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Applied Anatomy of the Head Regions of the One-Humped Camel (*Camelus dromedarius*) and its Clinical Implications During Regional Anesthesia

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Abstract: One-humped camel (*Camelus Dromedarius*) is found in Iran, Iraq, Arabia, Egypt, Sudan, North Africa, Somaliland, India and many other countries. This animal adapted to the rigorous climate of the desert where it is subjected to high temperature and the scorching sun rays. Since there is a lack of comprehensive data on the applied anatomy of the head region of this specie and its clinical value during regional anesthesia; therefore, the present work was carried out. This study involved some osteometric parameters of the mandibles and upper jaws of ten adult one-humped camels without any apparent skeletal disorders. Then, a total of seventeen head measurements and indices were recorded. The supraorbital foramina distance, infraorbital foramina distance, skull length, cranial length and nasal length of the Iranian one-humped camels were 18.3 cm, 6.43 cm, 46.2 cm, 32.5 cm and 13.3 cm, respectively. In addition, the distances from the root of the third upper premolar tooth to the infra-orbital canal and from the latter to root of the first upper premolar tooth were 6.2 cm and 3.47 cm, respectively. The length and height of the mandibles of the Iranian one-humped camels were 39.9 cm and 9.92 cm, respectively. Furthermore, the distances from the lateral alveolar root to cranial mental foramen and from the cranial mental foramen to caudal mandibular border were 4.74 cm and 34.18 cm, respectively. In the present study, the distances from mandibular foramen to the base of mandible as well as from caudal border of mandible to below of the mandibular foramen were 3.88 cm and 2.6 cm, respectively. Also, the distances from the base of mandible to condyloid fossa and from the latter to the maximum height of mandible were 6.27 cm and 3.29 cm, respectively. Finally, the distance from caudal border of mandible to mandibular foramen and from the latter to mandibular angle were 3.7 cm and 4.3 cm, respectively. The craniometric information provided in this study will be important for clinical maneuvers around the head of the Iranian native camels particularly for the regional anesthesia during treating head injury and dental extraction.

Key words: Applied Anatomy · Head · Camel · Regional Anesthesia

INTRODUCTION

One-humped camel (*Camelus Dromedarius*) is found in Iran, Iraq, Arabia, Egypt, Sudan, North Africa, Somaliland, India and many other countries. This animal adapted to the rigorous climate of the desert where it is subjected to high temperature and the scorching sun rays [1]. Generally, camels are experiencing a resurgence of interest and their importance in the modern era may depend in great part to the complete understanding of their anatomy and physiology [2]. The sudden rise in the last decade of camel domestication for their meat and milk, rich in minerals and vitamin C [3,4], will demand more knowledge for effective management.

The head is a very important region for animals. It is the location of vital organs as the brain, eyes, nose, tongue ear and mouth. Also, the health of an animal can be deduced from the functional state of any of these organs [5]. Additionally, a unique head aspect of the anatomy of any animal is the skull typology of that animal with usefulness in providing a database on the bone features [5] and also morphological interpretation

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of the biomechanics of mastication [6]. The regional anatomy of the head is therefore, very useful tool that will aid the regional anesthesia [5].

It has been demonstrated that the morphologic and morphometric studies of the head region are not only reflect contributions of genetic and environmental components to individual development and describe genetic and ecophenotyipic variation, but also are foundations of the clinical and surgical practices [7,8]. On the other hand, clinical anatomy is one of the principles of the clinical and surgical practice; because it enables the clinician to visualize details of structures relevant to the case at hand [9,10]. Furthermore, the directions of the cranial nerves and their passages from different foramina in the skull are of clinical importance in regional anesthesia around the head [10,11].

There are a few studies on the gross anatomy of the skull and its clinical value for regional anesthesia in the domestic animals. For instance, Louei Monfared *et al.* [12] determined the applied landmarks on the head region of the Iranian native goats and their application to clinical maneuvers around the head.

The present work was carried out because of there is a lack of comprehensive data on the head region of the adult one-humped camel and its clinical implications during regional anesthesia.

MATERIALS AND METHODS

This study involved some morphometric parameters of the mandibles and upper jaws of ten adult Iranian one-humped camels (*Camelus dromedarius*) without any apparent skeletal disorders. The specimens were brought for dissection purposes in the anatomy laboratories, University of Tehran (Tehran, Iran), University of Urmia (Urmia, Iran), University of Shahid Chamran (Ahwaz, Iran), University of Shahid bahonar (Kerman, Iran) and also University of Semnan (Semnan, Iran). The heads were severed at the occipito-atlantal joint and processed in the veterinary anatomy laboratory using the boiling maceration techniques for skeleton preparation that have been reported by Simoens *et al.* [13]. The main steps in skull skeleton preparing briefly are following:

- On the working day, frozen camel heads were allowed to thaw.
- Skin and most of the muscles were separated and eyes were enucleated.
- Heads were heated to over 80°C for at least 1 hour in solution of anionic surfactant (detergent) and soap chips.
- Muscles of boiled heads were separated with the aid of forceps and scalpel in running water.
- Further separation of muscles and ligaments from the skulls was done after left in detergent water at least 20-30 minutes.
- Separation of remaining muscles and ligaments from the skull was done after left in 1% sodium hypochlorite solution for at least 24 hours.
- After that, the skulls were left in the above solution, for 48-72 hours with solution, being changed at least twice and clean in running tap water.
- The skulls were then left to dry.

A total of seventeen morphometric measurements were done in the upper jaw and mandibles using scale, thread and digital calipers and the results were presented as means ± SD in Table 1. These morphometric parameters of the upper and lower jawbones of the Iranian native camel´s skulls are defined below and shown in Figs. 1-5.

A. Supraorbital Foramina Distance: Greatest width between the supraorbital foramina.

B. Infraorbital Foramina Distance: Facial width between the supraorbital foramina.

C. Skull Length: From the dorsal lateral nasal cartilages to the external occipital protuberance; sub-divided into cranial length and nasal length.

D. Cranial Length.

E. Nasal Length.

F. The Root of the Third Upper Premolar Tooth to Infra-orbital Canal: From the root of the third upper premolar tooth of the infra-orbital canal.

G. Infra-orbital Canal to Root of the First Upper Premolar Tooth: Measurement is taken from the mid-level of the in infra-orbital canal to root of the first upper premolar tooth.

H. Mandibular Length: From the level of the cranial extremity of the alveolar root of the incisor to the level of the caudal border of the mandible.

I. Lateral Alveolar Root to Cranial Mental Foramen: Shortest distance from the mental foramen to the lateral extent of the alveolar root of lower incisor.

J. Mental Foramen to Caudal Mandibular Border: From the level of the mental foramen to the extreme caudal border of the mandible.

K. Mandibular Foramen to Base of Mandible: Vertical line from the ventral limit of the mandibular foramen to the base of the mandible.

L. Caudal Border of Mandible to below of the Mandibular Foramen: Length from the caudal most border of the mandible to the vertical line produced by description of measurement of mandibular foramen to base of the mandible.

M. Condyloid Fossa to Height of Mandible: From the maximum height of mandible to the condyloid fossa.

N. Condyloid Fossa to the Base of the Mandible.

O. Maximum Mandibular Height: From the basal level of the mandible to the highest level of the coronoid process.

P. Caudal Border of Mandible to the Level of Mandibular Foramen.

Q. Mandibular Foramen to Mandibular Angle: Shortest distance from the mandibular foramen to the extreme caudal border of the angle of the mandible.

RESULTS

In the present study, the supraorbital foramina distance, infraorbital foramina distance, skull length, cranial length and nasal length of the Iranian one-humped camels were 18.3 cm, 6.43 cm, 46.2 cm, 32.5 cm and 13.3 cm, respectively (Figure 1, Table 1). In addition, the distances from the root of the third upper premolar tooth to the infra-orbital canal and from the latter to root of the first upper premolar tooth were 6.2 cm and 3.47 cm, respectively (Figure 2, Table 1).

The length and height of the mandibles of the Iranian one-humped camels were 39.9 cm and 9.92 cm, respectively. Furthermore, the distances from the lateral alveolar root to cranial mental foramen and from the cranial mental foramen to caudal mandibular border were 4.74 cm and 34.18 cm, respectively (Figure 3, Table 1). In the present study, the distances from mandibular foramen to the base of mandible as well as from caudal border of mandible to below of the mandibular foramen were 3.88 cm and 2.6 cm, respectively.

Table 1: Mean ± SD of the morphometric measurements of the mandibles and upper jaws of the Iranian one-humped camel (cm).

Morphometric parameter	Mean ± SD
A	18.3 ± 1.34
B	6.43 ± 2.81
C	46.2 ± 2.74
D	32.5 ± 4.83
E	13.3 ± 3.18
F	6.2 ± 0.36
G	3.47 ± 0.08
H	39.9 ± 6.37
I	4.74 ± 0.01
J	34.18 ± 4.76
K	3.88 ± 0.37
L	2.6 ± 0.09
M	3.29 ± 0.64
N	6.27 ± 1.03
O	9.92 ± 0.36
P	3.7 ± 0.11
Q	4.3 ± 0.73

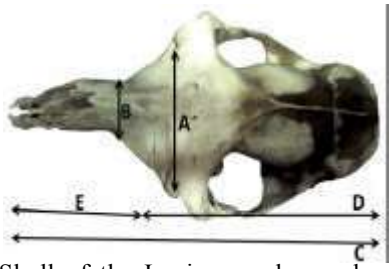

Fig. 1: Skull of the Iranian one-humped camel; dorsal view. A: Supraorbital foramina distance, B: Infraorbital foramina distance, C: Skull length, D: Cranial length, E: Nasal length.

Fig. 2: Skull of the Iranian one-humped camel; lateral view. F: The root of the third upper premolar tooth to infra-orbital canal, G: Infra-orbital canal to root of the first upper premolar tooth.

Fig. 3: Mandible of the Iranian one-humped camel; lateral view. H: Mandibular length, I: Lateral alveolar root to cranial mental foramen, J: Mental foramen to caudal mandibular border.

Fig. 4: Mandible of the Iranian one-humped camel; medial view. K: Mandibular foramen to base of mandible, L: Caudal border of mandible to below of the mandibular foramen, M: Condyloid fossa to height of mandible, N: Condyloid fossa to the base of the mandible, O: Maximum mandibular height.

Fig. 5: Mandible of the Iranian one-humped camel; caudal view. P: Caudal border of mandibule to the level of mandibular foramen, Q: Mandibular foramen to mandibular angle.

Also, the distances from the base of mandible to condyloid fossa and from the latter to the maximum height of mandible were 6.27 cm and 3.29 cm, respectively (Figure 4, Table 1). Finally, the distance from caudal border of mandible to mandibular foramen and from the latter to mandibular angle were 3.7 cm and 4.3 cm, respectively (Figure 5, Table 1).

DISCUSSION

The values of supraorbital foramina distance, skull length, cranial length and nasal length of the Iranian native camels were relatively higher than the results obtained from the immature one-humped camel in Nigeria [14].It is may be due to the existence of significant differences in the some skull's morphometric indices between adult and young animals.

In the Iranian native camels; the distances from the root of the third upper premolar tooth to the infra-orbital canal and from the latter to root of the first upper premolar tooth were 6.2 cm and 3.47 cm, respectively. It had been demonstrated that the infra-orbital foramen in the skull of camel is over the alveolus for the second premolar tooth and infra-orbital nerve emerges through this foramen [9]. Therefore, these data can be useful for tracking the infra-orbital nerve and necessary for the desensitization of the skin of the upper lip, nostril and face on that side of the level of the foramen [9]. The injection of local anesthetic agents within the canal via the infra-orbital foramen will also lead to analgesia of the incisor, canine and first two premolars. Furthermore, the infra-orbital foramen is located directly dorsal to the second upper premolar tooth in Iranian native camels. This information would provide a major landmark to regional anesthesia involving the infra-orbital nerve in this specie.

In the present study, the distance from the lateral alveolar root to cranial mental foramen was 4.74 cm. This parameter is a vital guide that will detect the location of the mental nerve for this regional nerve block in the Iranian native camels; especially for lower lip anesthesia. The injection of the local anesthetic drugs can be made in the rostral aspect of the mandibular canal through the mental foramen to mandibular nerve block in the mental zone. This will ensure the loss of sensation of the lower incisors, premolar and lower lip on the same side [11] during lower lip trauma, dental extraction and treatment of the tooth injuries.

The mandibular length and height in the Iranian native camels (Table 1) were higher than the data obtained for immature one-humped camel in Nigeria [14]. Similar results had been reported in the values of the distances between the mandibular foramen to base of mandible, the condyloid fossa to height of mandible and condyloid fossa to the base of the mandible [14].

The caudal border of the mandible to bellow of the mandibular foramen was 2.6 cm in the Iranian native camels. In addition, the distance from the caudal border of mandible to the level of mandibular foramen and from the latter to the border of mandibular angle was 3.7 cm and 4.3 cm, respectively. The anesthetic agents must to be injecting on the medial side of the mandible, thereby; a successful nerve block produces anesthesia of the lower jaw with its teeth and the lower lip. These data are necessary for achieving the regional anesthesia of the mandibular nerve and also have clinical importance for desensitization of all the teeth in lower jaw [11].

In conclusion, the craniometric measurments of the skull and applied anatomy of the head region of the Iranian native camels provide an important baseline data for further research in this field. Furthermore, these results are of clinical importance that will aid the regional anesthesia of the various nerves around the head especially during treating head injury and dental extraction.

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