Pathology of the Salivary Glands and Esophagus (16-Dec-2003)

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Salivary Glands
Anatomy and Function -
The horse has paired parotid, mandibular and polystomatic sublingual salivary glands. Since salivary gland pathology is very uncommon and if it does occur most cases will involve the parotid gland, only the parotid gland will be discussed here. The **parotid gland** is the largest of the salivary glands and is located in the retromandibular fossa between the ramus of the mandible and the ventral wing of the atlas. The rostral border of the gland reaches the temporo-mandibular joint dorsally and the caudal border of the mandible, overlapping the masseter muscle while the caudal border extends to the atlas. Dorsally the gland extends to the base of the ear and ventrally it extends into the intermandibular space. Multiple smaller ducts converge at the ventral and rostral aspect of the gland in the region of the mandibular angle to form the parotid duct. The duct travels along the medial surface of the mandible and then around the ventral border with the facial artery and vein. It ascends along the rostral border of the masseter and opens into the buccal vestibule on the parotid papilla opposite the upper third cheek tooth.

Before surgically exploring the retromandibular fossa the clinician should have a good grasp of the pertinent topography of the parotid region. The lateral surface of the gland is covered by the parotidoauricularis m. The ventral border follows the linguofacial vein. The maxillary vein runs through the middle of the gland. The medial surface contacts the following structures; the mandibular gland, the cranial cervical lymph nodes, the tendon of insertion of the sternomandibularis and cleidomastoideus, the maxillary vein and external and internal carotid arteries, and branches of the facial nerve. The hypoglossal and glossopharyngeal nerves pass rostroventrally towards the tongue on each side of the external carotid. The vagus and sympathetic nerves pass into the neck on the deep surface of the common carotid artery. The parotid lymph nodes lie directly ventral to the temporo-mandibular joint on the caudal border of the mandible under the parotid gland.

Pathology of the Salivary Glands and Ducts -
Trauma from lacerations or penetrating wounds to the parotid duct or gland are the most common abnormalities associated with the salivary glands. Since the parotid gland and duct is the most superficial, damage to this salivary gland is more common than to the other salivary glands. If the integrity of the salivary duct or gland is disrupted, the horse will secrete saliva from the wound. The amount of secretion will increase during eating. As with any wound, treatment involves cleaning and debridement of necrotic tissue. Although fresh wounds can be surgically treated by suturing the parotid duct or suturing the fibrous capsule of the damaged parotid gland, in general the damage to the glandular tissue or duct is not noticed at the time of wounding and it has been recommended to let these wounds heal by second intention. Some reports have recommended that the horse be fed through a nasogastric tube for several days after injury to the parotid gland to prevent stimulation of salivation by eating. This has sum merit although the author has observed that horses fed through esophagostomy tubes during treatment of esophageal rupture still produce copious amounts of saliva.

In some instances the salivary secretion prevents healing and a **salivary fistula** develops. Retrograde contrast radiography can be used to determine if the fistula communicates with the parotid salivary gland. Salivary fistulas from damage to the parotid duct can be treated by reconstructing the duct, duct transposition, or chemical involution of the parotid gland. Surgical repair of the duct is accomplished by dissecting over the fistula, passing polyethylene tubing caudad towards the gland and rostrad through the parotid papilla. This stent is sutured to the buccal mucosa and brought out through the cheek and remains in place for several weeks. The duct is sutured end-to-end with simple interrupted pattern using 5 - 0 to 7 - 0 nonabsorbable sutures. Translocation of the duct involves isolating the proximal portion of the duct, cannulation of the duct

with tubing and bringing it out a new opening in the oral cavity. These above techniques have not been consistently successful. Chemical ablation of the gland and duct is a relatively easy procedure and appears to produce consistent results. Sclerosing agents that have been used are 10% formalin, 2% iodine, 2% chlorhexidine and 2% silver nitrate. All the above agents have been shown to eliminate glandular tissue. Since 10% formalin produces the least amount of necrosis and suppurative inflammation, this is probably the best choice of the above chemical agents. The formalin is injected via a cannula placed into the parotid duct. A suture is placed around the duct and cannula to prevent leakage of the formalin during infusion. 35 ml of formalin is infused through the cannula into the parotid gland and left in place for 90 seconds. It is then allowed to drain out. The cannula is left in place for 36 hours. Horses should be treated with NSAIDs to reduce pain. Postoperative complications that have been seen with chemical ablation are periocular and facial swelling, transient facial nerve paralysis, temporary loss of motor function to the ear, anorexia and dyspnea. Most of these complications were associated with the other agents and not formalin.

If the skin stays intact or heals while the duct or gland still leaks salivary fluid, the saliva will accumulate in the subcutaneous space and form a salivary mucocele. **Salivary mucoceles** are collections of saliva in spaces not lined by epithelium. **Ranula** is a mucocele of the sublingual salivary gland and a **salivary cyst** is aberrant salivary tissue. The large fluid filled swelling will appear similar to a hematoma or seroma. Salivary fluid has a higher potassium and calcium content and an alkaline pH compared to serum so aspiration and fluid analysis can help with the diagnosis. Salivary fluid will also contain amylase. Retrograde sialography can confirm the diagnosis. If possible, marsupialization of the mucocele into the mouth creating a permanent fistula should be performed. Dissection and removal of the structure can also be attempted. If the damaged duct leading into the mucocele can be isolated, chemical involution of the parotid gland should stop saliva from draining into the mucocele which could then be drained with no future accumulation of fluid.

Sialoliths are hard, nonpainful, moveable swellings that can obstruct the parotid duct usually in older horses. They occur on the lateral aspect of the face near the rostral end of the facial crest. They can usually be palpated orally. They are composed of calcium carbonate and organic matter. Removal by an external approach may lead to a salivary fistula. Consequently, it is recommended to remove them by an oral approach. The incision is made is through the buccal mucosa directly over the sialolith. The incision is left to heal by second intention.

Neoplasia involving the salivary glands in the horse is infrequent. Adenocarcinoma, acinar cell tumors, melanomas and mixed cell tumors have all been reported. Clinical signs are parotid welling and pain. Wide excision with benign mixed cell tumors or acinar cell tumors as well as with melanomas is usually not successful as they recur. Adenocarcinomas often metastasize.

Esophagus
Anatomy -
The esophagus is a musculomembranous tube approximately 125 to 150 cm long. It starts in the median plane dorsal to the rostral border of the cricoid cartilage. About one third of the way down the neck, at the level of the 4th cervical vertebra, it passes to the left side of the trachea and assumes a more superficial position left and ventral to the trachea. After passing through the thoracic inlet between the left side of the trachea and the 1st rib, it moves again to the dorsal surface of the trachea. It continues to travel dorsal to the trachea in the mediastinum between the lungs to the esophageal hiatus of the diaphragm. It the abdominal cavity the esophagus enters the cardia of the stomach at the level of the 14th rib.

Certain aspects related to the anatomy of the esophagus are important when treating esophageal problems. First, traveling dorsolateral to the esophagus are several vital structures such as the common cartoid artery, the vagosympathetic trunk, and the recurrent largyngeal nerve. Surgical approaches to the esophagus need to avoid these structures. Except for the distal portion of the esophagus, the esophagus does not have a serosal layer which in other areas of the gastrointestinal tract promotes a rapid seal due to exudation of fibrin. The esophagus is supplied by the carotid, bronchoesphageal and gastric arteries. The blood vessels to the esophagus are short and easily damaged, and it lacks extensive collateral circulation which may effect healing of surgical incisions. The proximal two-thirds of the esophagus contains two helical layers of striated muscle, while the distal one third starting at about the level of the base of the heart is composed of smooth muscle. This is important when considering pharmacological manipulation of esophageal contractions. Atropine will decrease contractions in the smooth muscle segment of the esophagus, abolishing peristalsis, while it has no effect in the striated esophagus where most impactions occur. The esophageal mucosa is made up of a keratinized stratified squamous epithelium arranged in longitudinal folds. Innervation of the esophagus is primarily from pharyngeal and esophageal branches of the vagus to the striated muscle and parasympathetic fibers of the vagus to the smooth muscle.

1. Esophageal Impaction

Esophageal impaction (choke) is the most common esophageal disorder. The clinical signs associated with horses having esophageal impaction are well known. These include feed and water reflux from the nostrils and mouth. Excessive salivation is also noted. Initially the horse may want to eat but can't. The horse may intermittently extend and flex the neck. Eventually the horse will become inappetant and dehydrated. Feed impactions may occur with grain, hay, pellets and beet pulp. Other substances seen have been pieces of fruit, corncobs, wood chips and phytobezoars.

Diagnosis -

A thorough physical examination is necessary including an oral examination to rule out a foreign body lodged in the mouth and careful **palpation** of the neck. If the obstruction is within the cervical esophagus, focal swelling may be palpated as the esophagus is in a relatively superficial position. Esophageal perforation will quickly lead to cellulitis and subcutaneous emphysema. In this case the swelling may be warm and painful to the touch. If the condition is chronic, there may also be a fistula with feed material present. **Nasogastric intubation** is helpful to assess if the obstruction is still present and to determine it's location. In my experience, a significant number of horses will have resolved the choke between time of referral and arrival at the University. Care should be taken to not force the tube distally if it meets resistance in order to prevent rupture of the esophagus. In some cases with partial obstruction from feed or with a stricture or diverticulum the tube may be able travel past the obstruction. Further diagnostic procedures that can be used are endoscopy, radiography (plain and contrast) and ultrasonography. In most field cases, these additional diagnostic techniques are not employed.

Treatment -

If simple choke is diagnosed (no cellulitis) gentle lavage with warm water may dislodge the obstruction. In order to prevent aspiration during this procedure, the horse should be tranquilized sufficiently to cause them to lower their head. Xylazine (Rompun; 0.88 mg/kg IV) or Detomidine (0.01 mg kg) will produce enough sedation to accomplish this. Sedation will also help relax the esophageal musculature. If the obstruction still persists, food and water should be withdrawn and the horse left alone for 12 hours and then the lavage repeated. In many instances, the obstruction will have resolved over the previous 12 hour period. If the obstruction has not been relieved by this technique, a large diameter malleable cuffed nasogastric tube may be placed through the nose into the proximal esophagus and the cuff inflated. Water can be lavaged through a smaller diameter tube passed through the nasogastric tube to dislodge the obstruction without the worry of reflux being aspirated from the nasopharynx. Another technique is to pass a tube specifically made to relieve choke. This tube is similar to the endotracheal tube in that it has a cuffed end but it is longer allowing the end of the cuffed tube to be passed to the level of the impaction. Insufflation of the cuff dilates the esophagus at the obstruction facilitating dislodgement of the obstruction with gentle lavage.

In order to further relax the esophageal musculature during the above treatments, various drugs have been used. Atropine has been used but that will only relax the smooth muscle of the distal esophagus which is not where the choke usually occurs. Oxytocin (0.11 to 0.22 IU/kg IV) has been shown to decrease esophageal pressure in the proximal esophagus. Lidocaine (50 - 100 ml via naosgastric tube) may also relax the esophagus at the level of the impaction.

For refractory cases, general anesthesia with pressure lavage is indicated. Esophagoscopy is useful to determine the nature of the obstruction and whether it is likely to be dislodged with lavage. Foreign bodies can sometimes be removed with a biopsy instrument passed through an endoscope. For feed impactions the animal should be positioned with it's head down and hind end elevated. In my experience it is very unusual for feed impactions not to respond to this treatment.

The horse should be placed on NSAIDs (banamine; 1.1 mg/kg IV BID), and broad spectrum antibiotics (procaine penicillin G; 22,000 IU/kg BID and gentocin; 6.6 mg/kg SID) during the period of the choke and for 5 days after it's resolution due to the chance of aspiration pneumonia. For chronic obstructions intravenous fluids should be used to rehydrate the horse. Patients may have hypochloremic hypokalemic metabolic alkalosis requiring intravenous physiologic saline with spiked with potassium (20 mEq/L). Thoracic radiography should be performed if aspiration is suspected. Endoscopic evaluation of the esophagus after resolution of the choke can be used to assess the extent of mucosal damage. Feed should be withheld for 24 to 72 hours after relief of the obstruction. The initial diet should be soft in texture. Soaked pellets are easy to swallow and should be continued for several weeks after the obstruction is relieved.

Esophagotomy is necessary for removal of certain foreign bodies or for persistent feed impactions. A nasogastric tube should be passed as far as possible to assist the surgeon in identification of the esophagus and obstruction. An 8- to 10- cm ventral midline incision is made over the area of the obstruction. The paired sternothyrohyoideus and omohyoideus muscles are separated along midline and the trachea exposed. The fascia on the left side of the trachea is dissected down to the esophagus carefully preserving the vasculature. The left carotid sheath should be retracted laterally. A scalpel is used to make

a 5cm longitudinal incision into the esophagus, preferably over an area of healthy tissue if permitted. The decision to close the esophagus depends on the amount of damage to the esophageal wall. If the tissue has not been traumatized extensively primary closure is performed. The muscosa is closed with 3-0 polypropylene suture (Prolene) in a simple continuous pattern with the knots tied in the lumen. The muscle layer is closed with 3-0 monofilament nonabsorbable or synthetic absorbable material in an interrupted pattern. A polyethylene drain (Hemovac, 0.25-in outer diameter; Snyder Laboratories) is placed besides the esophagus and brought out through a small stab in the skin ventral to the incision. The muscles and subcutaneous tissues are closed with 2-0 synthetic absorbable suture. Staples can be used on the skin.

Postoperative Care and Complications -
It has been recommended to withhold feed for 2 days after primary closure of an esophagotomy. After this period the horse can be started on small amounts of pelleted feed in a slurry and maintained on this for at least 10 days or longer depending on radiographic and endoscopic assessment of healing. The drain can be removed in 3 days. In the event of an impending dehiscence the incision should be opened immediately to prevent infection from spreading along tissue planes into the thorax.

If a decision is made to allow the esophagotomy to heal by second intention, an esophagostomy tube should be placed through the esophagotomy incision, or the tube may be placed through a new incision made closer to the stomach. The horse should be fed a complete pelleted feed (7 g/kg in 5 L water BID with NAC added if needed). Once a bed of granulation tissue has covered the wound (approximately 8 - 10 days) the tube can be removed. Although ingest will continue to leak out the esophageal opening, the fistula will close in several weeks.

2. Esophageal Rupture
Rupture (full thickness) of the esophagus usually results from a chronic impaction that either hasn't been noticed as the horse has been turned out to pasture or occurs as a sequella of an impaction that has not responded to medical treatment. Other causes may be traumatic nasogastric intubation, trauma to the cervical area such as a kick, or possibly a laceration. I have seen approximately 10 cases and all except one (which was from traumatic tubing) were the result of a chronic choke. In my experience, the trauma from a kick occurs more commonly in the distal third of the cervical esophagus and dos not result in a full thickness tear but causes a tear in the muscular layer of the esophagus resulting in a pulsion diverticulum that appears similar to megaesophagus. Horses with full thickness esophageal tears will exhibit swelling in the area of the rupture. The swelling usually becomes diffuse as the escaping ingest and a saliva dissect distally and laterally through the tissues down the neck. The swelling may be warm and painful. It is critical that if suspicion exists that the esophagus is torn, the diagnosis be confirmed so appropriate treatment can be started immediately. If the infection dissects ventrally and extends into the mediastinum, prognosis changes from good to grave. The two diagnostic techniques are most useful are endoscopy and radiography. Tears are sometimes difficult to see with the endoscope. Distension of the esophagus with air can help identifying the lesion. Plain radiography should reveal subcutaneous emphysema around the tear and a contrast should indicate the disruption in the esophageal wall.

Treatment of esophageal rupture requires opening the tissue over the tear to expose the tear and establish adequate drainage. This can be done in the standing sedated horse. A ventral midline incision is made over the swelling. In most cases the necrotic tissue and ingest is readily evident in the subcutaneous tissue. The dissection is continued to the esophagus. A nasogastric tube placed in the esophagus can help in the identification of the esophagus. The incision should extend to the ventral aspect of the involved tissue to prevent any further migration of the infection down the neck. An esophageal feeding tube is placed in order to feed the horse for the next several weeks, until a sufficient amount of granulation tissue forms in the wound to seal off the tissue planes and form a stoma from the esophagus to the outside. Some clinicians recommend placing the tube in the esophagus distal to the area of injury. I do not think this is necessary or that it provides any advantage. I place the tube though the tear and secure it to the neck. The horse is then fed a gruel slurry with sodium and potassium added to compensate for loss in the saliva. The horse is placed on broad spectrum antibiotics and NSAIDs until the infection is resolved, usually for approximately 10 days. In my experience the tube can be removed in 10 to 14 days. At this time the horse will still lose a portion of the feed as it eats but a sufficient amount will pass the tear and enter the stomach. Usually the fistula that forms closes on it's own over time (several months). If not it can be surgically removed.

3. Esophageal Stricture
Stricture may be a sequella of choke, trauma from a kick or nasogastric intubation, or it may be a congenital abnormality. An important observation made from experimental studies of mucosal resection and anastomosis and from clinical cases of the post-obstruction healing is that stricture formation with narrowing of the esophageal lumen is greatest between 15 and 30 days after the initial insult. The lumen diameter starts to increase after 30 days with no significant further increase after 60 days. These findings suggest that surgical repair of a stricture should be delayed until 60 days after the initial insult, as tissue

remodeling during this period may leave the horse with an adequate esophageal lumen. Also, horses with trauma to the esophageal mucosa may benefit from being fed a low bulk nonabrasive diet and being kept on NSAIDs for a more prolonged period after an insult.

Strictures have been classified as mural (involving the adventitia and muscularis), esophageal rings or webs (involving the mucosa and submucosa), and annular (involving all layers). Endoscopy and positive pressure contrast esophagograms will aid in characterizing the lesion. Surgical treatment and prognosis is dependent on the type of stricture. A longitudinal esophagomyotomy is performed over the area of mural strictures. Through the myotomy incision, the mucosa is freed from the muscularis circumferentially around the entire esophagus. In this technique the mucosa is not incised. The **esophagomyotomy** is not closed. Since the mucosa is not entered exposing tissue to contamination and saliva, dehiscence is not a common complication. A drain is placed and the incision closed routinely. The horse is fed small amounts of soft feed until the esophagus appears normal on a contrast esophagogram.

Mucosal and submucosoal resection is usually necessary for esophageal rings or webs and annular strictures. In a **partial esophageal resection**, a longitudinal esophagomyotomy is combined with mucosal resection. The surgery is performed similar to the myotomy technique described previously. Once the mucosa/submucosa is freed from the muscularis, a longitudinal incision is made through the mucosa/submucosa for the length of the stricture. Circumferential incisions are then made in normal mucosa/submucosa directly proximal and distal to the stricture and the abnormal mucosal tissue resected. The mucosa is closed by three simple continuous sutures of 3-0 polypropylene with knots tied in the lumen. If the lesion involves only a mucosal web, the muscularis is sutured. If the lesion is a full thickness annular stricture, the muscularis should not be sutured. Alternatively, the entire section of involved tissue can be resected and an **esophageal anastomosis** performed. A 2 layer closure is used, one layer incorporating the mucosa/submucosa in continuous or interrupted pattern and the next layer a simple interrupted pattern in the muscle. It is recommended to place a distal esophageal feeding tube and to also keep the head and neck flexed with a tie-down in the postoperative period. One additional technique described is the combination of first performing an esophagostomy through the stricture site, providing extraoral alimentation through a tube in the esophagostomy incision for a period long enough to allow a fistula to form and then fenestrating the mucosal /submucosal cicatrix thru the esophageal fistula. It is thought that the traction diverticulum that forms as the esophagostomy heals may increase the esophageal lumen size.

4. Esophageal Inclusion Cysts
Esophageal cysts are congenital abnormalities developing from the primitive foregut. Horses may present with clinical signs similar to esophageal obstructive disease, recurrent respiratory infections, or the owner may merely notice a mass on the ventral aspect of neck. Esophagoscopy, ultrasonography, and positive contrast radiography help to identify the extent of the lesion. Squamous epithelial cells are seen on cytology of a cyst aspirate. Both surgical resection and marsupialization have been described. A ventral midline approach is made to expose the esophagus. If the cyst is small, an attempt can be made to resect it out of the esophageal wall. It can be difficult avoiding perforating the mucosa. If this is done, the incision is closed as described for an esophagotomy. For larger cysts, the contents can be aspirated and the cyst lining marsupialized to the skin with interrupted sutures. The cyst can be flushed with 2% iodine diluted in water until a tight seal has formed between the cyst and skin at which time the cyst can be flushed with 7% iodine until the necrotic lining can be manually removed. The skin sutures are removed in 10 days and the fistula left to heal by second intention. It is important to coat the adjacent skin with petroleum jelly to prevent scalding.

5. Esophageal Diverticulum
Traction diverticula, or true diverticula, result when contraction of periesophageal fibrous scar tissue causes outward traction of all layers of the esophageal wall. These are usually clinically insignificant. Pulsion diverticula are local protrusions of esophageal mucosa through a defect in the muscularis. These may occur secondary to blunt trauma to the muscle or from the esophagus being overstretched during choke. As I stated earlier, I have seen them after a kick to the chest area. They appear flasklike on an esophogogram. Surgical repair involves either inverting the redundant mucosa into the lumen followed by debriding and closing the defect in the muscle, or performing a diverticulectomy. The former is preferred if the diverticulum is not to large because it avoids entering the lumen and contaminating the surgical area. I have repaired three of them in the distal neck and have had two successes resolving chronic choke and one horse that was a failure and required a permanent diet of a gruel.

6. Esophageal Neoplasia
Reports of esophageal neoplasia are rare in the horse. Squamous cell carcinoma has been described in a few cases. If it is caught early, resection and anastomosis is possible.

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