International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG(USA) Volume 4, Issue 11 - 2017

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2017.04.11.005

Parotid and Mandibular Salivary Glands Segmentation Of The One Humped Dromedary Camel (*Camelus dromedarius*)

Hamdy M. Rezk and Nora A. Shaker*
Department of Anatomy and Embryology, Faculty of Veterinary Medicine, Cairo University, Egypt
*Corresponding author: *dr_norashaker@yahoo.com*

Abstract

The present study provides detailed anatomical description of the parotid and mandibular salivary glands of the one humped camel with their segmentation based on arterial blood supply and salivary ducts; to facilitate partial removal of the pathologic gland. The shape, position, relations and blood supply of both salivary glands with their ducts were studied on six cadaveric heads. The mandibular and parotid ducts were injected with Urographin® as contrast medium; through inserting the catheter into their openings in the oral cavity; then applying lateral radiography immediately after the injection. The common carotid arteries were injected with red Latex Neoprene and dissected. The parotid gland was irregular rectangular and had five processes while the mandibular gland was irregular triangular with rounded proximal and pointed distal extremity. The parotid duct enters the oral cavity on the cheek opposite the upper 4th molar tooth. The mandibular duct opens in the oral cavity at the sublingual caruncles on the sublingual floor, just about 2cm cranial to frenulum linguae. Both The parotid and the mandibular salivary glands could be divided into four segments**.** Partial removal of the pathologic parotid or mandibular salivary glands could be performed based on their segmentation. Tumor arrest could be established by ligation of the arterial supply of specific part of the gland.

Keywords: parotid; mandibular; salivary gland; segmentation; radiology; dromedary camel.

Introduction

The salivary glands are known as multifunctional organs that perform many important digestive, protective, excretory and endocrine functions (Miletich, 2010). They collectively produce and secrete saliva, a fluid that assists in the initial activities of digestion (Micheal and Valerie 2006).

The study of the salivary gland forms an important link between the anatomy and surgery, however available literatures lake detailed information about the surgical anatomical characters of the salivary glands in dromedary camel. The salivary glands and ducts may be affected by inflammation, calculus formation (sialoliths), rupture or neoplasia. Sialoadenitis is commonly associated with salivary mucoceles. The recognition and treatment of these lesions depend on an adequate knowledge of anatomy of the salivary glands and their ducts (Ettinger and Feldman, 2010; Reece, 2004; Termote 2003; Dehghani and Tabatabei, 1993).

Our study is helpful in diagnosis of pathological conditions of these glands as parotid swelling and large parotid duct mucocele with a calculus. Sometime the duct is damaged, lead to saliva escape to form a large submucosal swelling (runula) to the tongue so surgical interference as parotidectomy was performed. (Pospieszng et al., 2010; Cunningham and Klein, 2007; Ong et al., 2005; Dunning 2003 and Pal, Chandra and Bharadwa, 1992). Also, it assists in approaching at a clinically cases as it was useful in sialography protocol.

Materials and Methods

The present study was conducted on six fresh heads of apparently healthy camel were collected from the slaughter house to identify the anatomical features of the monostomatic salivary glands, their ducts and their arterial blood supply. For morphological studies; two heads were preserved in 10% formalin for two days prior to dissection. The length and width of the glands and their ducts were measured. Two specimens were injected through their ducts and the common carotid artery with colored latex neoprene for describing the intra-glandular distribution of each duct and the glandular blood supply. The salivary ducts of two heads were injected with Urographin® as contrast medium and lateral radiography was applied immediately. The exposure factors were 100 cm. FFD, with 15 mAs and 55 KV.

Results

The parotid salivary gland:

The parotid salivary gland (fig.1/I) was irregular rectangular in shaped. It had five processes; two processes at dorsal border, the latter was notched by the base of the ear, the preauricular and postauricular processes (fig.1/1,2). Moreover, two processes at its ventral border; the rostral one related to the caudal angle of the mandible so called mandibular process (fig.1/3) while the caudal process related to the bifurcation of jugular vein so termed jugular or (maxillary) process (fig.1/4).

The parotid salivary gland was located on the caudal part of vertical ramus of the mandible and masseter muscle, ventral to the wing of the atlas and attached to the base of the ear. It partially covered the mandibular salivary gland. Its length was 11 ± 0.54cm and its width 7 ± 0.62 cm. It had true facial capsule and partially covered by parotidoauricularis muscle. The rostral border of the glandrelated to masseter muscle. It was concave dorsally and ventrally and carried the masseteric process (fig.1/5) in the middle. The dorsal concavity occupied and partially covering the parotid lymph node. However, the caudal border of the gland was convex dorsally and concave ventrally. That border overlapped the obliquus capitis caudalis muscle, the mandibular salivary gland and the external jugular vein.

The parotid duct (fig. 1/6) emerged from the inner surface of the ventral concavity of the rostral border. It passed a rostral superficial course (5 ± 0.5cm) then inclined dorsally between the masseter muscle and zygomaticus. Finally, it turned medially to pierce the cheek opposite the fourth upper cheek tooth. It opened into the buccal vestibule as the parotid papilla (fig. 1/7). The parotid duct crossed caudally by the ventral buccal branch of facial nerve and passed rostral between the facial vein laterally and the facial artery medially. The parotid duct measured about 20 ± 0.41cm in length and 0.5 ± 0.2cm in diameter.

The parotid duct was formed by four radicals (fig. 1/8,9,10,11). The first one (fig. 1/8) was short and drained the mandibular process. It aroused from two small branches. The second radical (fig. 1/9) formed by two branches and drained the jugular process. The third radical (fig. 1/10) was the largest; it drained the postauricular process and the caudal border of the gland. The fourth radical (fig. 1/11) was long and drained the preauricular process and the rostral border of the gland.

The arterial supply of the parotid salivary gland was numerous and came from several arteries; facial, superficial temporal, transverse facial, rostral auricular and caudal auricular arteries (fig. 1/12,13,14,15,16). The curved part of the facial artery (fig. 1/12) supplied the mandibular process by two branches. The straight part of the facial artery supplied the jugular process by one branch. The caudal auricular artery (fig. 1/16) supplied the dorsal part of the caudal border. While, the dorsal part of the rostral border was supplied by branches from the superficial temporal, transverse facial and rostral auriculararteries (fig. 1/13, 14, 15)

According to the intra-glandular distribution of the arteries and duct, the parotid salivary gland could be segmented into four segments. The mandibular process segment, the jugular process segment, the caudal border and post-auricular process segment as well as the rostral border and the pre-auricular process segment (fig.1.diagram/17,18,19, 20 respectively).

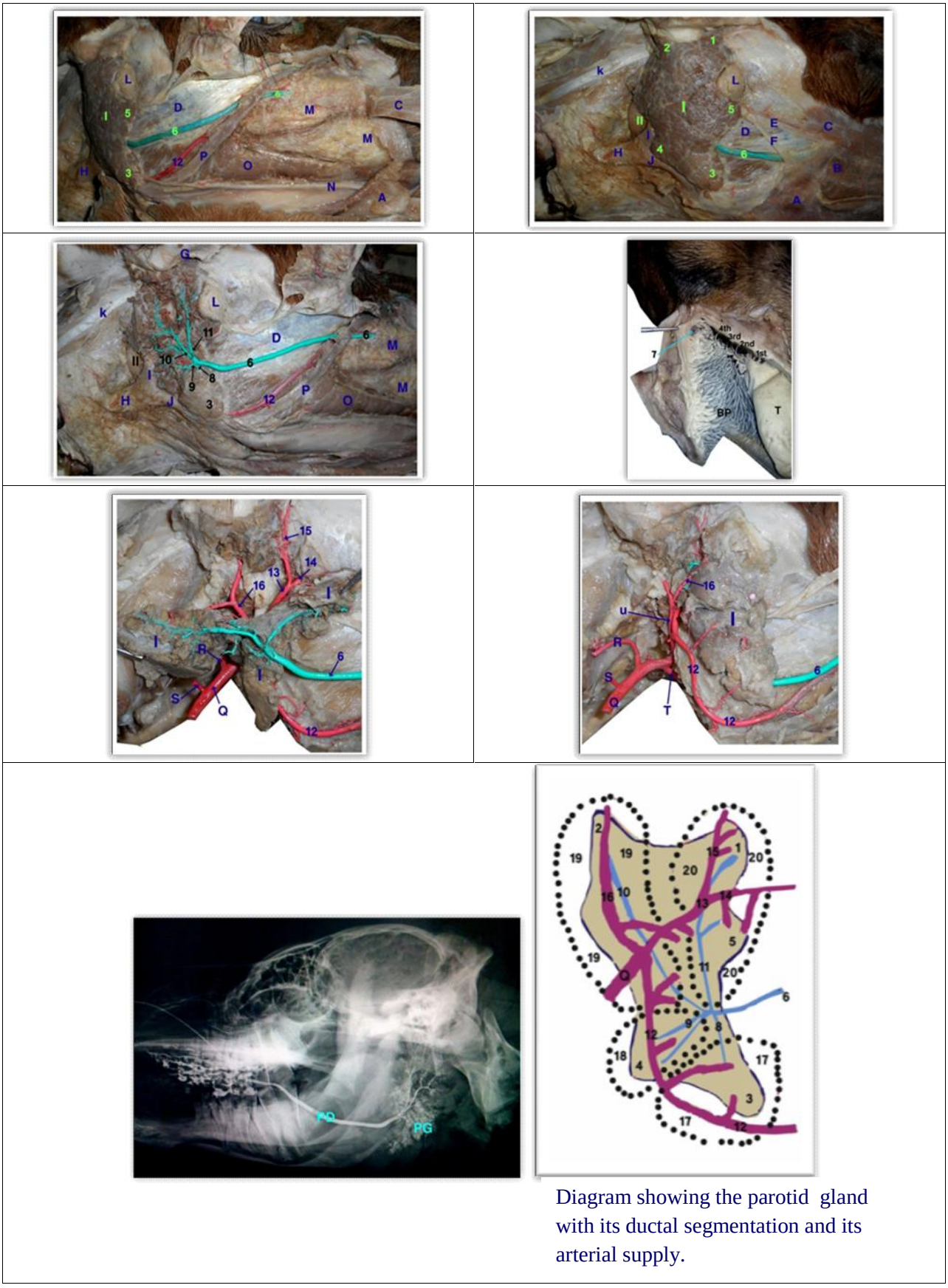

Fig (1): Parotid salivary gland and duct in camel with its arterial supply.

I. Parotid gland, II. Mandibular gland,1. The periauricular, 2. postauricular processes, 3. The mandibular process, 4. Jugular process, 5. Masseteric process, 6. Parotid duct, 7. Parotid papilla, 8. 1st parotid radical, 9. 2nd parotid radical, 10. 3rd parotid radical, 11. 4th parotid radical, 12. facial artery, 13. superficial temporal artery, 14. transverse facial artery, 15. rostral auricular artery, 16. caudal auricular artery,17. The mandibular process segment, 18. The jugular process segment, 19. The post-auricular process segment, 20.the pre-auricular process segment
A. risorius M., B. buccinator M., C.zygomaticus M., D. masseter M., E. dorsal buccal nerve, F. ventral buccal nerve, G. Parotidoauricularis M., H. jugular vein, I. superficial temporal vein, J. facial vein,K. longissimus capitis M., L. parotid lymph node, M. dorsal buccal salivary gland, N. transverse facial nerve, O. ventral buccal salivary gland, P. facial vein, PD. Parotid duct, PG. parotid salivary gland Q. common carotid artery, R. Internal carotid artery, S. occipital artery, T. lingual artery, U. common trunk.

The mandibular salivary gland:

The mandibular salivary gland (fig. 2,3 /II) was irregular triangular with rounded proximal end and pointed distal extremity. This gland was lobulated and pale yellow in color. It measures about 9 ± 0.5cm in length and about 3 ± 1cm in width. The mandibular gland was smaller in size than the parotid salivary gland. It was partially covered by the parotid gland and placed obliquely between the wing of atlas and the angle of the mandible. It was covered by true facial capsule. It divided into four main lobes; dorsal superficial, ventral superficial, dorsal deep and ventral deep lobes.

The mandibular gland had two extremities; the dorsal extremity or base (fig. 2,3/1) was round-shaped and related cranially to the occipitomandibularis muscle and caudally to the obliquus capitis caudalis muscle. While, its ventral extremity or apex (fig. 2,3/2) was pointed, partially overlapped with mandibular lymph node and related to the transverse facial nerve, facial artery and facial vein, sternohyoideus, omohyoideus muscle and the common carotid artery.

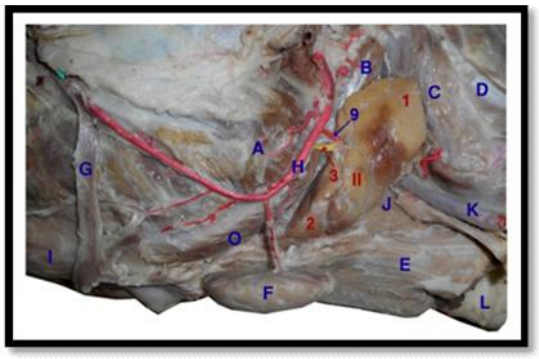

Fig (2): Mandibular salivary gland and duct in camel.
II. Mandibular gland, 1. Base of mandibular gland, 2. Apex, 3. Mandibular duct, 9. The artery of the mandibular salivary, A. masseter M., B. occipitomandibularis M., C. obliquus capitis caudalis, D. longissimus capitis, E. omohyoideus, F. mandibular L.N., G. linguofacial vein, H. facial artery, I. Mandible, J. retropharyngeal L.N., k. common carotid artery, L. trachea.

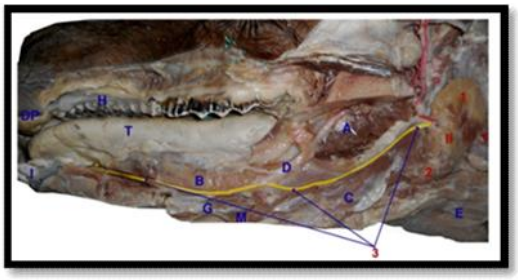

Fig (3): The Mandibular duct in camel.
II. Mandibular gland, 1. Base of mandibular gland, 2. Apex, 3. Mandibular duct, A. medial pterygoideus, B. sublingual salivary gland, C. Digastricus M., D. lingual nerve, DP. Dental pad, E. omohyoideus M., H. hard palate, I. lower incisors teeth, G. geniohyoideus M., M. mylohyoideus M.

The lateral surface of the gland was related to the parotid salivary gland, vertical ramus of the mandible, skin, fascia, facial vein and superficial temporal vein. While, its medial surface was related to the retropharyngeal lymph node, common carotid artery, sternohyoideus and omohyoideus muscles.

The caudal border related dorsally to the obliquus capitis caudalis and ventrally to retropharyngeal lymph node, common carotid artery, sternohyoideus and omohyoideus muscles. The rostral border accompanied with facial artery and linguofacial vein, the vertical ramus of the mandible and medial pterygoid muscle.

The mandibular duct (fig. 2,3/3) emerged from the middle part of the rostral border of the gland. It had a longer course than the parotid duct. It coursed medial to the mandible. First it passed between the digastricus and medial pterygoid muscle accompanied with the lingual nerve. Then passed medial to the mylohyoideus and geniohyoideus M. and ventral to polystomatic sublingual salivary gland. The mandibular duct opened on the floor of the oral cavity at a mucosal fold ventral to apex of tongue at the sublingual caruncles (fig. 4/4). The latter represented by slightly raised circular area of mucous membrane located just 2cm cranial to frenulum linguae. The duct measured 28± 2cm in length and diameter from its beginning about 0.4 ± 0.08cm then decreased gradually till terminal part of the duct about 0.2 ± 0.06 cm.

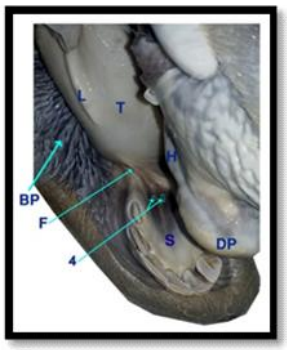

Fig (4): The opening of the mandibular duct in camel.
BP.buccal papilla, DP. Dental pad, F. frenulum linguae, H. hard palate, L. lyssa, T. Tongue, S. sublingual floor, 4. Sublingual caruncles.

The mandibular duct collected saliva from two principle radicals; small ventral and large dorsal radicals. The ventral radical (fig. 5/5) drained the ventral superficial lobe. The dorsal radical (fig. 5/6) formed from two main branches; the ventral branch (fig. 5/7) drained the ventral superficial lobe by four rami (fig. 5/7a, 7b, 7c,7d) and the ventral deep lobe by two branches (fig. 5/7e,7f). While the dorsal branch (fig. 5/8) was slightly larger than ventral one. It drained the dorsal superficial lobe by three rami (fig. 5/8a) and drained the dorsal deep lobe by several branches (fig. 5/8b).

The arterial supply of the mandibular salivary gland was represented by two main branches. The first branch (fig. 5/9) detached from the beginning of the facial artery. It passed caudally, enter the gland just dorsal to the duct. It bifurcated directly into large dorsal and small ventral branch (fig. 5/9a,9b) accompanied with the radicals of the duct. The ventral branch supplied the ventral deep lobe while the dorsal branch supplied the dorsal superficial lobe by two rami and the dorsal deep lobe by another three rami. The ventral deep lobe was supplied by another branch from the beginning of the external carotid artery (fig. 5/10).

Regarding the formation of the mandibular duct and the gland blood supply, the mandibular salivary gland could be segmented into four main segments for the four lobes; Dorsal superficial, dorsal deep, ventral superficial and ventral deep segments (fig.7/11,12,13,14).

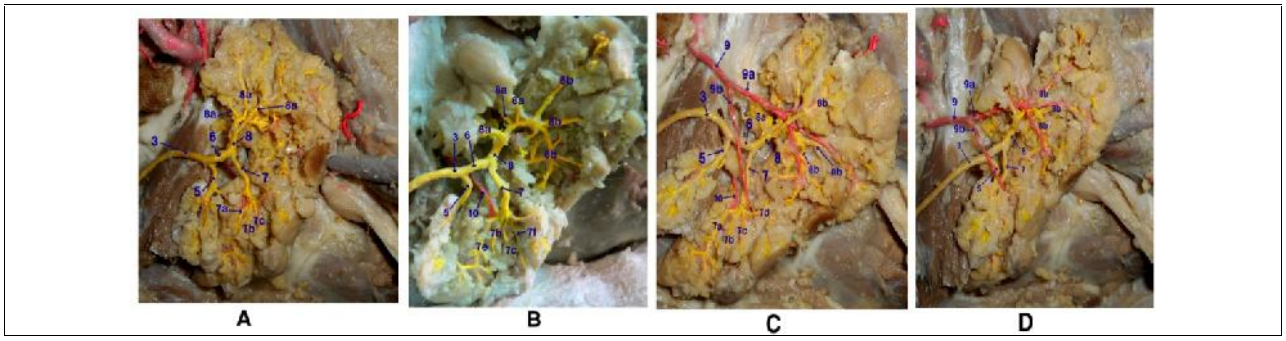

Fig (5): a photograph showing the radical of the mandibular duct with its arterial supply in camel.
A. Superficial radical of mandibular duct, B. Deep radicals of mandibular duct, C, D. Arterial blood supply of the gland

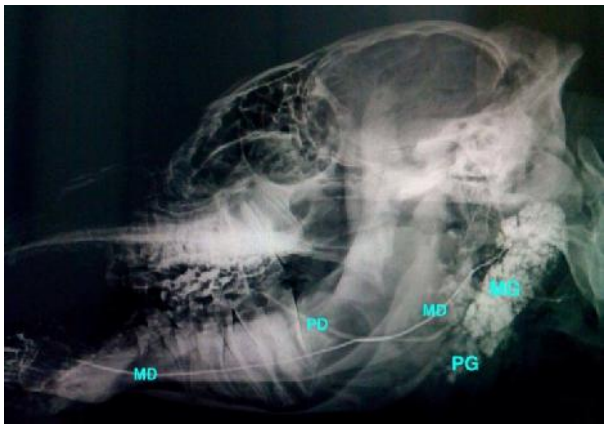

Fig.(6): contrast X-ray photo of camel head.
MG. mandibular salivary gland, MD. mandibular duct, PG. parotid gland, PD. Parotid duct.

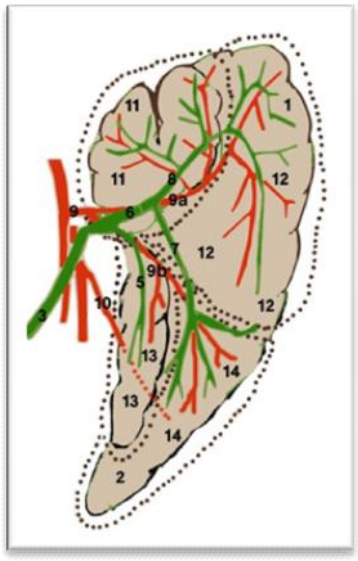

Fig. (7): Diagram showing the mandibular gland with its ductal segmentation and its arterial supplyand its arterial supply

Discussion

The parotid salivary gland:

The present study investigated the anatomical features of the parotid and the mandibular salivary glands in camel such as the previous studies in bovines (Shacklefort and Wilborn, 1969), buffalo (Venkata and Mariappa, 1969), sheep (May, 1970), equines (Getty, 1975), goat (Islam and Anna, 2004; Nawar, 1980), dogs (Dyce *et al.*, 2010), domestic cat (Mohammad Pour, 2010) and pig (Zhou *et al*., 2010).

Regarding to our observation, the parotid glands of camel was larger than the mandibular salivary gland. It was located on the caudal part of vertical ramus of the mandible and masseter muscle, ventral to the wing of the atlas and attached to the base of the ear. That similar to Mohammed (2016) and Abdalla (1979) in camel, (Dehghani *et al*., 2000) in sheep, (Rauf et al. 2004; Nawar, 1980) in goat, (Al-Sadi, 2013 and Getty, 1975) in ox, (Mina *et al.*, 2004) in dog. While (Al-Samarrae *et al.*, 1989) in camel reported that gland situated around the ventral part of the auricular cartilage extending rostral to the masseter muscle, ventrally toward the angle of the jaw and caudally to the atlantic fossa.

The finding of the present work revealed that the parotid salivary gland was irregular rectangular in shaped. It had five processes. It partially covered the mandibular salivary gland. It had true facial capsule and partially covered by parotidoauricularis muscle. Its rostral border was concave dorsally occupied and partially covering the parotid lymph node that agreement with (Mohammed, 2016; Al-Sadi, 2013; Khalil 1989 and Nawar and El-Khaligi, 1975).

The present study revealed that the mean length of the gland of camel was 11 ± 0.54cm and its width 7 ± 0.62 cm. This agrees with Mohammed (2016) and Khalil (1989) whom reported that the gland of camel measured 11-16 cm in length and its width 7.5-9 cm. Obviously, the gland was longer than that of ox 5.94±0.273 cm, sheep 6.04±0.48 cm and goat 6.56±0.361 cm per (Mohammed, 2016 and Dehghani *et al.*, 2000) and in dog the length is 3.96±0.26 cm (Mina *et al.*, 2004).

In the current investigation, the parotid duct emerged from the medial side of the ventral part of the rostral border. It ran rostral under the skin for about 5 ± 0.5cm then inclined dorsally between the masseter muscle and zygomaticus. It turned medially to pierce the cheek opposite the fourth upper cheek tooth. It opened into the buccal vestibule as the parotid papilla. The parotid duct crossed caudally by the ventral buccal branch of facial nerve and passed rostral between the facial vein laterally and the facial artery medially. This agrees with Mohammed, (2016) in domestic animal and Al-Sadi, (2013) in ox, but the later author differed in the opening of duct located opposite the fifth upper cheek tooth. Our result like Khalil (1989), Nawar (1980) and Nickel *et al.* (1976) in sheep and goat and Nawar and El-Khaligi (1975) in camel detected this opened in the oral vestibule at a mucosal papilla opposite to the second molar tooth in camel.

The present study reported that the parotid duct measured about 20 ± 0.41cm in length and 0.5 ± 0.2cm in diameter that disagreement with (Mohammed, 2016 and Al-Sadi, 2013) reported that the length of duct was 21.36±0.089 cm, 28.6±1.194 cm, 10.6±0.866 cm and 11.5±1.118 cm in camel, ox, sheep and goat respectively and the diameter was large in camel 0.22±0.447 cm, ox 0.24±0.548 cm, but small in sheep 0.18±0.447 cm and goat 0.18±0.447 cm.

In accordance with (Kassab, 1997; Khidr, 1978 and Kenawy, 1973) in the camel, the arterial supply to the parotid salivary gland was numerous. The superficial temporal and caudal auricular arteries were reported by all authors. Kassab, 1997 and Khidr, 1978 added the external carotid artery as a blood source. In this study, thetransverse facial artery was mentioned like Khidr, 1978 and Kenawy, 1973 in the same animal. Unlike the previous authors, the facial artery constituted the large blood supply to the gland.

The mandibular salivary gland:

In the present study, the shape of the mandibular salivary gland was irregular triangularwith rounded proximal end and pointed distal extremity. Similar observations were reported in dog (Mina *et al*., 2004) and in camel (Mohammed, 2016) but irregular oval in camel (Khalil, 1989; Nawar and El-Khaligi, 1975), elongated in Ox (Al-Sadi, 2013), irregular in shape in sheep and goat (Nawar, 1980; Nickel *et al*., 1976).

In the present study, the color of the gland was pale yellow in camel, dark yellow in ox and yellow in the sheep and goat. In domestic animals, it has been generally described as bright yellow (Dyce *et al.*, 2010).

The results applied in this study agreed with (Mohammed, 2016**;** Nawar and El- Khaligi, 1975) in camel and (Getty, 1975) in other domestic animals. It was partially covered by the parotid gland and placed obliquely between the wing of atlas and the angle of the mandible. It was covered by true facial capsule. It divided into four main lobes; the dorsal and ventral superficial lobes and dorsal and ventral deep lobes.

Our observation reported that the length of the gland in camel about 9 ± 0.5cm. This agrees with (Mohammed, 2016 and Khalil, 1989) who reported a length of 9.5 cm in camel but in disagreement with Van Lennep (1957) who reported 11-12 cm in camel. According to Khalil, (1989) the width of gland of camel was 3 ± 1cm.cm but Van Lennep (1957) reported 7-9 cm.

The mandibular gland had two extremities; the dorsal extremity or base was round shaped and related cranially to the occipitomandibularis muscle and caudally by the obliquus capitis caudalis muscle. While its ventral extremity or apex was pointed, partially overlapped with mandibular lymph node and related to transverse facial nerve, facial artery and facial vein, sternohyoideus, omohyoideus muscle sand common carotid artery. This result is like (Mohammed, 2016**;** Khalil, 1989) in camel and Al-Sadi (2013) in cattle.

Regarding to our result, the lateral surface of the gland was related to parotid salivary gland, the vertical ramus of the mandible, the skin, the fascia, facial vein and superficial temporal vein while its medial surface was related to the retropharyngeal lymph node, common carotid artery, sternohyoideus and omohyoideus muscles. This result adapted as well as (Mohammed, 2016**;** Nawar and El-Khaligi, 1975).

In this study, the mandibular duct emerged from the middle part of the rostral border of the gland. It coursed medial to the mandible. First it passed between the digastricus and medial pterygoid muscle accompanied with the lingual nerve. Then passed medial to the mylohyoideus and geniohyoideus M. and ventral to polystomatic sublingual salivary gland. A similar course was given by (Mohammed, 2016 and Khalil,1989) in camel, Al-Sadi (2013) in cattle, Rauf *et al.* (2004) in goat and Dehghani *et al.* (2000) in sheep.

The present investigation revealed that the mandibular duct opened on the floor of the oral cavity at a mucosal fold ventral to apex of tongue at the sublingual caruncles. The latter represented by slightly raised circular area of mucous membrane located just 2cm cranial to frenulum linguae. The duct measured 28± 2cm in length and diameter from its beginning about 0.4 ± 0.08cm then decreased gradually till terminal part of the duct about 0.2 ± 0.06 cm. This agrees with Al-Sadi (2013) in cattle, Tadjalli *et al.* (2002) in goat, Dehghani *et al.* (2000) in sheep and Nawar and El-khaligi (1975) in camel.

Like the results of Kassab, 1997 In the camel, the mandibular salivary gland was supplied by the external carotid artery. Kassab, 1997 and Khidr, 1978 in the same animal, added another branch from the occipital artery. Khidr, 1978 and Kenawy, 1973 in the camel mentioned the lingual artery as the main blood supply to the mandibular salivary gland. Dislike the previous authors. this study reported the facial artery as the main blood supply to the gland.

The radiographic technique and normal glandular appearance described in this study can assist in the diagnosis of many different salivary gland diseases in camel that like reported by Tadjalli, et al., (2004).

Conclusion

The arterial and duct segmentation of the salivary glands of the camel will facilitate partial removal of the diseased gland as well as the selective inhibition (occlusion) of blood supply to certain region as a treatment of neoplasm. The anatomical description of the duct will facilitate diagnostic sialography of both glands.

References

Abdalla, **A. B**. **(1979).** Structure of the secretory cells of the salivary glands of the dromedary camel, *Sudan Journal of Veterinary Science and Animal Husbandry*, **20**: 65-76.

Al-Sadi, S. (2013). Gross and Radiological studies of the salivary glands in cattle. *Basic Journal of Veterinary Research*, **12**: 65-76.

Al-Samarrae, N. S., Rabie, F. O. **and Abbas**. **(1989).**Topography and histology of parotid gland of one humed camel. *Iraqian Journal of Veterinary Medicine*, **13** (1): 42-49.

Cunningham, G. J. & Klein, G. B (2007): Text book of veterinary physiology .4th. Ed. Saunders EL-Sevier, evolve; pp :328

Dehghani, S.N., Tabatabai, A., (1993): Salivary calculi in donkey. Indian J. Vet. Surg. 14 (2), 94 95.

Dehghani, S. N., Tadjalli, M. Manuchehry,S. T. (2000): Sialography in camel: technique and normal appearance. J. Camel Pract. Res. 6, 295-299.

Dunning, **D.(2003):** Oral cavity. In Textbook of Small Animal Surgery. 3rd Ed D. Slatter. Philadelphia, W. B. Saunders. pp 553-561

Dyce, K. **M., Sack, W. O., Wensing, C. J. G. (2010).** *Textbook of Veterinary Anatomy*. Published in China library of Congress Catalouging in WB Saunders Comp.

Ettinger, S. & Feldman E. (2010): Text book of veterinary internal medicine .7th Ed. Vica president and publisher Linda Duncan; pp: 1479

Getty, R. (1975): Sisson and Grossman's the anatomy of domestic animals. 5th ed. WB Saunders Co. Philadelphia, Vol. 1, 872 -874.

Islam, M. R. & Anna, M. K. (2004): Macroscopic and microscopic study of the mandibular salivary gland in black Bengal goats. Vet Med J., 2 (2): 137-144.

Kassab, A.A. (1997): Some Anatomical studies on the external ear in camel and donkey. MVSc, Thesis (Zagazig University- Benha Branch).

Kenawy, A. (1973): Arteries of the head of the camel. M.S. C. thesis. (Assuit University).

Khidr, I. (1978): Myology, innervation and vascularization of the face region of the one humped camel (*Camelus dromedarius*). M.S. C. thesis. (Zagazig University).

Khalil, **M. M. K**. **(1989).** *Morphological studies on the salivary glands of the one humped camel* (*Camelusdromedarius*). MVSC thesis. Faculty of Veterinary Science. U.K.

May, **N. D. S. (1970).** *The Anatomy of the sheep*. 3rd Ed. University of Queensland Press.

Michael, **M**. **and Valerie, D. O.** (**2006**). *Human anatomy*. 4th Ed. McGraw Hill; America, New York.

Miletich, **I**. (**2010**). Introduction to salivary glands: structure, function and embryonic development. *Front Oral Biology*, **14**: 1-20.

Mina, T., Seifollah, N. D. and Mehrdad, B. (2004). Sialography in dog: normal appearance. *Veterinarski Arhiv*, **47**: 225-233.

Mohammed, N. J. (2016). Comparative Morphological, Histometric and Histochemical studies of Parotid and Mandibular Salivary Glands of Camel, Ox, Sheep and Goat, PHD, Sudan University of Science and Technology

Mohammad pour, **A**. **A**. **(2010).** Anatomical and histological study of molar salivary gland in domestic cat. *Iranian Journal of Veterinary Researches*, **11**: 164-167.

Nawar, S. M. and El-Khaligi, G. E. (1975): Morphological and Histochemical Studies of the mandibular salivary glands of one humped camel (*Camelus dromedarius*). *Anatomischer Anzeiger*, **142** (4): 346-362.

Nawar, S. M. (1980): Micromorphological study of the salivary gland of the goat. Vet Med J.; 28 :329-339.

Nickel, R., Schummer, A. and Seiferle, E. (1976). The viscera of the domestic animals. 2ed Ed. Verlag Paul Parery. Berlin. Hamburg. pp: 39

Ong, C. A., Loganathan, A., Prepageran, N., Rahmat, O., Lingham, O. R. (2005): Parotid duct mucocele. Med J Malaysia. 60(5):644-6.

Pal, C., Chandra, G. & Bharadwa, M. B. (1992): Histological and histochemical observation on the parotid salivary gland of buffalo (Bubalus bubalis). Indian J. Ani. Sci.,42 (1): 420.

Pospieszng, N., Kuryszko, M., Juszyki, A. & Damski, M. (2010): Morphology and histology analysis of mandibular and sublingual glands in pig. Bull Vet. Ins. Pulaway., 54 (2): 351.

Rauf, S. M. A., Islam, M. R. and Anam, M. K. (2004). Macroscopic and microscopic study of the mandibular salivary gland of Black Bengal goats. *Bangladesh Journal of Veterinary Medicine*, **2**: 137-142.

Reece, O. W. (2004): Dukes physiology of domestic animals .12th. Ed. Comstock publishing associated a division of Cornell university press, Ithaca and London. 2004; pp: 405.

Shackleford, **J. M. andWilborn**, **W**. **H**. **(1969).** Ultrastructure of bovine parotid glands. *Journal of Morphology*, **127**: 453-473.

Tadjalli, M., Dehghani, S.N. and M. Ghadiri, M. (2002): Sialography of the goat parotid, mandibular and sublingual salivary glands. Small Ruminant Research 44: 179- 185

Tadjalli, M., Dehghani, S. N., and Mehrdad Basiri, M. (2004): Sialography in dog: normal appearance *Veterinarski Arhiv 74* (3), 225-233

Termote, S. (2003). Parotid salivary duct mucocele and sialolithiasis following parotid duct transposition. *Journal of Small Animal Practice* **44,** 21-23

Van Lennep, E. W. (1957). The glands of the digestive system in the one humpedcamel, (*Camelus dromedarius*). 1.The salivary glands. *Acta Morphologica Neerlando Scandinavica*, **1**: 286-292.

Venkata, K,A. and Mariappa, D. **(1969).** Studies on the structure of salivary glands of Indian buffaloes (*Bos bubalis*). *Indian Veterinary Journal*, **46**: 768-773.

Zhou, **J**., **Wang**, **H**., **Xang, G., Wang, X., Sun, Y., Song, T., Zhang, C. and Wang**, **S. (2010).** Histological and ultrastructural characterization of developing miniaturepig salivary gland. *Anatomical Records*, **293**: 1227 1239.

Access this Article in Online	
	Website: www.ijarbs.com
Quick Response Code	Subject: Veterinary Medicine
DOI:10.22192/ijarbs.2017.04.11.005	

How to cite this article:
Hamdy M. Rezk and Nora A. Shaker. (2017). Parotid and Mandibular Salivary Glands Segmentation Of The One Humped Dromedary Camel (*Camelus dromedarius*). Int. J. Adv. Res. Biol. Sci. 4(11): 32-41.
DOI: http://dx.doi.org/10.22192/ijarbs.2017.04.11.005