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SOME MORPHOLOGICAL STUDIES ON THE VOMERONASAL ORGANS OF DONKEY

(With 1 Table and 6 Figures)

By

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**بعض الدراسات التشريحية والهستولوجية على العضو الأنفي الميكعي
في الحمير**

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أجرى هذا البحث على عدد (١٥) رأس حمار بالغ صحيح ظاهريا من كلا الجنسين. لفحص العضو الأنفي الميكعي وقد وجد أن هذا العضو يتكون من غضروف أنبوبي الشكل ويقع في قاع التجويف الأنفي على جانبي الحاجز الأنفي ويمتد لمسافة ٩-٣ سم حيث تكون بدايته من الخلف مسدودة ويمر من الأمام في الشق الحنكي حيث يتحد مع القناة القاطعية قبل نهايتها تحت الجزء الأمامي من الحنك الصلب. والقناة القاطعية في هذا الحيوان نهايتها مسدودة من ناحية التجويف الفمي وتختلف في هذا عن كثير من الحيوانات الأخرى. أما من الناحية الهستولوجية فإن قناة العضو الأنفي الميكعي تبطن من الناحية الأنسية بالغشاء الطلائحي الشهي ومن الناحية الوحشية فتبطن بالغشاء الطلائحي العمادي المهذب من الأسام والغشاء الشهي مركب العمادي المهذب من الخلف. أما الجزء الغضروفي فهو من النوع المطاطي.

SUMMARY

The vomeronasal organ was a tubulo-cartilaginous organ presented in the floor of the nasal cavity under the mucous membrane on either sides of the ventral border of the nasal septum. It formed of a duct surrounded by a cartilage. The rostral end of the vomeronasal organ passed through the palatine fissure to join the incisive duct just before its rostral end under the mucous membrane of the hard palate. The length of this organ was 9-13 cm. Microscopically, the vomeronasal duct was lined on the medial side by an olfactory epithelium while the lateral side was lined with stratified columnar ciliated epithelium rostrally and pseudostratified ciliated columnar epithelium caudally. The lamina propria submucosa consisted of loose connective tissue with large blood vessels and very

rich in serous or seromucoid glands laterally. Medially, the glands were very few and the majority of the vomeronasal nerve fibers were found. The vomeronasal cartilage was elastic in type, which is different from that described in the available literature.

Key words: Vomeronasal organs, donkey.

INTRODUCTION

The vomeronasal organ of the domestic animals consists of a pair of ducts which lies in the floor of the nasal cavity on each side of the nasal septum, the epithelial lining of the ducts resembles that of the nasal cavity and contains elements of both the respiratory and olfactory regions (Nickel, Schummer, Seiferl and Sack, 1973). This organ is formed from tubular hyaline cartilage lined internally by respiratory mucosa except a strip along the medial wall that bears an olfactory like epithelium, its lamina propria contains serous glands (Trautman and Fiebiger, 1957). Crypt like glandular invaginations containing mucous cells and ciliated cells are frequently observed and the propria submucosa has mucous or mixed glands (Dellman and Brown, 1992). In horse and donkey, the vomeronasal organ are mucous membranous tubes enclosed totally, except their extremities in a hyaline cartilage capsule (Lindsay, Clayton and Piric, 1978). The stimulation of the vomeronasal organ in mammals induces sexual behaviour and changes the hormonal status of males and females (Trotier, Dring and Floit, 1996). The meagre literature about the vomeronasal organ in donkey attracted the attention of the authors to give a more informations on the morphology of such organ in this animal.

MATERIALS and METHODS

This work was carried out on 15 apparently healthy adult donkeys of both sexes. 10 donkeys were used for gross anatomical study and 5 donkeys were used for histological study. The animals were bled by incision of the common carotid artery and the histological samples were taken just after bleeding.

The bled animals were injected through the common carotid artery by formalin solution 10% for preservation. For gross anatomical study, sagittal sections were carried out and 5 specimens were injected with coloured latex..

For histological study, small pieces from different parts of the vomeronasal organ were taken and fixed in Bouine's solution for 24 hr. After proper fixation, the specimens were dehydrated in ascending grades of alcohol then some specimens decalcified in formic acid 5% for 3-4 days. Then cleared in methyl benzoate and embedded in paraffin. Sections were obtained at 5-7 μ m thickness and stained with Haematoxylin and Eosin, Periodic Acid Schiff technique, and Verhoeff's method for elastic fibers.

All stain techniques were adapted to that reported by Bancroft and Stevens (1990).

RESULTS

The vomeronasal organ was a tubulo-cartilaginous organ presented in the floor of the nasal cavity under the mucous membrane on either sides of the ventral border of the nasal septum. It formed of a duct surrounded by a cartilage. The duct was enclosed by the cartilage and supported by the vomer bone. The cartilage enclosed the duct along its whole length except at its extremities. The vomeronasal duct was nearly straight except at its opening into the incisive duct rostrally, where the vomeronasal organ became convex laterally. The rostral end of the vomeronasal organ passed through the palatine fissure to join the incisive duct just before its rostral end under the mucous membrane of the hard palate. Since, the incisive duct did not open into the oral cavity, the vomeronasal organ was not communicated with the oral cavity but opened indirectly into the nasal cavity through the incisive duct. The caudal end of the vomeronasal organ was blind and leveled with the second cheek tooth. The length of this organ was about 9-13 cm (Fig. 1, 2 & 3).

Microscopically, the vomeronasal organ formed of the vomeronasal duct, the vomeronasal cartilage, nerve fibers, blood vessels and glands. The vomeronasal duct lined on the medial side by an olfactory epithelium (Fig. 4) while the lateral side was lined with stratified columnar ciliated epithelium rostrally and pseudostratified ciliated columnar epithelium caudally. The lamina propria submucosa consisted of loose connective tissue with large blood vessels and very rich in serous or seromucoid glands laterally, while medially, the glands were very few and the majority of the vomeronasal nerve fibers presented (Fig. 5). The vomeronasal cartilage was elastic in type (Fig. 6) and enclosed the vomeronasal duct completely except at a small dorsal opening from which the large nerves emerged (Fig. 5). In the

cross section of this organ, the lumen of the vomeronasal duct appeared elliptical and the organ appeared semicircular or half moon shaped owing to the lateral thick connective tissue area.

DISCUSSION

In the present study, the vomeronasal organ was a paired tubulo cartilaginous structure presented under the mucous membrane of the floor of the nasal cavity on both sides of the nasal septum. It was communicated with the incisive duct which was blind orally, therefore, the organ communicated indirectly with the nasal cavity only and not communicated with the oral cavity. These results simulated the findings in the horse (Bradley and Grahame, 1947, El-Hagri, 1967; Hare, 1975 and Schummed *et al.*, 1979) and camel (Badawi and Fath El-Bab, 1974) and disagreed with the findings in other domestic animals in which the vomeronasal organ was communicated with the oral cavity through the incisive duct which opened into the oral cavity (Hare, 1975 and Schummer *et al.*, 1979).

The caudal blind end of the vomeronasal organ in the present investigation leveled with the second cheek tooth while it leveled with the second to fourth cheek tooth in the horse (Bradley and Grahame, 1947, Hare, 1975 and Schummer *et al.*, 1979), Frewin, 1972, stated that the caudal end of the vomeronasal organ extended to 2 cm rostral to the first cheek tooth in ox, and to the level of the fourth cheek tooth in sheep, second cheek tooth in goat, first premolar in foal and cat, third cheek tooth in dog and third incisor in the pig. Regarding the length of the vomeronasal organ, species variation was observed (Table 1).

The vomeronasal duct in the donkey was enclosed in the vomeronasal cartilage along its whole length except at its extremities. This result resembled that reported by Lindsay *et al.* (1978) in donkey and horse. The vomeronasal cartilage in the donkey was found to be elastic in type. This result is in contrast with that of Lindsay *et al.* (1978) and Dellman and Brown (1992), in the donkey, horse and in domestic animals, who mentioned that the vomeronasal cartilage was hyaline in type. In the current study, the lining epithelium of the vomeronasal duct was olfactory type medially and pseudostratified ciliated columnar to stratified ciliated columnar laterally, this is in great resemblance with the Trautmann and Fiebiger (1957) in the domestic animals, Filotto and Vigo (1957) in equines and bovines, Lindsay *et al.* (1978) in donkey and horse and Dellmann and Brown (1992) in domestic animals. The glands

were found to be concentrated in the propria submucosa of the lateral side of the duct and were mainly serous or seromucoid in nature, this agreed with the results of Lindsay *et al.* (1978) in donkey and horse but differed from that of Dellmann and Brown (1992) in domestic animals who stated that these glands were mucous in nature or seromucoid.

The function of the vomeronasal organ has been the subject of considerable speculation Read (1988) in dog, cat and man described it as being closely related to the olfaction. Negus (1956) in the dog stated that the most likely function of the organ is related to the after smell of the food rather than to its immediate detection and associated with the secretion of gastric juice is possible. Arey (1965) recorded that this organ is not functional in man, yet, in many tetrapods it evidently constitute a supplementary olfactory apparatus. Lindsay *et al.* (1978) in the donkey and horse stated that, the possible function of the vomeronasal organ is related to the sexual behaviour. Schummer *et al.* (1979) added that this organ performs a special olfactory functions notably the investigation of urinary pheromones, which is very important not to trespassing other animals territories. This seems to be related to the "Flehmen" reaction, a peculiar sustained retraction of the upper lip.

Table 1: Showing the length of the vomeronasal organ in different species.

Animal	Length	Reference
Donkey	9-13 cm	Present study
Horse	15-20 cm	Hare, 1975 and Schummer <i>et al.</i> , 1979
Ox	15-20 cm	Schummer <i>et al.</i> , 1979
Buffalo	13-26 cm	Abdel-Aziz, 1983
Sheep	7 cm	Hare, 1975
Goat	6-7 cm	Gharib <i>et al.</i> , 1983
Camel	19 cm	Badawi and Fath El-Bab 1974
Pig	2 cm	Schummer <i>et al.</i> , 1979
Dog	2-3 cm	Hare (1975)

REFERENCES

- Abdel-Aziz, S.E. (1983):* Some anatomical studies on the nasal cavity of the buffalo in Egypt (*Bos bubalis*). M.V.Sc. Thesis, Zagazig University, Egypt.
- Arey, L.B. (1971):* Human Histology, A textbook in outline form. 3rd ed. Kotari Book Depot., Bombay, Madras, Ahmed Abad, Poona, Indore, Hyderabad.
- Badawi, H. and Fateh El-Bab, M.R. (1974):* Anatomical and Histological studies on the nasal cavity of the camel. *Assiut Vet. Med. J. Vol. 1(1,2):* 3-14.
- Bancroft, J.D. and Stevens, A. (1996):* Theory and Practice of Histological Technique. 4th ed. Churchill & Livingstone, New York.
- Bradley, O.C. and T. Grahame (1947):* The topographical anatomy of the head and neck of the horse. Green, Son. Ltd., Edinburgh, London.
- Dellmann, H.D. and E.M. Brown (1992):* Text book of veterinary histology, 2nd ed., Lea & Febiger, Philadelphia, USA.
- El-Hagri, M.A.A. (1967):* Splanchnology of Domestic Animals. The Public organization for books and scientific appliances. Cairo University press, Cairo.
- Filloto, U. and A. Vigo (1957):* Morphology and histology of vomeronasal organ in horse and ox. *Atti, Soc. Ital. Scienze Vet. Vol. XI, 771-775.*
- Frewein, J. (1972):* Rontgenanatomie des organum vomero nasale bei den Hianssayetieren. *Zbl. Vet. Med. C., 1, 55-63.*
- Gharib, N.A.; E.L.S. Mossalami; M.A. El-Sakhawy; M. El-Ayat and S. Nawar 91982):* The glandular elements of the nasal mucosa of buffalo in Egypt. *Egypt. Soc. of Histology and Cytology, 6th Scientific Conference.*
- Here, W.C.D. (1975):* Equine, ruminant respiratory system in Sisson and Grossmans the anatomy of domestic animals. W.B. Saunders Company, Philadelphia, London, Toronto.
- Lindsay, F.E.F.; H.M. Clayton, and M.E.S. Pirie, (1978):* The vomero nasal organ of the horse and donkey. *J. Anat., 127(3):* 655.
- Negus, V.E. (1956):* The organ of Jacobson, *J. Anat. 90(4):* 515-519.
- Nickel, R.; A. Schummer; E. Seiferle and W.O. Sack (1973):* The viscera of the domestic mammals. 1st ed. Verlage Paul Parey, Berlin, Hamburg.

- Read, E.A. (1908):* A contribution to the knowledge of the olfactory apparatus in dog, cat and man. *Am. J. Anat.*, Vol. VIII, 17-47.
- Schummer, A.; R. Nickel, and W.O. Sack, (1979):* The viscera of domestic mammals. Vol. 2. Verlag-Paul Parey, Berlin, Hamburg English ed.
- Trautmann, A. and J. Fiebiger, (1957):* Fundamentals of histology of domestic animals. 8th Ed., pp. 230-239, Comstock Publishing Associates, Ithaca, New York.
- Trotier, D.; Dving, M. and Ebit, C. (1996):* The vomeronasal organ-a rediscovered sensory organ. *Tidssk Nor Laegeforen.* 116(1): 47-51.

LEGENDS OF FIGURES

- Fig. 1:** A photograph of sagittal section of the rostral end of the nasal cavity (medial view) showing:
The vomeronasal organ injected with coloured latex" (1).
The dorsal nasal Concha (2)
The ventral nasal Concha (3)
The straight fold (4)
The alar fold (5)
The basal fold (6).
- Fig. 2:** A Photograph of sagittal section of the rostral part of the nasal cavity (medial view) showing:
The vomeronasal organ (1).
The incisive duct (2)
The straight fold (3).
The alar fold (4).
The basal fold (5).
- Fig. 3:** Stereo microscopic picture of the vomeronasal organ and the ventral part of the nasal septum showing:
The cartilage of the nasal septum (1)
The mucous membrane of the septum (2)
The vomeronasal duct lumen (3)
The vomeronasal cartilage (4)
(Stain: PAS, H X = 12)
- Fig. 4:** Microscopic picture of the vomeronasal organ of the donkey showing:
The medial olfactory epithelium (1)
The lateral stratified ciliated columnar epithelium (2)
(Stain H & E, X = 400)
- Fig. 5:** Microscopic picture of the vomeronasal organ showing:
The vomero nasal cartilage (1)
The vomero nasal duct (2)
The nerve fibers (3)
(Stain: PAS, X = 40)
- Fig. (6):** Microscopic picture of the vomero nasal organ showing:
The elastic cartilage of the vomero nasal organ (1)
The vomero nasal duct lumen (2)
(Stain: Verhoeff X = 40)



