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# GUTTURAL POUCH EMPYEMA AND TYMPANY : DIAGNOSIS AND MANAGEMENT

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## SUMMARY

Guttural pouch (GP) tympanites and empyema were diagnosed in twelve animals (nine horses and three donkeys) with respiratory stridor and tympanic swelling in the parotid region. The diagnosis was based upon the anamnesis, clinical findings, paracentesis and radiographic and bacteriologic examination. Two fillies with GP tympanites were treated by using long-term implantation of an indwelling catheter through the pharyngeal orifice. Seven horses and three donkeys with GP empyema was managed by hyovertebrotomy with ventral drainage approach. The follow-up information revealed that one filly had persistent tympany; one donkey died of pneumonia and the other animals recovered completely within three weeks.

## INTRODUCTION

Unique to equidae, the guttural pouches are bilateral air-filled diverticulae of the Eustachian tubes that communicate between the middle ear and the pharynx. The two are separated from each other on the midline (Milne & Fessler 1972; Getty 1975; Honnas & Pascoe 1996). The capacity of each pouch is approximately 300-500 ml (Holmes 1962; Lokai et al., 1976; Raker 1976; Freeman 1980; Dyce et al., 1996; Honnas & Pascoe 1996; Mair et al., 1998).

Recent work has provided good evidence that the equine guttural pouches may have a brain-cooling function, specially, to cool the blood flowing within the internal carotid artery (Baptiste et al., 1993; Baptiste 1997;1998).

Diseases commonly affecting the guttural pouches are tympanites, empyema and mycotic infections (Raker 1976; Freeman 1980; Trigo & Nickels 1981; Graber 1984; McCue et al., 1989; Freeman 1992; Butler et al., 1993; Baptiste et al., 1996; Honnas & Pascoe 1996; Mair et al., 1998). Other uncommon miscellaneous conditions such as neoplasms, fracture of the hyoid bone, foreign bodies and cystic structures have been reported (Merriam 1972; Trigo & Nickels 1981; Greene & O'Connor 1986; Seahorn & Schumacher 1991; Hance et al., 1992).

Tympany (tympanites) of the guttural pouch occurs infrequently and is recognized in foals and young horses up to 1.5 years old (Wheat, 1962; Freeman, 1980; Soliman, 1986; McCue et al., 1989; Butler et al., 1993; Mair et al., 1998). It is characterized by non-painful, soft, fluctant swelling in the parotid region. Tympanites is usually unilateral but bilateral cases have been observed, and it is more common in fillies than in colts. The etiology of GP tympany is not known although a number of mechanisms have been postulated (Holmes 1962; Wheat 1962; Manson 1972; Milne & Fessler 1972; Raker 1976; Walsh & Weinberg 1979; Mcilwraith & Turner 1987; McCue et al., 1989; Freeman 1992; Misk et al., 1992; Ohnesorge & Deegen 1995; Tate et al., 1995; Honnas & Pascoe 1996; Mair et al., 1998).

Guttural pouch empyema affects horses of any age, and is a common sequela to equine upper respiratory tract infections especially those caused by Streptococcus equi as in strangles. Pus may fill one or both pouches (Raker, 1976; Freeman, 1980; Nyack et al., 1983; White & Williamson, 1987; Walmsley, 1988; Lavoie et al., 1991; Freeman, 1992; Butler et al., 1993; Newton et al., 1997; Mair et al., 1998).

Radiographs of the pouch area may demonstrate a fluid line within, a loss of portions of the outline of the pouch, radiopaque foreign bodies in addition to an space-occupying masses (McClure 1984; White & Williamson 1987; Freeman 1992; Hance et al., 1992; Butler et al., 1993; Mair et al., 1998).

Surgical intervention for treatment of various guttural pouch affections in the horse have been described in several literature (Freeman 1980; Mcilwraith & Turner 1987; McCue et al., 1989; Freeman 1992; Misk et al., 1992; Ohnesorge & Deegen 1995; Tate et al., 1995; Honnas & Pascoe 1996; Mair et al., 1998).

**Case history and clinical findings**

Nine horses and three donkeys of different ages (3-42 month old) suffering from guttural pouch affections were admitted to the Surgery Clinic, Faculty of Veterinary Medicine, Cairo University from march, 1992 to April, 1999. Out of these cases 2 fillies were suffered from tympanites and 2 colts; 4 mares; a stallion and 3 male donkeys were affected with empyema.

Clinically the two cases of tympanites showed visible, non-painful, tympanic swelling of the right parotid region, with slight extension of the swelling on the left one (Fig. 1). The heart rate and body temperature were within normal. Inspiratory and expiratory dyspnea were noted.

Regarding GP empyema, all animals had a past history of strangles infection about 21 days back. Affected animals had bilateral variable painful swelling of the parotid region, with intermittent greenish muco-purulent nasal discharge containing variable amounts of masticated food around the external orifices of the nostrils (Fig. 2). The oral, vulvar mucosae and conjunctivae were pale. Variable degrees of dysphagia and body weight loss were observed especially in donkeys. Rectal temperature and heart rate were ranging between 38.5-41°C and 40-90/ minute. Respiration was dyspneic (15-40/min.) and characterized by distinct dilatation of the external nares, necessitating forceful contraction of the abdominal muscles especially during expiration. A few bilateral wheezes were ausculted in the thoracic region of the affected donkeys.

**Radiographic findings**

An X-ray unit with an output 70 Kvp, 100 MA; 0.5 second and 75 cm FFD has been used. Ventro-dorsal and lateral radiographic views of the GP were obtained under sedation. Radiographs of the tympanites revealed an enlargement and widening of Eustachian tube diverticulum with gas extending caudally to the atlas with rounded outline (Fig. 3). In some cases of empyema, smooth free gas/fluid interface was observed within the guttural pouch on standing lateral radiographs (Fig. 4). Radiographs showed also an accumulation of radiopaque material in the pouch that cause complete loss of the normal radiolucent outline in other cases of empyema (Fig. 5).

**Carotid angiogram**

Arteriography of the common carotid, in the horse and donkey, was performed to study the topographic distribution of the common carotid over the GP region (Fig. 6 & 7). Carotid angiography was carried out on 8 anaesthetised horses and donkeys. Then animals were placed on lateral recumbency with their heads on an X-ray cassette. After routine surgical preparation, a 8 to 10 cm skin incision was made parallel to and dorsal to jugular vein in the middle of the neck. Careful blunt dissection was used to isolate the common carotid artery. A small longitudinal incision, just enough to admit the 16-gauge I.V. cannula, was made into the lumen of the artery. Then it was threaded up the carotid artery. 30-40 ml. of the contrast agent (Urografin, Schering chemicals) were injected in a bolus, and the film was taken immediately. The skin was closed in the usual manner. Carotid angiogram was performed following the technique described by Colles & Cook, (1983) and Mcilwraith & Turner, (1987).

**Microbiological findings**

In ten cases, sterile swabs were used to obtain purulent exudate from the GP. The swabs were directly transferred to nutrient broth and were incubated at 37°C for 4-6 hours, then cultivated on the nutrient agar, blood agar, MacConkey's agar and Sabarud's agar media. B. haemolytic Streptococcus Spp., Staph. aureus and Coryne Spp. were the bacterial isolates from the affected GP. Antibiogram showed that the isolates were highly sensitive to tetracycline and thiophenicol.

**Surgical intervention**

Needle aspiration of GP gases and ventro-dorsal radiographs showed that all the affected cases were unilateral affections. One horse was severely dyspneic from GP distention, a tracheostomy was performed for immediate relief (Fig. 8).

The affected GP in all animals was approached through hyovertebrotomy following the technique described by Freeman, (1992) and Mair et al., (1998). After deep narcosis and routine surgical preparation, a skin incision 10-15 cm. long was made parallel and just cranial to the wing of the atlas. The dense parotid fascia was incised and the parotid gland and overlying parotidoauricularis muscle were reflected cranially. The GP lining was exposed and grasped with Allis tissue forceps. It was punctured and the wound was enlarged to admit the hand fist. In cases of tympanites, when the affected GP was incised it collapsed immediately. Long-term (4-6 weeks) indwelling long plastic tube of 3 cm diameter was placed in the GP; through the pharyngeal opening of Eustachian tube and against the ventral nasal meatus; then fixed with a stitch to the nostril (Fig. 9).

In cases of empyema, the purulent and inspissated materials within the GP was removed and thoroughly irrigated with diluted-iodine (10%) solution (Betadine ®, the Nile co.). Straight hemostat was inserted through the incision into the GP and directed ventrally. The skin, underlying tissues and GP were carefully incised over the point of the hemostat to establish an effective ventral drainage through a fixed soft rubber tube for 7-10 days. Another drainage was accomplished through an indwelling long plastic tube of 2-4 cm diameter inserted in the GP and through the pharyngeal orifice; and ventral nasal meatus for 2 weeks (Fig. 10). The hyovertebrotomy incision was closed by suturing the GP, fascia of the parotid gland and then the skin respectively.

Post-operative management- The GP cavity was flushed daily with diluted Betadine solution (250-500 ml) for one week. Prophylactic tetanus antitoxin and antibiotics for 5 days were given. Radiographs were taken at 2 days intervals to evaluate the conditions.

After surgical intervention, ten animals recovered completely within 3 weeks. One filly had mild unilateral distention recurred 5 weeks after surgery, and one donkey died of pneumonia.

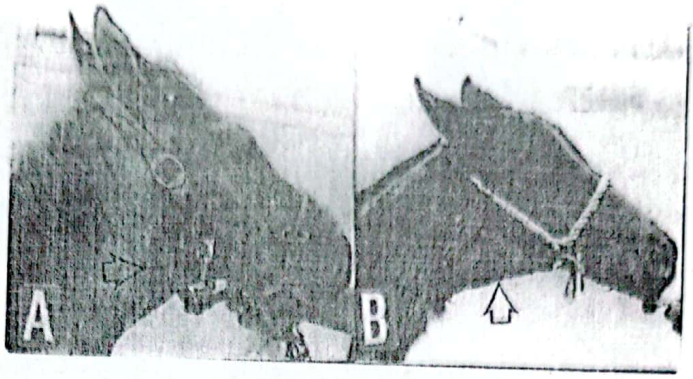


Fig. 1 (A & B): Lateral view showing two fillies with GP tympanites (arrows).

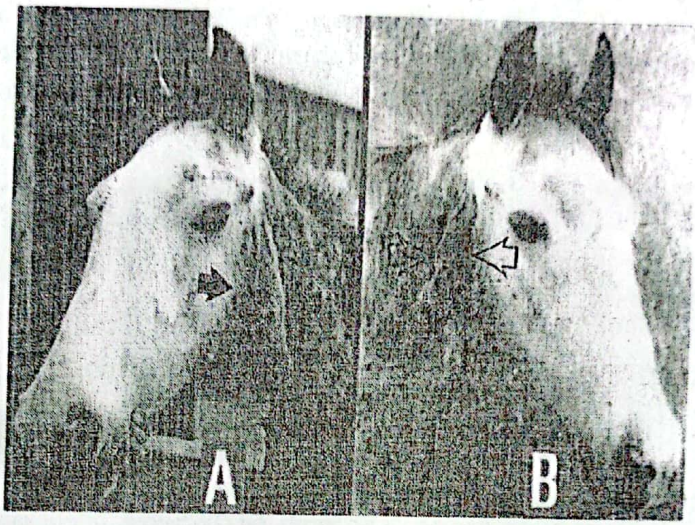


Fig. 2 (A & B): Anterolateral view showing two horses with empyema of the guttural pouch (arrows).

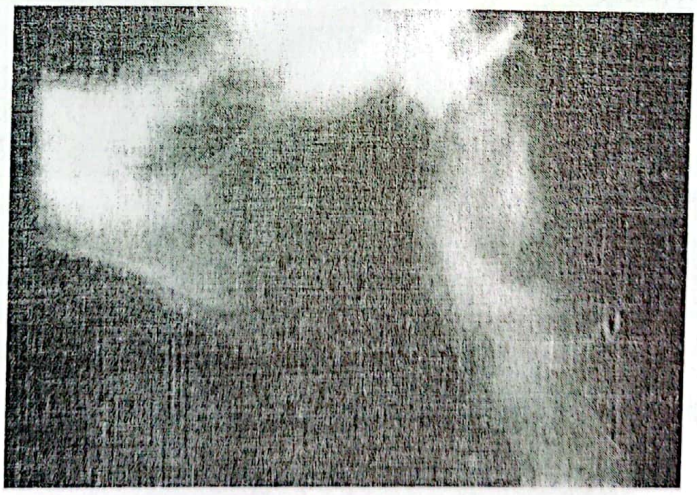

Fig. 3: Lateral radiographic view of the GP region of a filly. Eustachian tube diverticulum is markedly distended with gas, and extends caudally to the level of the third cervical vertebrae (tympanites).

Fig. 4: Standing lateral radiographic view of a horse's head and neck. There is a smooth gas-fluid interface in the GP (open arrow). The ventral third of the diverticulum is opaque due to the accumulation of purulent material (empyema).

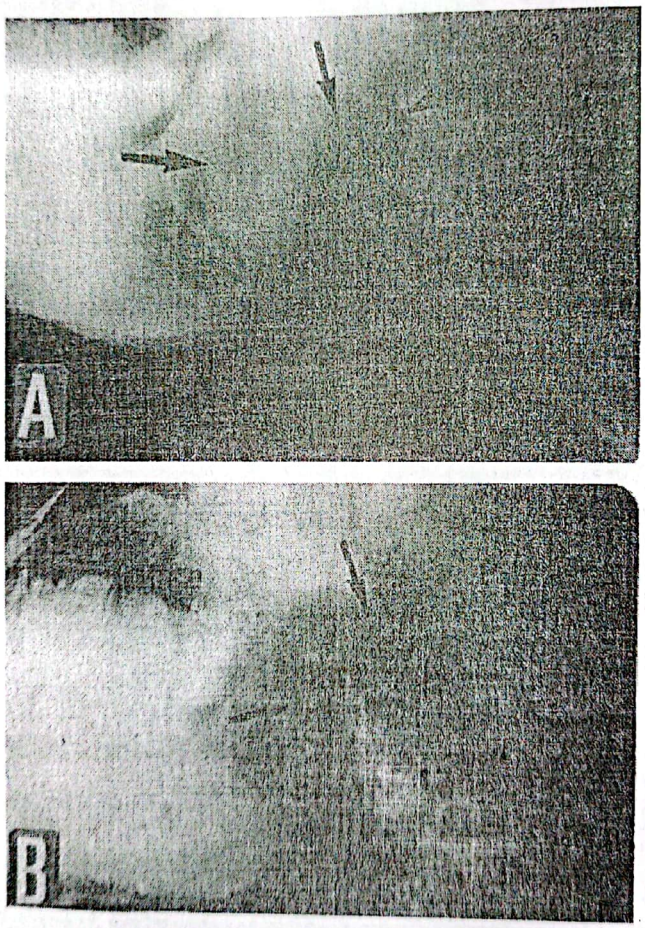


Fig. 5 (A & B): Lateral radiographic view of a donkey's head and neck.

A- An accumulation of radiopaque material in the GP (before treatment).

B- A normal radiolucent outline of the GP (after treatment).

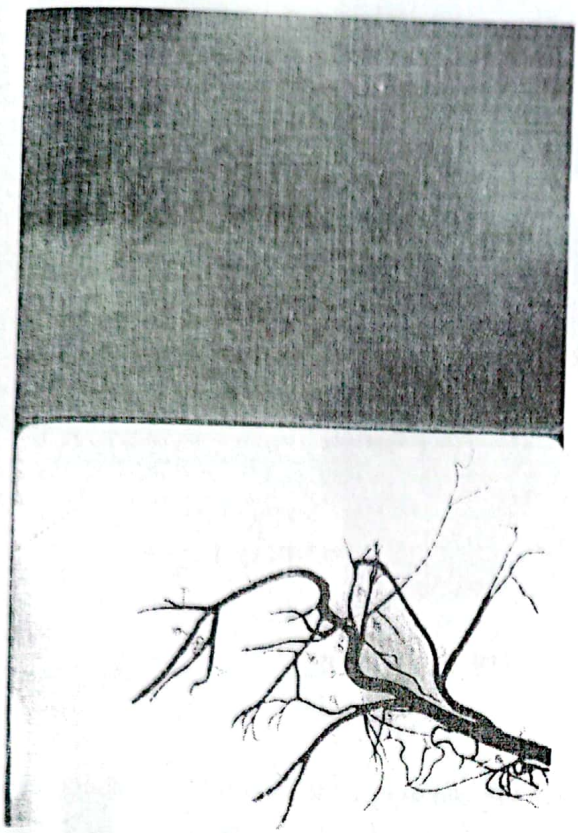

Fig. 6: Lateral angiogram of the head of a normal horse showing distribution of branches of the common carotid artery:
1-common carotid a.
2-external carotid a.
3-internal carotid a.
4-occipital a.
5-external maxillary (lingofascial)a.
6-thyrolaryngeal a.
7- massetric a. 8-pharyngeal a.
9- lingual a. 10- fascial a.
11- posterior branch of occipital a.
12- anterior branch of occipital a
13- posterior auricular a.
14- anterior auricular a.
15-internal maxillary a.
16-mandibular alveolar a.
17-external ophthalmic a.
18-ethmoidal a. 19- malar a.
20-sphenopalatine a.
21-great palatine a.

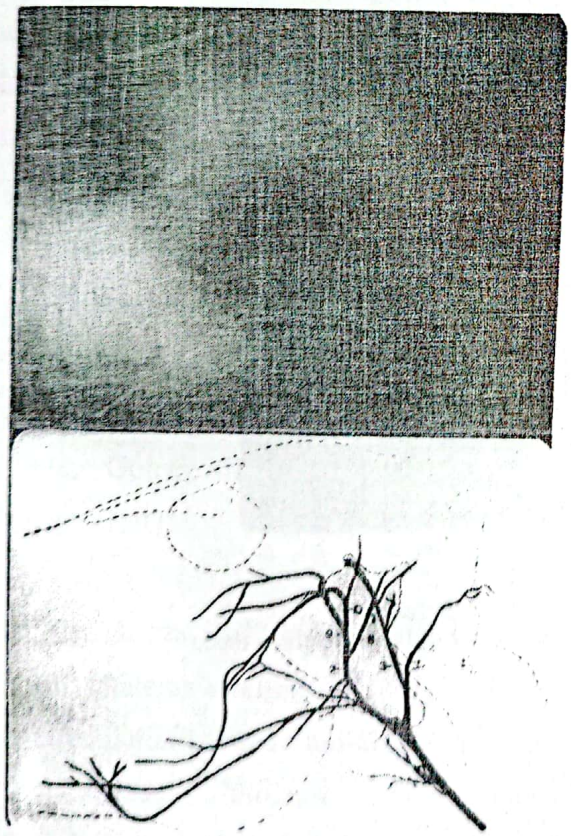

Fig. 7: Lateral angiogram of the head of normal donkey showing distribution of branches of the common carotid artery:
1-common carotid a.
2-external carotid a.
3-internal carotid a.
4-occipital a.
5-external maxillary (lingofascial) a.
6-thyrolaryngeal a.
7- pharyngeal a.
8-posterior auricular a.
9-internal maxillary a.
10- posterior auricular a.

Fig. (8): Anterolateral view showing a horse with empyema of the GP (solid arrow) and tracheostomy (open arrow).

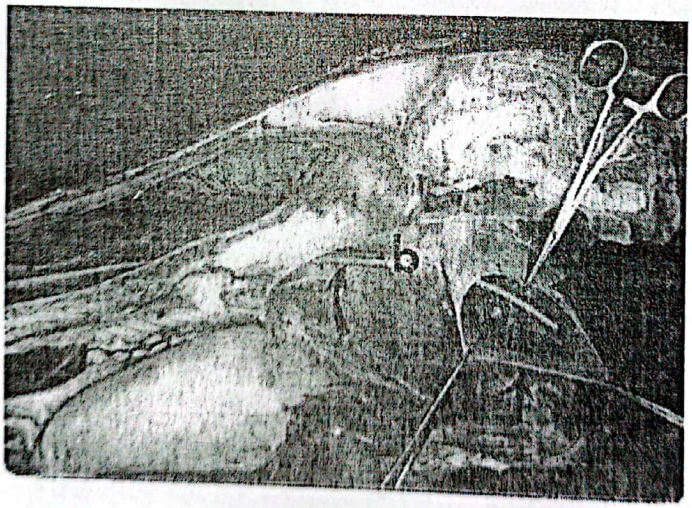


Fig. 9: A sagittal section of a horse's head with a catheter (arrow).
a- Guttural pouch. b- The nasopharyngeal orifice of the Eustachian tube.

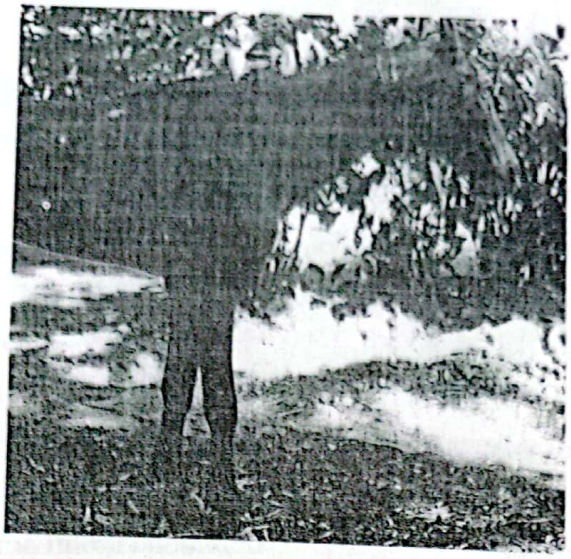

Fig. 10: Lateral view of two affected animals showing an indwelling catheter in the GP (arrows).

## DISCUSSION

Guttural pouch affections of the horse are given in several veterinary textbooks. However, due to infrequent occurrence of this condition, many veterinarians are unfamiliar with it (Wheat 1962).

In the present study the diagnosis of the clinical cases was based on the anamnesis; clinical findings, paracentesis, radiographic and microbiological examination (Lokai et al., 1976; Raker 1976; Trigo & Nickels 1981; Nyack et al., 1983; Freeman 1992; Gomezvillamandos et al., 1994; Muylle et al., 1997).

In this study, all cases of tympanites and empyema showed bilateral swelling of the parotid region; differentiation between uni-and bilateral involvement was through ventro-dorsal radiographic view and percutaneous aspiration which led to deflate of the affected GP (Raker 1976; Freeman 1980; McCue et al., 1989; Misk et al., 1992; Butler et al., 1993; Honnas & Pascoe 1996).

In the affected animals, occurrence of dyspnea and dysphagea with expulsion of food through nostrils and mouth may be attributed to either soft palate and pharyngeal paresis or mechanical pharyngeal and laryngeal compression by GP distention (Habel & King 1975; Scott McAllister 1977; Nyack et al., 1981; McCue et al., 1989; Radostitis et al., 1994; Honnas & Pascoe 1996; Mair et al., 1998).

Examination of the presented cases showed that tympany was relatively uncommon (2 out of 12 cases) and seen only in fillies. This confirms the previous observations of Wheat (1962); Gibbons

(1964); Johnson & Raker (1970); Milne & Fessler (1972); Forbes & Bennel (1975); Lokai et al., (1976); Raker (1976); Freeman (1980); Soliman (1986); Mcilwraith & Turner (1987); McCue et al., (1989); Tate et al., (1995); Mair et al., (1998) who stated that the tympany was more common in fillies than in colts.

Regarding GP tympanites in foals, the previous reports stated that the exact cause is not clear although a number of mechanisms have been postulated. The most popular theory suggested the possible presence of a congenital mucosal flap existing within the nasopharyngeal orifice that acts as a one-way valve, so that air can enter but not leave the GP (Holmes 1962; Wheat 1962; Cook 1966; Manson 1972; Milne & Fessler 1972; Raker 1976; Scott Mcallister 1977; Freeman 1980; Cook 1987; Mcilwraith & Turner 1987; Freeman 1992; Hawkins 1992; Mair et al., 1998). GP tympany could be also due to a functional muscle impairment of the stylopharyngeus or pterygopharyngeus muscle preventing proper closure of the pharyngeal orifice during resting respiration (McCue et al., 1989; Baptiste 1997).

All the affected animals with GP empyema in this study had a past history of strangles infection. The causative microorganism of strangles might be carried for a long period after an attack of strangles and that the infection was localized in retropharyngeal lymph nodes or GP resulting in pouch empyema (Nyack et al., 1981; White and Williamson 1987; Walmsley 1988; Freeman 1992; Butler et al., 1993; Golland et al., 1995; Newton et al., 1997; Mair et al., 1998; Khamis, 1999).

In this study, the carotid angiogram of normal guttural pouches in horses and donkeys was performed to demonstrate the carotid tree and the differences in-between. The external maxillary artery (lingofascial) arose directly from the common carotid artery and not as a branch of the external carotid artery. The external carotid artery lies most laterally on the lateral compartment in donkeys than in horse. The anterior and posterior auricular arteries were larger in donkeys than in horse. These findings help a lot in surgical management of the clinical cases (Colles & Cook 1983).

Surgical approaches of GP tympany provide the most satisfactory treatment. One involves enlargement of the pharyngeal orifice by mucosal flap resection of the pharyngeal opening (Holmes 1962; Manson 1972: Milne & Fessler 1972; Freeman 1980; Mcilwraith & Turner 1987; Freeman 1992) other by long-term implantation (8 weeks) of an indwelling catheter placed through the defect pharyngeal orifice (Hackathorn, 1975; Nyack et al., 1981; Freeman, 1992; Mair et al., 1998). The third involves fenestration of median septum between the GP especially in unilateral tympanites (Milne & Fessler 1972; Lokai et al., 1976; Raker 1976; Walsh & Weinberg 1979; Freeman 1980;

Tate et al., 1995). Misk et al., (1992) and El-Seddawy (1996) stated that external fistulation may be indicated as an alternative treatment for bilateral GP tympany with absence of median septum.

In the present study the decision of long-term implantation of an indwelling catheter, to create a large opening into the pharynx in cases of GP tympanites was according to Mair et al., (1998). In one filly, the pharyngeal orifice was found partially sealed after surgical intervention and tympany recurred. This might be attributed to inadequate time of plastic tube implantation (4 weeks). In the meantime, complete recovery of the other filly after 6 weeks implantation confirmed this postulation.

The classic approaches for GP drainage in cases of empyema are two-folds: one by placement of suitable catheter in the GP through ventral nasal meatus and pharyngeal orifice (Hackathorn 1975; Nyack et al., 1981; 1983; Freeman 1992). The second by surgical means through Viborg's triangle; hyovertebrotomy; whitehouse and modified whitehouse approaches (Holmes 1962; Raker 1976; Mcilwraith & Turner 1987; Walmsley 1988; McCue et al., 1989; Freeman 1992; Mair et al., 1998).

In this study, a hyovertebrotomy technique with ventral drainage was the approach of choice in cases of GP empyema. This technique provided better access to pharyngeal orifice interference, as it was located rostrodorsal to the floor of the GP and drainage could be achieved by lowering the horse head (Holmes 1962; Raker 1976; Freeman 1980; Walmsley 1988; Baber 1991). Viborg's triangle approach is not recommended as the access to the GP is very restricted; in addition to its critical manipulation because the presence of vital structures as jugular vein and internal carotid artery (Raker 1976; Mair et al., 1998). On the other hand, Abdel-Hamid et al., (1988) mentioned that trials for treatment of GP tympanites and empyema were unsuccessful in all handled cases contradicting with the findings of the presented cases.

In conclusion: long-term implantation of an indwelling catheter in the GP through the pharyngeal orifice, in addition to ventral drainage may be indicated in cases of GP tympany and empyema.

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## REFERENCES

Abdel-Hamid, M. A., Ragab, S. and Gohar, H. M.; (1988): Emphysema and empyema of the guttural pouch in donkeys. Alex. J. Vet. Sci, 4 (1): 409-418.

Baber, S. M., (1991): Diseases of the guttural pouches. In: In: Equine Medicine, Surgery, 4th ed. by Colahan, P.T., Mayhew, I.G., Merritt, A.M. and Moore,J.N Goleta, Californi: American Vet. Publications. PP: 402-411.

Baptiste, K. E., Grandage, J. and Johnson, K., (1993): Is the guttural pouch of the horse a brain-cooling device?. J. Anat., 183:174.

Baptiste, K. E., Hollady,S.D and Freeman, D. E., (1996): Alterations in guutural pouch morphology with head position: Observations using a new technique for producing accurate casts. The Anatomical record, 246: 579-584.

Baptiste, K., (1997): Functional anatomy observations of the pharyngeal orifice of the equine guttural pouch (Auditory Tube Diverticulum). Vet. J.,153: 311-319.

Baptiste, K., (1998): A preliminary study on the role of the equine guttural pouches in selective brain cooling. Vet. J., 155 (2): 139-148.

Butler, J. A., Colles, C. M., Dyson, S. J., Kold, S. E. and Poulos, P. W., (1993): Pharynx, larynx and Eustachian tube diverticulum. In: Clinical Radiology of the Horse. 1st. ed. by Oxford, Blackwell Scientific Publications.

Colles, C. M. and Cook, W. R., (1983): Carotid and cerebral angiography in the horse. Vet. Rec., 113: 483-489.

Cook, W. R., (1966): Clinical observations on the anatomy and physiology of equine upper respiratory tract. Vet. Rec. 79, (16) : 440-446.

Cook, W. R., (1987): Diseases of the Auditive Tube Diverticulum (Guttural Pouch ). In: Current Therapy in Equine Medicine. 2nd. ed. by Robinson, N. E., Philadelphia, W.B. Saunders Company. PP: 612-618.

Dyce, K. M., Sack, W. O. and Wensing, C. J. G., (1996): The head and ventral neck of the horse. In: Textbook of Veterinary Anatomy. 2nd. ed. Philadelphia, W.B. Saunders Company. PP: 501-504.

El-Seddawy, F. D., (1996): Surgical management of some guttural pouch affections in equines. Zag. Vet. J. ISSN. (1110-1458), 24 (1): 43-52.

Forbes, J. R. S. and Bennel, D. G., (1975): Tympany of the guttural pouch in a foal. Aust. vet. J., 51: 164.

Freeman, D. E., (1980): Diagnosis and treatment of diseases of the guttural pouch (part 1). Compend. Contin. Educ. Prac. Vet. 2: S3-S11.

Freeman, D. E., (1992): Guttural pouch. In: Equine Surgery. Ed. by Auer, J. A., W.B. Saunders Company. 480- 487.

Getty, R., (1975): Sisson and Grossman's The Anatomy of the domestic Animals. 2nd. ed., Philadelphia, W.B. Saunders Company. PP: 724-725.

Gibbons, (1964): Tymanites of the guttural pouch. Mod. Vet. Pract., 45 (14): 66

Golland, L., C., Hodgson, D. R., Davis, R. E., Rawlinson, R. J., Collins, M. B., McClintock, S. A. and Hutchins, D. R., (1995): Retropharyngeal lymph node infection in the horse: 46 cases (1977-2992). Aust. Vet. J., 72 (5):161-164.

Gomezvillamandos, R., Santisteban, J. M., Novales, M. Ruiz, I. and Avila, I., (1994): Empyema of the guttural pouches-description of a clinical case treated using endoscopy. Archivos De Medicina Veterinaria. 26 (1): 53-57.

Graber, A., (1984): Diagnosis and therapy of guttural pouch diseases in horses. Tierarztl. Prax. 12 (3):329-341.

Greene, H. J. and O'Connor, J. P., (1986): Haemangioma of the guttural pouch of 16-year-old thoroughbred mare: Clinical and pathological findings. Vet. Rec., 118: 445-446.

Habel, R. E. and King, J. M., (1975): Clinical anatomy of the guttural pouch (Diverticulm tubae auditivae). Proceeding of the 20th world Veterinary Congress, 6-12 July, 1975, Thessaloniki-Greece. PP: 113.

Hackathorn, T. A., (1975): A practical approach to the chronic pharyngitis/guttural pouch problem. Procc. of the 21th. Cong. of the Am. Ass. of Equine Prac., Canada., PP: 35.

Hance, S. R., Robertson, J. T. and Bukowiecki, C. F., (1992): Cystic structures in the guttural pouch (Auditory Tube Diverticulum) of two horses. J.A.V.M.A., 12 (15): 1981-1983.

Hawkins, D. L., (1992): Diseases Guttural pouch. In: Current Therapy in Equine Medicine. 3rd. Ed. by Robinson, N. E., Sydney: W. B. Saunders Company. PP: 275-280.

Holmes, R. A., (1962): The guttural pouch of the horse. M.od. Vet. Pract., 43 (6): 45- 49.

Honnas, C. M. and Pascoe, J. R., (1996): Guttural pouch diseases. In: Large Animal, Internal Medicine. 2nd. ed. by Smith, B. P., Mosby: Philadelphia, PP: 610-615.

Johnson, J. H. and Raker, C. W., (1970): The relationship of the guttural pouch to upper respiratory conditions. Proc. Am. Ass. Equine Practnr, 267.

Khamis, M.Y., (1999): Personal communication.

Lavoie, J. P., Couture, L., Higgins, R. and Laverty, S., (1991): Aerobic bacterial isolates in horses in a university hospital. Canad. Vet. J., 32 (5): 292-294.

Lokai, M. D., Hardenbrook, H. J. and Benson, G. J., (1976): Guttural pouch tympanites in a foal. VM/SAC : 1625-1627.

Mair, T., Love, S., Schumach, J. and Watson, E., (1998): Diseases of the auditory tube diverticulum (ATD) (guttural pouch). In: Equine Medicine, Surgery and Reproduction. Philadelphia, W.B. Saunders Company. PP: 84-89.

Manson, T. A., (1972): Tympany of the Eustachian tube diverticulum (guttural pouch) in a foal. Equine Vet. J.: 153-154.

McClure, J. J., (1984): Guttural pouch empyema and lymph node abscessation: Diagnosis and management. J.A.V.M.A., 185 (3): 324.

McCue, P. M., Freeman, D. E. and Donawick, W. J., (1989): Guttural pouch tympany: 15 cases (1977-1986). J.A.V.M.A., 194 (12): 1761-1763.

Mcilwraith and Turner, (1987): Surgical management of guttural pouch tympany (tympanites). In: Equine Surgery "Advanced Techniques" 1st ed. by Lea & Febiger. Philadelphia, PP: 235.

Merriam, J. G.,(1972): Guttural pouch fibroma in a mare. J.A.V.M.A., 161 (5): 487-489.

Milne, D. W. and Fessler, J. F., (1972): Tympanites of the guttural pouch in a foal. J.A.V.M.A., 161 (1): 61-64.

Misk, N. A., Ahmed, J. H. and Youssef, H. A., (1992): External fistulation for the treatment of guttural pouch tympany in two fillies. Equine Practice., 14 (1): 31-35.

Muylle, S., Vanloon, G., Deprez, P. and Simoens, P., (1997): Anatomic validation of guttural pouch endoscopy in the horse. Vlaams Diergeneekundig Tijdschrift. 66 (2): 75-80.

Newton, J. R., Wood, J. L. N., Dunn, K. A. DeBrauwere, M. N. and Chanter, N., (1997): Naturally occurring persistent and asymptomatic infection of the guttural pouches of horses with Streptococcus equi. Vet. Rec., 140 (4): 84-90.

Nyack, B., Willard, M. J., Grime, S., Stott, J. and Padmore, C. L., (1981): Chronic suppurative infection of the left

guttural pouch and Eustachian tube in a horse. VM/SAC: 1769-1772.

Nyack, B., Dennis, A. and Padmore, C. L., (1983): Empyema of the guttural pouch associated with Streptococcus equi and E. coli infection in a mare. Mod. Vet. Pract., 399-402.

Ohnesorge, B. and Deegen, E., (1995): Transendoscopic management of guttural pouch tympany in foals. PFERDEHEIL. KUNDE., 11 (4): 233-237.

Radostits, O. M. Blood, D. C. and Gay, C. C., (1994): Diseases of the guttural pouch. In: Veterinary Medicine. A textbook of the diseases of cattle, sheep, pigs, goats and horses, 8th ed. by EL BS with Bailliere Tindall, PP: 433.

Raker, C. W., (1976): Diseases of the guttural pouch. Mod. Vet. Pract.: 549-552.

Seahorn, T. L. and Schumacher, J., (1991): Nonsurgical removal of chondroid masses from the guttural pouch of two horses. J.A.V.M.A., 3 (1): 368-369.

Scott McAllister, E., (1977): Guttural pouch disease. Proc. of the 23rd. Cong. of the Am. Ass. of Equine Practnr. Canada, PP: 251.

Soliman, A. S., (1986): Bilateral guttural pouch tympanites in foal (case-report). Vet. Med. Review, No. 1 : 107-108.

Tate, L. P. J. Blikslager, A. T. and Little, E. D., (1995): Transendoscopic laser treatment of guttural pouch tympanites in eight foals. Vet. Surg., 24 (5): 367-372.

Trigo, F. J. and Nickels, F. A., (1981): Squamous cell carcinoma of a horse's guttural pouch. Mod. Vet. Pract., 62: 456-459.

Walmsley, J. P., (1988): A case of atlanto-occipital arthropathy following guttural pouch mycosis in a horse. The use of radioisotope bone scanning as an aid of diagnosis. Equine Vet. J., 20 (3): 219-220

Walsh, J. M. and Weinberg, H., (1979): tympanites of the guttural pouch in a foal. VM/SAC, 204-205.

Wheat, J. D., (1962): Tympanites of the guttural pouch of the horse. J.A.V.M.A., 140 (5): 453-454.

White, S. L. and Williamson, L., (1987): How to make a retention catheter to treat guttural pouch empyema. Vet. Med., 76-82.