Surgical Treatment of Upper Airway Abnormalities in the Equine Athlete

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Once the diagnosis of laryngeal hemiplegia has been made then treatment options need to be considered. There are numerous procedures such as prosthetic laryngoplasty, ventriculocordectomy, reinnervation of the cricoarytenoideus dorsalis muscle (CAD), and arytenoidectomy that are available as treatment options. The choice of surgical procedure will depend on the presenting complaint, the type of work the horse performs, and owner expectations. It is very important to determine if the problem is causing a decrease in performance prior to recommending a surgical treatment. For example, a horse that is not expected to perform any athletic work (i.e., “pasture pet”) does not need a laryngoplasty to live a normal life.

A prosthetic laryngoplasty is typically referred to as a tie-back. The procedure involves placing a non-absorbable suture (prosthesis) between the cricoid cartilage and the muscular process of the arytenoid cartilage. The suture mimics the action of the CAD muscle. The goal of the procedure is to achieve permanent abduction of the affected arytenoid cartilage. Ideally the cartilage will be abducted sufficiently enough to return airflow to near normal. Over abduction is problematic and can lead to aspiration of food and/or water with the end result being coughing and pneumonia.

The tie-back procedure is performed with the horse in lateral recumbency with the affected side up. Following appropriate surgical preparation and draping a horizontal incision is made just ventral and parallel with the linguofacial vein. Blunt dissection is continued to gain access to the lateral aspect of the larynx. Care must be taken not to disturb the first cervical nerve and cranial laryngeal nerve. The septum between the cricopharyngeus and thyropharyngeus muscles is separated. This will expose the muscular process of the arytenoid cartilage. Blunt dissection is continued caudally to expose the caudal aspect of the cricoid cartilage. Typically there is a notch in the cricoid cartilage that is just lateral to midline of the cricoid. The conformation of the caudal aspect of the cricoid cartilage is variable among horses. The cricoid notch is important when placing the prosthetic suture(s). Most surgeons attempt to seat the suture(s) in the cricoid notch. This prevents the suture from slipping laterally. The choice of suture material is based on surgeon preference. The surgeon will place the suture just underneath the caudal edge of the cricoid cartilage approximately 3–4 mm lateral to the dorsal midline. The needle is advanced and rotated through the cartilage. The size the “bite” is approximately 1 cm. Care is taken so that the suture does not penetrate into the tracheal lumen during placement. Endoscopic observation is used to monitor for this. A second suture may be placed in similar fashion. The sutures are then brought underneath the cricopharyngeus muscle. The larynx can be rotated laterally to facilitate exposure of the muscular process using a Senn retractor. Each strand of suture material is then used to take a bite through the muscular process. Under endoscopic observation each strand of suture material is tightened and then tied once appropriate abduction has been achieved. The degree of abduction is subjective and always appears greater under general anesthesia as compared to the examination the following day. Most likely this is related to the fact there is no pharyngeal tone under anesthesia. Usually a ventriculocordectomy is performed in combination with the laryngoplasty. This can be performed before or after completing the laryngoplasty.

Potential complications include seroma formation, surgery site infection, coughing, aspiration, loss of abduction, and complete failure of the prosthetic suture. Arytenoid chondritis can develop in the arytenoid cartilage that was “tied back”. It is typical for all horses will lose abduction of the arytenoid cartilage over time. A repeat laryngoplasty can be performed in horses that experience dynamic collapse of the arytenoid following laryngoplasty. Repeat procedures are much more difficult due to the scar tissue that forms following the first surgery. Horses that chronically aspirate and cough are candidates for removal of the prosthetic suture(s). Most of the time the problem resolves following removal of the prosthesis.

Ventriculocordectomy is the removal of the mucosal lining of the laryngeal ventricle and removal of the vocal cord. This does not result in abduction of the arytenoid cartilage therefore its use in race horses
as a sole treatment for laryngeal hemiplegia is not recommended. Horses that are suitable surgical candidates include: sport/show horses that have laryngeal hemiplegia with the complaint of abnormal respiratory noise without exercise intolerance; racehorses with grade III arytenoid movement and do not experience arytenoid collapse during high speed exercise but do have vocal cord collapse; and finally a ventriculocordectomy can be used as an adjunct procedure following laryngoplasty as a means to increase airway diameter. Ventriculocordectomy can be performed through a laryngotomy or as a transnasal endoscopic procedure using a laser. The transnasal endoscopic procedure is most often performed in the standing, sedated horse. Local anesthetic is sprayed on the surgery site through the biopsy channel on the video endoscope. The laser fiber is passed through the biopsy channel and used to excise the vocal cord. A long curved grasping forceps is passed up the opposite nasal passage and used to manipulate and place tension on the vocal cord during the procedure. The grasping forceps is used to evert the mucosal lining of the ventricle and that tissue is excised using the laser.

Hemorrhage is the most common complication encountered during surgery. The risk of aspiration of feed material and/or water following a ventriculocordectomy as the sole treatment for laryngeal hemiplegia is very low. When performing a ventriculocordectomy procedure through a laryngotomy the incision is left open to heal by second intention. Complications can arise if the surgical site is not cared for properly.

Younger horses and those with grade III arytenoid movement are good candidates for this surgical procedure. This procedure involves implanting a nerve-muscle pedicle graft (NMP) into the affected cricoarytenoideus dorsalis muscle. The first cervical nerve and omohyoideus muscle are used for the NMP graft. The reason these are chosen is the omohyoideus muscle is active on inspiration and the first cervical nerve is in close proximity to the CAD muscle. The surgical approach is the same as for a laryngoplasty. Care must be taken not to damage the first cervical nerve during the approach. The ventral branch of the first cervical nerve divides into three branches and inserts into the dorsal border of the omohyoideus muscle. Careful and meticulous dissection is required to create the NMP grafts. Once the NMP grafts are harvested they are implanted into the CAD muscle. Each graft is placed into a pocket that is made in the CAD muscle. The NMP grafts are sutured into position. Closure of the incision is routine. Post-operative management includes stall rest and then paddock turnout. The horse is typically returned to exercise approximately 4 months after surgery. When returning to exercise the horse will need to exert considerable effort in order to activate the first cervical nerve. Six weeks after returning to work the horse should be examined endoscopically. Usually the arytenoid looks the same as before surgery. This is because the first cervical nerve is not activated during resting respiration. In order to assess if reinnervation has taken place raise the horse’s head and neck as high as possible while observing with larynx with the endoscope for a flicker of movement from the left arytenoid. A second reflex involves using your finger or a bit to pull back quickly at the commissure of the lips. This should result in movement of the arytenoid cartilage as well. Another option is to perform a dynamic endoscopic examination. If there is evidence of reinnervation then training is continued. If there is no evidence then the horse should be turned out for 2 months then start back in training for 6 weeks and have another examination. Horses can take up to 12 months to show evidence of successful reinnervation.

There are few complications associated with this procedure. The most frequent complication is seroma formation. The biggest “down-side” to the procedure is that it can take up to 1 year to determine if the procedure has been successful. Horses with partial paralysis should respond faster than horses with complete paralysis. The technique is not appropriate for a horse that needs to return to performance quickly.

Partial arytenoidectomy is another treatment option for laryngeal hemiplegia or a failed laryngoplasty. The surgical procedure will be discussed in the Arytenoid Chondritis section.

Arytenoid chondritis is a disease process affecting one or both arytenoid laryngeal cartilages and is secondary to inflammation and swelling of the arytenoid cartilage. This results in decreased motion of the affected cartilage(s) and varying degrees of airway obstruction. The etiology is likely the consequence of ascending inflammation and/or infection into the body of the arytenoid cartilage through a mucosal disruption on the axial side of the cartilage. Occasionally granulation tissue is present without more
significant underlying pathology to the cartilage and can be treated with local resection in the standing, sedated patient.

Clinical history, palpation of the larynx, resting endoscopy, and laryngeal ultrasound are used to diagnose arytenoid chondritis. The findings will vary slightly, depending on the stage of the disease process. In the acute stage, dramatic laryngeal and perilaryngeal inflammation and edema are seen on resting endoscopy. Infrequently there will be an associated cellulitis in the perilaryngeal region and palpation of the larynx may be difficult.

Horses may be presented as an emergency because of severe respiratory distress. The severity of the mucosal swelling during the acute phase may even make it difficult to determine which arytenoid is affected. The final shape and function of the arytenoid cannot be determined until aggressive medical treatment is performed. In the acute inflammatory stage, arytenoid chondritis cases should be treated aggressively with intravenous antimicrobials and anti-inflammatories. A tracheotomy may need to be performed if the obstruction is severe. A tracheotomy allows the upper airway to “rest” since airflow will be diverted. Within a few days of initiating treatment there is should be a dramatic improvement, with a decrease in the laryngeal soft tissue swelling observed endoscopically. Surgical treatment should be further delayed, since many horses will continue to improve for 30 days with rest and antimicrobial treatment. There are infrequent cases that improve so dramatically, that they never require arytenoidecmy. Horses that do not show dramatic improvement within the first few days of intravenous antimicrobial treatment likely have extension of purulent material beyond the larynx and should be treated surgically sooner rather than later.

Different forms of arytenoidectomies have been described, and it is well accepted that partial arytenoidecmy is superior to subtotal arytenoidecmy for returning respiratory mechanics closer to normal. With a partial arytenoidecmy, everything but the muscular process is removed. It is arguable whether a mucosal flap should be maintained when performing a partial arytenoidecmy. While it is more difficult and increases intraoperative time, there do appear to be benefits to performing a primary closure of mucosa if possible.

The procedure is performed through a standard laryngotomy. If a tracheotomy has not been performed preoperatively then one will need to be performed following induction of anesthesia. The endotracheal tube is passed through the tracheotomy site. A headlamp is very useful for illumination while working within the larynx, and placing the endoscope into the nasopharynx can also provide supplemental light.

To create the mucosal flap, mucosal incisions are made at the ventral, rostral and caudal borders of the arytenoid body. The mucosa is then elevated off the arytenoid body using a periosteal elevator. The mucosa remains attached at the dorsal aspect. The abaxial border of the arytenoid is then freed of its muscular attachments using a periosteal elevator. The muscular process is isolated and transected. The mucosa over the corniculate process is elevated and preserved. Mucosa is positioned together to plan closure, and excess mucosa is trimmed. The caudal edge of the mucosal flap is reapplied to the laryngeal mucosa in a simple continuous pattern with absorbable suture, working dorsal to ventral. The most ventral aspect is left open and the remaining vocal cord and ventricle are removed. A tracheotomy tube should be placed for recovery.

An endoscopic examination should be performed the day following surgery. A moderate opening to the glottis should be seen, and blocking the tracheotomy tube while watching the horse’s respiratory effort can affirm that the horse’s ability to breathe easily through its larynx. The tracheotomy tube should be removed as soon after surgery as possible based on the patency of the airway.

A portion of horses that have an arytenoidecmy develop intralaryngeal granulation tissue after surgery and it is easily removed with standing laser surgery if necessary. Generally the prognosis is good for returning to performance after unilateral partial arytenoidecmy, as long as the remaining unaffected arytenoid has normal function.

There are several potential complications of this surgery. An inadequate lumen or the presence of some degree of aspiration and coughing are the most likely complications. These complications can be minimized with careful dissection.
A permanent tracheostomy is indicated in certain cases of bilateral arytenoid chondritis or bilateral laryngeal paralysis. Surgery can be performed either standing or under general anesthesia. The horse is positioned in dorsal recumbency and ventral aspect of the neck is clipped and prepped for surgery. Many times a temporary tracheotomy has been performed. It is helpful if you think that a permanent tracheostomy will be needed to position the temporary tracheotomy towards the middle of the neck rather than more proximal. A ventral midline incision is made to expose the tracheal rings. It is best to remove a portion of rings two to five. The paired sternothyrohyoid muscles are isolated and a section of each should be excised. This decreases tension of the mucosal closure. Once the tracheal rings are exposed two paramedian incisions through the tracheal rings are made. These incisions are approximately 3 cm apart. It is very important to make sure that an excessive amount of the tracheal ring is not removed or tracheal collapse will occur. No more than one-third of the total circumference of the ring should be removed from the ventral aspect of each ring. When incising through the rings take care not to penetrate the tracheal mucosa. The rectangular pieces of cartilage are dissected from the tracheal submucosa and removed. Then the tracheal mucosa and annular tracheal ligaments are incised in a double-Y pattern. The tracheal mucosa is sutured to the skin using absorbable suture in a simple continuous pattern. The same procedure can be performed on the standing sedated horse. Using a set of stocks and a method to hold the head in an elevated and slightly extended position is helpful. Post operatively the stoma should be cleaned as needed taking care not to disrupt the sutures. Over time the care of the stoma is minimal. Postoperatively horses rarely have complications with development of pneumonia or lower airway disease despite have a direct route into their lungs through the stoma.

The guttural pouches (GP) are paired extensions of the eustachian tubes. They were originally described in 1756 by Bourgelat. They are separated by the rectus capitis ventralis muscle, the longus capitis muscle, and the median septum. Within each guttural pouch the stylohyoid bone separates the pouch into a medial and lateral compartment. Each guttural pouch communicates with the pharynx through a funnel shaped pathway bounded axially by a fibrocartilaginous lamina. The medial compartment of the guttural pouch contains the following neurovascular structures: internal carotid artery (ICA), cranial cervical ganglion, Cranial nerve IX, Cranial nerve X, Cranial nerve XI, Cranial nerve XII, Pharyngeal branch of the Vagus nerve, cranial laryngeal nerve, and retropharyngeal lymph nodes. The lateral compartment contains the external carotid artery (ECA), maxillary artery, branches of the mandibular nerve, and the Facial nerve. The guttural pouches are lined with ciliated, pseudostratified epithelium. They also contain numerous goblet cells and mucous glands. The function of the guttural pouches has not been fully defined. There are many theories but the most recent and probably the most logical is related to thermoregulation of blood going to the brain.

The diseases that will be covered include tympany, empyema, mycosis, neoplasia, rupture of the ventral straight muscles, and temporohyoid osteoarthropathy. Guttural pouch tympany is typically seen in foals from birth to 18 months of age. This disease is more common in fillies and is usually bilateral. GP tympany is characterized as a non-painful, fluctuant, soft tissue swelling in the parotid region. Often times the foal will be in respiratory distress depending on the degree of pharyngeal collapse that is present. Other features include dysphagia resulting in aspiration pneumonia. Ventral displacement of the roof of the pharynx is seen on upper airway endoscopy. Endoscopy of the guttural pouch is often normal but signs of empyema are not unusual. Often the tympany will be alleviated by passing the endoscope into the guttural pouch. This will be evident by a decrease in the degree of ventral displacement of the pharyngeal roof. The etiology of this disease is not known but the theory is that the plica salpingopharyngea is acting as a one way valve trapping air in the pouch. The diagnosis is based on history and physical examination however if laryngeal radiographs are taken the guttural pouch will be seen as a enlarged air filled opacity. The trachea will be deviated ventrally as well. Treatments options are divided into conservative and surgical options. Conservative treatment includes placing an indwelling catheter transnasally to keep the pouch decompressed.

Percutaneous aspiration can be performed but is not recommended due to the possibility of inadvertent damage to a neurovascular structure(s) in the pouch. Surgical options include fenestration of the median septum so that the air trapped in the abnormal pouch can exit through the normal guttural pouch. A second option is to enlarge the pharyngeal orifice of the affected pouch so the trapped air can
exit. Finally, a salpingopharyngeal fistula can be created into the abnormal guttural pouch. This allows a direct communication into the nasopharynx. These procedures can be performed transendoscopically using a laser or thorough open approaches. The laser procedures can be performed as a standing surgery or under general anesthesia.

Guttural pouch empyema can affect horses of any age but it is typically seen in youngsters. Most often it is secondary to an upper respiratory tract infection of Streptococcus origin. In chronic cases the purulent material becomes inspissated leading to the formation of chondroids. Clinical signs include purulent nasal discharge, fever, lymphadenopathy, and parotid swelling and pain. The diagnosis is confirmed by upper airway endoscopy. Samples for culture should be taken prior to starting therapy. Medical treatment includes systemic antibiotics, anti-inflammatory agents, lavage of the affected pouch(es), and instillation of antibiotic into the affected pouch(es). A salpingopharyngeal fistula can be created in cases where empyema fails to respond to aggressive treatment. Chondroids can form in cases of chronic empyema. These can be difficult to remove from the affected pouch. Methods utilized include lavage, endoscopic removal using a snare, or surgical removal through an approach to the guttural pouch. A devastating complication associated with surgical approaches to the guttural pouches is damage to one of the surrounding neurovascular structures.

Guttural pouch mycosis is a life threatening disease that typically involves only one guttural pouch. There is no age, sex, or breed predisposition. The fungal lesion is most commonly positioned on one or more of the arteries in the guttural pouch. The mycotic plaque is not always associated with a vessel it can be on the median septum or along the stylohyoid bone. Typically Aspergillus spp. is the causative organism. The actual cause of the fungal growth is not known. Most commonly epistaxis is the presenting complaint. However, some horses will show signs of dysphagia, Horner’s Syndrome or laryngeal hemiplegia without a history of epistaxis. Others clinical signs include parotid pain, abnormal head carriage, and nasal discharge. There have been reports of septic arthritis of the atlanto-occipital joint associated with guttural pouch mycosis. The diagnosis is confirmed using endoscopy (make sure to evaluate both guttural pouches). It can be difficult to determine the source of hemorrhage if the guttural pouch is filled with blood/blood clot. A fistula can form from the affected pouch into the normal guttural pouch. The ICA is the most common source of hemorrhage. However, it can be very difficult to determine the source of the hemorrhage. Often the pouch is full or blood or a large blood clot that obscures the vessels. The fungal plaque can be extensive and covering a large portion of the guttural pouch. Treatment decisions must be made quickly especially in cases of active hemorrhage. A horse can exsanguinate in a short period of time from a guttural pouch bleed. There are reports of successful medical management of these cases but this can be fatal because medical management does nothing to prevent future hemorrhage. Surgical options to occlude involved vessels include ligation, balloon occlusion using Fogarty catheters, detachable balloon systems, micro-coils, and combinations of ligation with balloon occlusion.

Aberrant vasculature is always a concern when dealing with these cases. The best option is to use fluoroscopy with contrast arteriography to identify the vascular anatomy of the guttural pouch in question. Evaluation of the changes in arterial flow following ligation of certain arteries has been done. One of the most significant findings was the significant amount of retrograde blood flow through the internal carotid artery following occlusion of the ipsilateral common carotid artery. This is very important to consider in an emergency situation where you are not sure of the source of hemorrhage. In this instance the best options are to occlude both common carotid arteries and the major palatine artery at the alar foramen or to occlude the ICA, the external carotid artery and occlusion of the major palatine artery at the alar foramen. Neoplasia of the guttural pouch is uncommon. Squamous cell carcinoma, melanoma, fibroma, hemangioma, and hemangiosarcoma have been identified in the guttural pouch. Often melanoma is seen in the guttural pouch as an incidental finding especially in grey horses. Treatment options are very limited for neoplasia of the guttural pouch.

Rupture of the longus capitis and the rectus capitis ventralis muscles is typically associated with trauma (flipping over backward). Severe epistaxis and swelling of the throat latch region are common signs. Radiographs should be taken to assess for basisphenoid-basioccipital avulsion fractures. A thorough neurologic examination is indicated as well. Treatment is symptomatic.
Temporohyoid osteoarthropathy is a progressive disease of the middle ear, stylohyoid bone, and the temporal bone. Most likely this disease is secondary to an ear infection. The clinical signs range from head tossing and rubbing the ear to being profoundly neurologic. The diagnosis is made using endoscopy, radiographs, and computed tomography. Medical treatment consists of long-term antibiotics. There are two surgical procedures advocated for this problem. One is a partial stylohyoid ostectomy and the second is a ceratohyoidectomy. The partial stylohyoid ostectomy is a more difficult procedure and has a higher potential complication rate compared to ceratohyoidectomy.