissue, and shows appropriate healing. Continued homecare instructions rendered included increased exercise of small turnouts, clearance for training and riding to begin in 30 days, and placing all food for consumption on the ground to limit the occurrence aspiration for the remainder of life. The laryngeal hemiplegia was resolved via a partial left arytenoidectomy and she continues to do well.

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