

Diseases of the guttural pouches.

Fieldborg, J. DVM, PhD, Associate professor(1) and Keith E. Baptiste(2), BVMS, PhD,
Dip. ACVIM, Dip. ECEIM

Department of Large Animal Science, Large Animal Surgery(1) and Internal Medicine(2),
Faculty of Life Science, University of Copenhagen, Denmark

Introduction:

The guttural pouches are ventral evaginations of the membranous portion of the auditory tube and classified as a *diverticulum tuba auditiva*. To date, a diverticulum of the auditory tube has been described in the *Perissodactyla* (i.e. equids, tapirs, rhinoceros), hyrax, some microchiropterans and one species of rodent (*Heteromys anomalus* -South American forest mouse)¹. The equine guttural pouches were first described in the year 1764 by the French veterinarian, Claude Bourgelat.

Anatomy:

The guttural pouches are paired air-filled diverticula of the Eustachian tubes that communicate between the middle ear and the pharynx. Each pouch has a capacity ranging in volume from 300-500ml, lying below the base of the skull, between the foramen lacerum and atlas dorsally and the retropharyngeal lymph node and roof of the nasopharynx (to the commencement of the esophagus) ventrally.

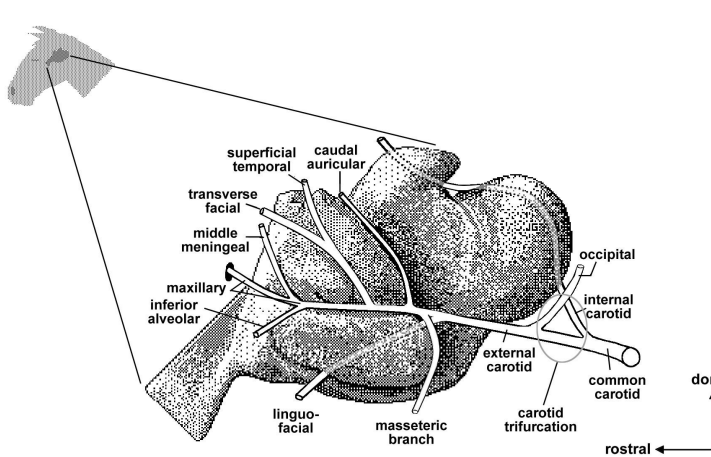
They are covered laterally by the pterygoid and digastric muscles, ramus of the mandible, parotid and mandibular salivary glands. Medially, the guttural pouches are divided by the strap muscles of the neck, except at their rostro-medial aspects where they are joined to form the medial septum². Each pouch is divided into a medial and lateral compartment by reflection of the mucosal lining around the dorsal, lateral and medial surfaces of the stylohyoid bone. The lateral compartment is approximately one-third the size of the medial. The 3 cm slit-like opening into the guttural pouch is obliquely positioned on the caudodorsal aspect of the lateral walls of the nasopharynx, just caudoventral to the choanae.

The shape of the guttural pouches is determined by the myriad of structures (eg. muscles, bones, lymph nodes) to which it is physically attached, making coherent anatomical descriptions difficult. From horse to horse, one can commonly find variations in the expression of these structures over the guttural pouch. Structures of veterinary concern include arteries to the head and brain and cranial nerves. The most prominent artery is the internal carotid artery, suspended within a pleat of guttural pouch membrane and against the caudal length of the medial compartment wall. This artery can be identified as being i) the first major branch of the common carotid artery at its trifurcation which crosses under the occipital artery; ii) intimately associated with the caudomedial and dorsal aspects of the pouch before entering the large foramen lacerum; iii) closely associated with the vagosympathetic trunk along its course over the guttural pouch. In some horses the internal carotid and occipital arteries leave the common carotid together as a common trunk and later separate into their respective arteries³. Cranial nerves in contact with the guttural pouch include the facial (VII), glossopharyngeal (IX), vagus (X), accessory (XI), hypoglossal (XII) as well as the pharyngeal plexus, cranial laryngeal and mandibular

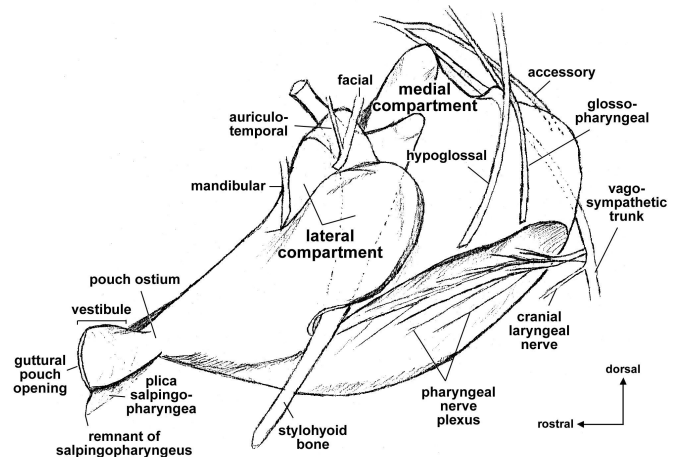
nerves.

Function:

The unique design of the equine guttural pouches has inspired the belief that it serves additional functions besides those known for the typical auditory tube. The best evidence for this unique function is that the guttural pouches function as brain-cooling devices to cool blood within the internal carotid artery destined for the brain⁴.



Arteries traversing the Equine Guttural Pouch



Nerves traversing the Equine Guttural Pouch

Nevertheless, the guttural pouches are not retained without penalty, for they are subject to a number of sometimes life threatening diseases. The guttural pouches are not sterile compartments, as they have the same bacterial composition as the pharynx. When horses are prevented from lowering their head for 12 to 24 hours the frequency of bacterial isolation will increase together with an increase in the neutrophil counts.

Diseases:

To date the following diseases have been associated with the equine guttural pouches:

- | | | |
|-------------------------------------|-------------------------|----|
| 1) Empyema/Chondroids /Foreign body | 2) Mycosis | 2) |
| 3) Tympany | 4) Otitis media/interna | |
| 5) Longus capitus muscle rupture | 6) Neoplasia | |
| 7) Stylohyoid bone fracture | 8) Pharyngeal paralysis | |
| 9) DDSP | 10) Cystic structures | |

The risk of fatal outcomes is most apparent when you consider the structures that traverse over the guttural pouch. The thickness of the guttural pouch membrane ranges from 45-200um, and this is all that separates potential pathogens or necrotic pus from major arteries and cranial nerves. Hopefully, this fact alone should dominate decisions about management of guttural pouch diseases in terms of the need for immediate treatment and the choice of solutions to lavage guttural pouches.

Empyema: - This is characterised as accumulations of purulent exudates within one or both guttural pouches, and often a consequence of an upper respiratory tract bacterial infection (*Streptococcus*, *Pasteurella*)^{5,6} or the rupture of abscessed retropharyngeal lymph nodes. This diagnosis should be considered in any horse with a uni- or bilateral

mucopurulent nasal discharge. The pus may be fluidy or thick, with occasional formation of hard concretions. Secondary pharyngitis, coughing, DDSP, exercise intolerance, respiratory distress and dysphagia may also be encountered.

In acute and mild cases of empyema, then guttural pouch lavage is recommended, with polyionic or a saline solutions. Iodine solutions or topical application of irritating solutions should not be used. The lavage is done via the endoscope or through indwelling catheters for a period of one week or more. To help the drainage, the owner should feed the horse on the ground and the animal should be sedated during lavage. In chronic cases whenever the exudate is inspissated or concretions have formed, an endoscopic removal with a basket-type forceps⁷ or a surgical excision⁸ through the Viborg's triangle or a Whitehouse approach is indicated. Incisions should heal by secondary intention. In horses with major respiratory distress, a tracheotomy may be necessary.

Mycotic Infection: - The end result of guttural pouch mycosis are lesions containing fungal organisms observed in any part of the guttural pouch, especially on the internal carotid artery along the dorsal roof of the medial compartment. Although a variety of fungal organisms have been isolated (*Aspergillus*, *Penicillium*)^{9,10,11}, it is still unclear why specific anatomical areas are invaded and what are the predisposing factors for their development.

Most common clinical signs of guttural pouch mycosis are epistaxis (intermittent to liters of blood) not induced by exercise, cranial nerve disorders (dysphagia, Horner's syndrome, laryngeal hemiplegia, facial paresis, etc.), uni- or bilateral mucoid nasal discharge or a combination of symptoms. Secondary clinical signs include abnormal respiratory noise, unilateral atrophy of the tongue and abnormal head posture. The presence of neurologic symptoms is typically associated with a worse prognosis, especially dysphagia. If untreated, then the likely fate is a fatal hemorrhage or irreversible neurological signs^{12,13}. Surgical vascular occlusion of the affected artery is vital in horses with guttural pouch mycosis. Since the 1980's, the treatment of choice has been surgical occlusion of the affected artery/s or better still, the correct surgical placement of a balloon-tipped catheter in the affected arteries¹⁴. Complications reported include recurrence of moderate to profuse epistaxis and retrograde infection. In some cases, the catheters have to be removed because of incision complications, bad cosmetic effect or incorrect placement. An improved method has been described with coils, and detachable, self-sealing latex balloons^{14,15}. The horse is placed under general anesthesia in lateral recumbency, with the affected side upward. The common carotid artery is isolated, punctured with an angiographic catheter and advanced to the level of the internal, the external carotid artery or the maxillary artery, depending on which structure to be occluded. The entire procedure is performed under fluoroscopic guidance. Compared with the balloon-tipped catheter surgery, coil embolization is less invasive, and often associated with a shorter period of anesthesia, but requires the use of fluoroscopy¹⁶. Long term (>2 years) follow-up of horses with guttural pouch mycosis (GPM), treated with transarterial coil embolization have been evaluated¹⁷, and found that prognosis for survival was 84% and prognosis for return to work was good (71%).

Tympany: - This rare disease usually develops shortly after birth and up to 20 months of age¹⁸. It results in excessive accumulation of air within one or both guttural pouches. The etiology is still under investigation, but theories proposed include a malfunction or structurally abnormal pharyngeal orifice acting as a one way valve, with the flap trapping

air inside the guttural pouch, or a genetic defect. Tympany is manifested as a non-painful, soft, tympanic swelling of the parotid region. In some cases respiratory noise, dyspnea, dysphagia or aspiration pneumonia can be observed. Centesis by means of a needle to evacuate the air can be used to determine whether the problem is uni- or bilateral. Radiographs can confirm the diagnosis and can assess if any secondary pulmonary disease.

Resolution is achieved by a surgical procedure that establishes communication between both pouches by fenestration of the medial septum for unilateral cases or resection of the medial lamina or pharyngeal fistulization for bilateral involvement. The fenestration of the medial septum can be performed via a skin approach¹⁹ or a transendoscopic cauterization approach²⁰, or with transendoscopic Nd-YAG-laser²¹. Recurrence makes a second surgery necessary in some foals but in general treated cases are successful and prognosis is good except in presence of pneumonia.

Rupture of the Longus capitus muscle: - Rupture of the strap muscles of the neck (*longus capitus* muscle) can be a cause of guttural pouch haemorrhage and epistaxis^{22,23}. This is associated with acute trauma and may also be a sequel to guttural pouch mycosis²⁴. Distinction between this condition and guttural pouch mycosis alone requires endoscopic examination of the entire guttural pouch, particularly at the site of insertion of the strap muscles on the base of the skull. Treatment involves conservative management²³, stall rest for 4-6 weeks, antibiotics, and analgesics.

Otitis media/interna: - This disease is commonly associated with headshaking, ear flopping and rubbing, vestibular disease, facial paralysis and exposure corneal keratitis^{25,26}. This may be the result of trauma to the petrous temporal area, ascending respiratory tract infection, or extension of otitis externa to the middle and inner ears. The result is inflammation and fusion of the stylohyoid bone to the petrous temporal bones²⁵. This may lead to dysfunction of the vestibulocochlear and facial nerves or fracture of the stylohyoid bone. Endoscopy of the guttural pouch is a commonly used diagnostic modality however, magnetic resonant imaging or computed tomography tend to be more specific to make the diagnosis. As yet, no infectious agent has been detected, nor has any single treatment modality been evaluated but conservative management with stall rest, antibiotics, NSAIDS or a partial stylohyoidostectomy are possibilities²⁵. Healing may take up to one year.

Dorsal Displacement of the Soft Palate: - DDSP can occur in horses during heavy exercise, and cases of guttural pouch mycosis and empyema, when the caudal free margin of the soft palate is positioned dorsal to the epiglottis, creating a velopharyngeal obstruction²⁷. Holcombe²⁸ reported a repeatable, reversible model for DDSP by bilaterally blocking the pharyngeal plexus branch off the vagus nerve as it courses along the floor of the guttural pouches. They propose that DDSP may be pharyngeal nerve plexus dysfunction from retropharyngeal lymph node inflammation secondary to upper respiratory tract viral infection.

References: - 1) Hinchcliffe R & A Pye (1969) *J. Zool.*, 157: 277-288; 2) Dyce KM. *et al.* (2002) *Textbook of Veterinary Anatomy*. 3rd ed., W. B. Saunders Co.; 3) Orr J. *et al.* (1983) *Am.J.Physiol.* 244, H142-H149.; 4) Baptiste KE *et al.* (2000) *Nature* 403:382-383.; 5) Knight AP *et al.* (1976) *Vet.Med.Small Anim.Clin* 70:1194-1199.; 6) Jaeschke G & Weiler H (1998) *Pferdeheilkunde* 14:115-122.; 7) Seahorn TL & Schumacher J (1991) *JAVMA* 199:368-369.; 8) Munroe GA *et al.* (1993) *Prat Vét Eq* 25:139-142.; 9) Cook WR *et al.* (1968) *Vet Rec* 83:422-428.; 10) Guillot J *et al.* (1997) *J Med Vet Mycol* 35:433-435.; 11) Ludwig A *et al.* (2005) *Vet J* 169:457-61.; 12) Léveillé R *et al.* (2000) *Vet Surgery* 29:389-397.; 13) Nation PN (1978) *Can Vet J* 19:194-197.; 14) Freeman DE & Donawick WJ (1980) *JAVMA* 176:236-240.; 15) Cheramie HS *et al.* (1999) *Vet Surg* 28:83-90.; 16) Freeman DE *et al.* (1993) *Vet Surg* 22:531-534.;

17) Lepage OM & Piccot-Crezollet C (2005) *Equine vet J* 37:430-434.; 18) McCue PM *et al.* (1989) *JAVMA* 194:1761-1763.; 19) McIlwraith CW (1987) *Equine surgery advanced techniques*. Lea & Febiger: 235-238.; 20) Tetens J *et al.* (1994) *JAVMA* 204:1927-1929.; 21) Ohnesorgue B & Deegen E (1995) *Pferdeheilkunde* 11:233-237.; 22) Sweeney CR *et al.* (1993) *JAVMA* 202:1129-1131.; 23) Freeman DE *et al.* (1994) *40th Annual Proc. AAEP*: 85-86.; 24) Knight AP (1977) *JAVMA* 170: 735-738.; 25) Hassel DM *et al.* (1995) *JAVMA* 207:1081-1084.; 26) Walker AM *et al.* (2001) *Proc Am Assoc Equine Pract* 47: 25-26; 27) Haynes PF (1983) *Comp.Cont. Ed.* 5: S379-S388.; 28) Holcome SJ *et al.* (1998) *Am J.Vet Res.*59: 504-508.