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Topographical and Morphological Anatomy of the Guttural Pouches of the Domestic Donkey (Equus asinus)

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Abstract: Guttural pouches are paired filled with air, located ventral to the atlas. The donkeys possessed large, symmetrical guttural pouches incompletely divided into medial and lateral compartments by the stylohyoid bone. The left and right guttural pouches have almost the same capacity. In this study, topographic and morphologic anatomy of the left and right guttural pouches was carried out in the heads of male and female healthy donkeys. Results of the transverse and median sections of the heads revealed that the guttural pouches of donkey were much smaller than those of the horse. All the anatomical structures related to the guttural pouches of donkey resemble those in the horse with differences in the pharyngeal recess which was deeper and larger in donkey. The lateral walls of each guttural pouch contain the five cranial nerves (VII, IX, X, XI and XII), the cranial cervical ganglion, the cranial sympathetic trunk, the cranial laryngeal and pharyngeal nerves and the linguofacial trunk, maxillary vein, the internal carotid and branches of the external carotid arteries. The volumes of the guttural pouches in the males were larger than females. The length, width and depths of the lateral compartment in right side were more than left guttural pouch, while these values for medial compartments were reversed. The retropharyngeal lymph node which located under the floor of guttural pouch was found in both sexes.

Key words: Anatomy %Donkey (Equus asinus) %Guttural Pouch %Morphologic %Topographic

INTRODUCTION

The guttural pouches are large paired auditory tube diverticuli present in the horse as well as in other mammals [1, 2], such as horse, donkey, tapir [3, 4]. The pouches are symmetrically extended from the pharynx to the atlanto-occipital joint in both sides [5-8]. The right and left guttural pouches meet each other at the median part to form a thin membranous septum. Moreover, each pouch incompletely divided into medial and lateral compartments by the stylohyoid bone [5].

The physiological function, if any, of guttural pouches is unknown, but recently it has been proposed that they might have an important function of brain cooling [3, 5, 9] and also intimately involved in the physiology of swallowing [4, 10].

Because of their localization and relationship with several cranial nerves and blood vessels, the pouches are of veterinary importance in perissodactyls [3, 6, 7]. The diseases of the guttural pouch such as emphysema, mycosis, tympany, neoplasia, cysts and muscle ruptures can result in erosion of the carotid artery and precipitate fatal hemorrhages [11, 12], or make the pouch susceptible to serious clinical conditions [5].

Although, some advanced studies give adequate detail on the topographic and morphologic anatomy of the guttural pouch of the horse [4, 7, 9, 13, 14], to our knowledge there are limited reports in the literature pertaining to the topographic and morphologic anatomy of the guttural pouch of the donkey [15]. Therefore, this study was undertaken to investigate more precisely the anatomical features of the guttural pouches of the donkey bilaterally.
MATERIALS AND METHODS

Four healthy adult donkeys for teaching purpose in the Department of Anatomy, College of Veterinary Medicine, Shahrekord Islamic Azad University, Shahrekord, Iran, were used in this study (2 each sex). Euthanization were made by using 20\(^{th}\) of Acepromazine (2%; Alfason, Woerden, Holland) as a sedative and 250\(^{th}\) of Magnesium sulfate (29.1%, Sahand, Tabriz, Iran). The guidelines of the ethical committee of Shahrekord Azad University were strictly followed during the procedure. All the heads were cut off transversely at the level of the sixth cervical vertebra. Transverse section of the donkey’s head passed at the level of the medial canthus of the eyes, whereas median section passed longitudinally on the head. The volume, the maximum length, width and depth of the right and left pouches were measured in both sexes. The specimens were submerged in 10\% formalin and dissection was performed carefully on the anatomical structures related to the guttural pouches. Definitions of the anatomical structures were based on the atlases regarding equine anatomy [16, 17, 18]. All steps were photographed by digital camera (Sony, Cyber-shot, DSC-H10).

RESULTS AND DISCUSSION

The current study demonstrated that donkeys possessed relative large symmetric guttural pouches which extended from the pharynx to the atlanto-occipital joint in both sides [5-8, 15, 19].

Manglai et al. [7] described the opening of auditory tube as a funnel form canal. On the contrary, Oto and Haziroglu [19] emphasized that the entrance of the pharyngeal part of the pouches was like a triangle shape orifice. In this study, it clearly observed parallel data to Oto and Haziroglu [19].

Each pouch incompletely divided into medial and lateral compartments by the stylohyoid bone. They lie between the base of the skull (basilar part of the occipital and sphenoid bones) and atlas dorsally, the pharynx, retropharyngeal lymph node and commencement of the esophagus ventrally, the parotid and mandibular salivary glands, caudal belly of the digastric and pterygoideus medialis muscles, laterally. In the median plane, the left and right sacs were separated from each other by the rectus capitis ventralis and longus capitis muscles (Fig. 1). These results are in agreement with those recorded previously [3, 5, 15, 16, 19-21].

Oto and Haziroglu [19] and Manglai et al. [7] described that the dorsal side of the pouches consisted of hard tissue (sphenoid bone and occipital bone) and except for the region connected to the stylohyoid bone, the other walls were in contact with soft tissue such as pharynx, esophagus and many muscles. Similar findings were observed in this study.

The results of topographic anatomy showed that the pharyngeal recess in the donkey was deep and large. This finding agrees with those reported by Alsafy et al. [15] and Lindsay and Clayton [22]. It has been shown to have a close physical relation with the medial laminae and septum of the auditory tube diverticula. It is equally likely, therefore, that the excursions of the recess reflect pressure changes within the auditory diverticula and that the asymmetric movements of its wall are due to differing pressures in the two diverticula [22].

The internal carotid artery, the linguofacial trunk, the cranial cervical ganglion, the cranial laryngeal and pharyngeal nerves, as well as the facial nerve, glossopharyngeal N., vagus N., accessory N., hypoglossal N., branches of the external carotid and maxillary vein were present in the lateral walls of the guttural pouches (Figs. 2-4). These results are in agreement with those recorded previously [5, 7, 15, 19, 23].

The total mean volume of the guttural pouches in the male donkeys was more (195 ml) than that in the females (185 ml). This may be due to the bray mechanism. It is believed that a remarkable large size of pharyngeal recess plays a role in braying [22].

The capacity of the right and left guttural pouch in male donkeys were respectively 164 ml and 227 ml, whereas in the females were 190 and 180 ml, respectively. The different values for the capacity of the right and left guttural pouches may be due to the deviation of the head to the right or left during euthanization. Since declination of the head to the right or left reduces the volume of the right or left guttural pouches, accordingly.

Although, Lepage [21] has stated that the capacity of guttural pouches in horses were generally ranged from 300 to 600 ml, but Manglai et al. [7] reported that the capacity of guttural pouches in adult horses were 472 cm\(^3\). In comparison of the capacity of guttural pouches in horses with donkey, It was determined that the donkeys possessed smaller guttural pouches than horses.

The average length, width and depths of the lateral compartments of the right guttural pouches (24.65 cm, 5.10 cm, 2.85 cm, respectively) were more than those in left side (23.45 cm, 5.05 cm and 2.35 cm, respectively),
Fig. 1: The topography of the guttural pouch (G.P) and close structures in the donkey. Medial view, right lateral compartment (R.L.C), right medial compartment (R.M.C), left medial compartment (L.M.C) left lateral compartment (L.L.C), pharynx (P), larynx (L), basisphenoid bone (B.S), basilar part of occipital bone (B.O), rectus capitis ventralis muscle (R.C.V), atlas (A), pterygoideus medialis muscle (P.M), pharyngeal orifice of auditory tube (P.O.A.T), spinal cord (S.C), nasopharynx (N.P), pharyngeal recess (P.R), stylohyoid bone (S), sphenoidal sinus (S.S), soft palate (S.P), frontal sinus (F.S)

Fig. 2: Median section of the head of a donkey, basisphenoid bone (B.S), internal carotid a. (I.C.A), retropharyngeal lymph node (R.P.L.N), linguofacial trunk (L.T), hypoglossal nerve (H.G.N), guttural pouch (G.P)

Fig. 3: Median section of the head of the donkey passes at the level of the middle of the nuchal crest, atlas and axis bones. Stylopharyngeus caudalis muscle (S.C.M), occipitohyoideus muscle (O.H.M), hypoglossal nerve (H.G.N), maxillary vein (M.V), pharyngeal nerve (P.N), pharynx (P)
while these values in the medial compartments of the left guttural pouches (30.40 cm, 5.55 cm and 2.05 cm, respectively) were more than those in right side (29.20 cm, 5.25 cm and 2.10 cm, respectively).

Oto and Haziroglu [19] and Carmalt [5] reported that the medial compartment was larger than the lateral part. On the contrary, Manglai et al. [7] emphasized that the lateral compartment was wider and medial part was narrow. We clearly observed that the medial compartment was a little bigger than that of the lateral part.

CONCLUSIONS

The results of topographic and morphologic anatomy demonstrated that the guttural pouches of donkey were relatively smaller than horse. All the anatomical structures related to the guttural pouches resemble those in the horse with differences in the pharyngeal recess which was deeper and larger in donkey. The volume of the guttural pouch in the males was more than females.

REFERENCES


