Beni-Suef University Journal of Basic and Applied Sciences xxx (2017) xxx–xxx

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Contents lists available at ScienceDirect

Beni-Suef University
Journal of Basic and Applied Sciences

journal homepage: www.elsevier.com/locate/bjbas

Full Length Article

Morphological, histochemical and computed tomography on the vomeronasal organ (Jacobson's organ) of Egyptian native breeds of goats (*Capra hircus*)

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ARTICLE INFO

Article history:
Received 13 March 2017
Received in revised form 14 March 2017
Accepted 14 March 2017
Available online xxxx

Keywords:
Computed tomography
Goats
Jacobson's organ
Morphology
Nasopalatine duct

ABSTRACT

Background: The vomeronasal organ (Jacobson's organ) is a chemosensory paired tubular organ located on both sides of the nasal septum at its base. It plays an essential role in reproduction process and social behaviors. *Objective:* The current study investigated both anatomical and histological structure of the vomeronasal organ (VNO) in Egyptian native breeds of goats using cross sectional anatomy, histological techniques and computed tomography (CT). *Methodology:* A total of thirty heads obtained from adult and apparently healthy goats of both sexes were collected from Beni-Suef slaughterhouse in Beni-Suef province, Egypt then subjected to anatomical, histological and computed topographical studies. *Results:* Grossly, the VNO appeared as two blind ducts on the either sides of the nasal septum at the floor of nasal cavity extending from the nasal opening of incisive papilla rostrally to the upper 2nd premolar teeth caudally. It connected with mouth by two nasopalatine ducts. The histological examinations revealed two types of lining epithelium; non sensory type lining the cranial portion and the lateral wall of the middle portion of the vomeronasal duct (VND), whereas an olfactory type was the lining epithelium of the medial wall of the middle and the whole caudal portions. The lamina propria submucosa exhibited vascular loose connective tissues, serous glands, nerve bundles and encapsulated by hyaline cartilage. *Conclusion:* The obtaining olfactory epithelium in VNO may indicate an essential role of this organ in sexual relationships and sociosexual behaviors through perception of pheromones.

1. Introduction

In mammals, the olfactory system composed of two different anatomically and functionally portions; the main olfactory system represented by main olfactory epithelium, and the vomeronasal system. The VNO comprises a part of vomeronasal system (Halpern and Martinez-Marco, 2003), and it acts as a chemoreceptive, chemosensory, paired tubular organ located on both sides of the nasal septum at its base (Schneider et al., 2008), with a length varies from 2 to 20 cm according to the size of mammals (Takigami et al., 2000).

The mammalian incisive, nasopalatine, duct maintains the communication between the oral and the nasal cavities except in horse and camel, where the oral opening is obliterated by the oral mucosa (Dyce et al., 2010; Hytell et al., 2010). It has two openings; oral and nasal. The former opens into incisive papilla behind the dental pad (Dyce et al., 2010), and the latter connected with the VNO (Besoluk et al., 2001; Dyce et al., 2010; Kassab and El-Shafey, 2012; Park et al., 2013).

In most animal species, the lumen of the VND is lined by sensory and non-sensory epithelium (Halpern and Martinez-Marco, 2003). Only in particular portions of the duct, the medial part carry sensory and the lateral one has respiratory epithelium (Salazar et al., 2000; Kassab and El-Shafey, 2012). It often encircled by an incomplete sheath of hyaline cartilage or bone.

Computed tomography (CT) is an accurate tool of diagnostic imaging with the assumption that unlike gross anatomical sections, CT can do for live individuals (Seddek et al., 2014). It is more accurate than plain radiography in the ability to visualize internal anatomy (Mackey et al., 2008).

Vomeronasal organ plays an essential role in mediating responses to many pheromone-like signals (Keller et al., 2009), recognition of various forms of chemical signal (Yoon et al., 2005). It may be involved in displaying flehmen responses to pheromones in many felids and ungulates (Abbasi, 2001; Besoluk et al.,

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http://dx.doi.org/10.1016/j.bjbas.2017.03.003
2314-8535/

Please cite this article in press as: Moawad, U.K., et al. Morphological, histochemical and computed tomography on the vomeronasal organ (Jacobson's organ) of Egyptian native breeds of goats (*Capra hircus*). Beni-Suef Univ. J. Basic Appl. Sci. (2017), http://dx.doi.org/10.1016/j.bjbas.2017.03.003

2001), urinary pheromones sensation (Abass et al., 2012) and determination the flavor of the ingested food in the mouth (Altaii, 2010). Inflammation of such VNO caused some behavioral disorders such as aggression in cats (Asproni et al., 2015). However, Booth and Webb (2011) reported that rendering VNO function through surgical cauterization of the nasopalatine duct under general anesthesia decreased pregnancy rate in does. Impairment of VNO in guinea pigs results in decrease the ability of males to mount, females did not show lordosis, lost interest to males and therefore number of pregnant animals decreases (Johnston and Peng, 2000).

Scarce data is available on the histomorpholgy of VNO in the Egyptian native breeds of goats and so this article aims to illustrate the morphological anatomy, topography, histological and histochemical structure of VNO in addition to topographic anatomy and computed topography of nasopalatine duct in goats using the cross sectional anatomy, computed tomography and histological stains.

2. Materials and methods

2.1. For gross examination

Twenty heads of adult apparent healthy goats (10 male and 10 female) aged 1.5 years were collected from Beni-Suef slaughterhouse in Beni-Suef province, Egypt following the guidelines given by the Institutional Ethical Committee. The collected heads were washed carefully using tap water and the incisive duct was irrigated with warm saline to remove any depresses. Five heads of the collected specimens were used for computed topography by using technical setting 120 KV and 250 mA. Transverse CT images were acquired perpendicular to the hard palate. Next Five heads were frozen and serially cut into cross sections (2 cm thickness) from the rostral nasal region, about 1 cm caudal to the incisive papilla, till the level of the caudal border of 2nd premolar tooth. The obtained slices were gently cleaned from debris using tap water and light brush, numbered and photographed immediately with the caudal surface of each slice facing the camera (Seddek et al., 2014; Abedellaah et al., 2015). The remainder ten heads were used as fresh samples to study the morphological topography of nasopalatine duct and VNO by making sagittal sections. Lengths and diameters of the nasopalatine duct and VNO were measured.

2.2. For histological examination

Ten adult and apparently healthy goats (5 males and 5 females) weighted 25–40 kg were used for histological study. Heads of slaughtered goats were obtained immediately after slaughtering the animals from Beni-Suef abattoir, Egypt following the guidelines given by the Institutional Ethical Committee. Specimens from cranial, middle and caudal portions of the VNO were obtained after

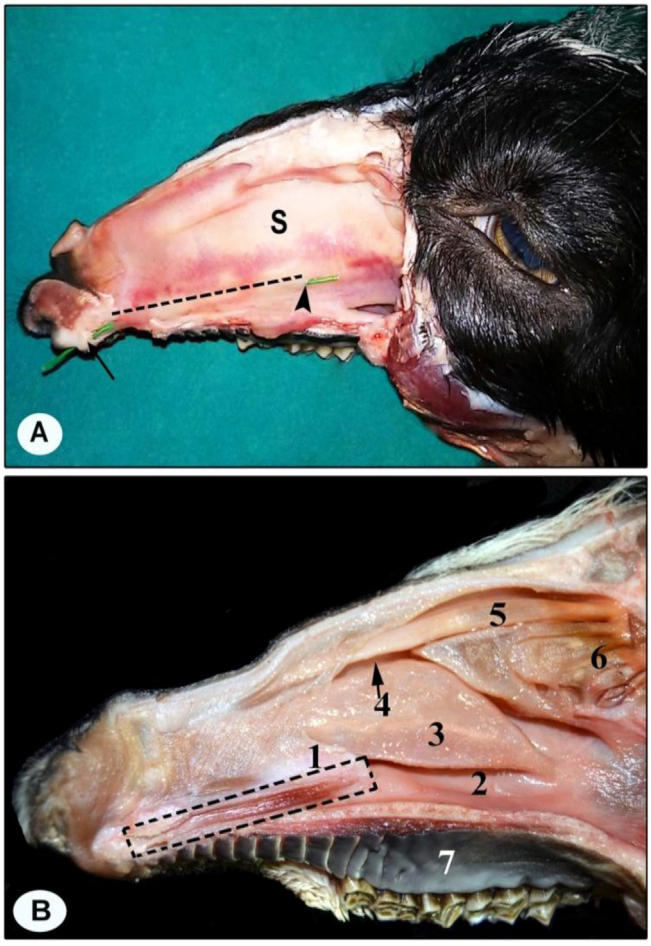

Fig. 1. (A) Photograph of Sagittal section of the nasal cavity on the right side showing nasal septum (S), VND extended from caudal aspect of the nasal opening of the incisive duct (arrow) till the second premolar tooth. Note: The green wire passes inside the nasopalatine duct, then pass through the vomeronasal organ till it perforate its caudal blind end (head arrow). (B) Photograph of Sagittal section of the nasal cavity on the right side after removal of mandible. VNO (1), Ventral nasal meatus (2), Ventral nasal concha (3), Dorsal nasal meatus (4), Dorsal nasal concha (5), Ethmoidal conchae (6), Hard palate (7).

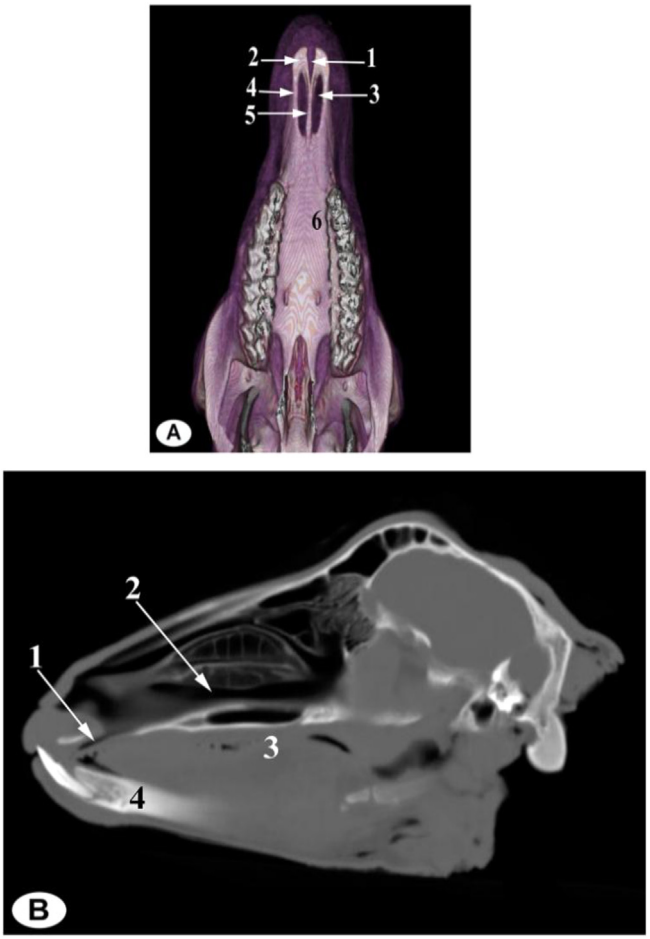

Fig. 2. (A) CT image of the ventral aspect of the skull. Incisive fissure (1), body of incisive bone (2), palatine fissure (3), nasal process of incisive bone (4), palatine process of incisive bone (5), palatine process of maxilla (6). (B) Lateral CT scan. Oral openings of the nasopalatine duct (1), Ventral nasal meatus (2), oral cavity (3), mandible (4).

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