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Histomorphological investigation of ossa cordis of adult male camels

Hadi Abd Awon[1] Abdulrazzaq B. Kadhim[2]

[1]Anatomy and histology department, College of Veterinary Medicine, University of Baghdad, Baghdad, Iraq

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Abstract Ossa cordis is the skeleton of the heart of one humped camels. It plays an important role in the heart; therefore, our Study was done to analyze the morphological and histological structures of the oscardia of the heart. Ten healthy adult hearts from one-humped camels were selected for morphological and histological investigation. This experiment was carried out in agreement with the animal ethics and rules of the College of Veterinary Medicine at the University of Al-Qadisiyah. The camel's cardia is a prominent, elongated bone that resembles a finger-like extension. It is lodged inside the heart wall and is an attachment point for the cardiac muscles. The os cordis surrounds the aortic base, particularly between the left and right atrium. The typical morphometric measurements of the ossa cordis in camels were as follows: weight (0.57 ± 0.12 gm), length (28.54 ± 2.28 mm), width (8.62 ± 1.12 mm), thickness (5.4 ± 0.24 mm), and volume (0.30 ± 0.03 cm3).Furthermore, the morphology and histological structures of the camel cardiac os cardia closely resemble those of many species in both large and small ruminants. However, the ossa cordis of camels is composed of cavities containing bone marrow, spongy bone, and collagen fibres. The ossa cordis of one-humped camels is located in the heart. The organ is in the central region of the mature camel's body. It is positioned at the foundation of the main artery, between the right and left chambers of the heart. Therefore, it has similarities with certain ruminants while exhibiting differences from others. In terms of its histological components, it closely resembles those found in other animals.

Keywords: Heart, ossa cordis, morphology, and histology

Introduction Ruminant animals have a crucial impact on different areas of agriculture, ecosystems, and human societies. Their significance spans a wide range of functions, encompassing their contributions to the cycling of nutrients and the promotion of sustainable agriculture and their crucial role in delivering critical resources for human use (1). The anatomical structure known as the visceral skeleton has a high degree of variability among animal species. The skeletal system consists of bony bones within the body's soft tissues. Only a few species possess an endoskeleton among the various animals kept as pets. The bones commonly identified as components of the visceral skeleton are the os cordis, os penis, and os rostri (2). The cardiac skeleton is a heart tissue component consisting of four fibrous rings made up of connective tissue, partially cartilage, or bone, known as fibrous trigones. The trigones consist of dense connective tissue that may include fibrocartilage, hyaline cartilage, and even bone in certain species (3). Heterotopic bones, or ectopic bones, are characterized by the abnormal development of bone in non-skeletal tissues or the ossification of tissues outside their usual origins. When there are multiple os cordis, they are distinguished as the right-sided, typically bigger os cordis dextrum and the left-sided, smaller os cordis sinistrum. (4). All members of the bovine family have the cordis at the origin of the aorta and the pulmonary artery at the base of the heart. The ossa cordis is believed to contribute to the stabilization of heart contraction and relaxation by inhibiting excessive valve dilation (5,6). In addition, it electrically isolates the atrium and ventricle to synchronize cardiac contractions, providing support to the aortic valve, pulmonary ostium, and atrioventricular orifice (5). The Study discovered novel roles of the cartilaginous foci in Syrian hamster hearts. These foci act as pivots to counteract the mechanical stresses caused by cardiac motion. A report documents a potential link between heart illness and the occurrence of ossa cordis in chimpanzees with idiopathic cardiac fibrosis (6,7). Due to the scarcity of research on the os cordis in local breed ruminants and the need for studies comparing the morphological, histological, and histochemical

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characteristics of the os cordis bone in different local breed ruminants, it is imperative to study this topic.

Materials and Methods

Ethical approval

The project was approved (1890 in 22/5/2025) by the Committee for Research Ethics at the College of Veterinary Medicine, University of Al-Qadisiyah, Iraq.

Methods

The present investigation utilized a sample of 20 mature male dromedary camels in good health. We acquired camel hearts from a livestock supplier during a mass slaughter in Diwanyha. The camels were divided into two equal groups, with the first group used for morphological and morphometric observations and the second group used for the histological research of the os cardia of the heart. The weight of the camel heart was measured using a precise electron balance that was recorded in grams. Morphological Study of the Os cardia: Following the slaughter of male camels, we promptly dissected and cut the rings of the heart and ossa cordis into small pieces. We preserved the specimens in a 10% formalin solution with a neutral pH. We documented the physical observations of each camel's ossa cordis, including its weight, position, shape, and external aspects. We used a digital camera (Nikon D7) to document the gross anatomy of the ossa cordis. Then the morphometric parameters were recorded, which included:

1-Weight (g): The weight of the os cardia was recorded using the sensitive digital balance.

2- Length (mm): The length of the os cardia was measured using the electronic digital calliper (from the cranial to caudal ends).

3- Width (mm) of the os cardia measured using the digital Vernier calliper from the middle region.

4-Volume (ml): The volume of the os cardia was measured by the water displacement method.

5-Thickness (mm): The thickness of os cardia was measured using the electronic digital calliper from the middle region.

Histological Study of the ossa cordis:

A total of five male camel hearts were used for histological analysis. After removing the ossa cordis, we rinsed the specimen with a normal saline solution, preserved it in 10% formalin, and decalcified it using Ethylene Diamine Tetra Acetic Acid (EDTA). Next, continue with the standard histological approach using hematoxylin and eosin stain (8).

Result:

Morphological and morphometric results:

The camel's heart contains a prominent bony structure called the os cordis. The cardiac muscles attach to the heart wall, where this elongated bone, resembling a finger-like extension, lodges. The os cordis is located in the aortic ring, particularly between the aorta and the left and right atrium. We positioned the object in the atrioventricular plane, near the interatrial and interventricular septa intersection, and it extended forward into the atrioventricular valve rings. The object is characterized by a triangle form with compressed sides, with two ends on the right and left, as well as two boundaries on the dorsal and ventral sides (Fig.1). The os cordis' average weight, length, width, thickness, and volume in camels were 0.57 ± 0.12 gm, 28.54 ± 2.28 mm, 8.62 ± 1.12 mm, 5.4 ± 0.24 mm, and 0.30 ± 0.03 cm3, respectively.

The histological results revealed that chambers filled with bone marrow encased the os cordis of the camel's heart. The bone marrow consisted of fatty connective tissue and blood vessels and was enveloped by spongy bone trabeculae with a high concentration of osteoblasts, osteocytes, and collagen fibres. There is hyaline cartilage within the bone, which contains clusters of chondrocytes and chondroclast. In addition, certain areas exhibited fibroblastic cartilage, as depicted in (Figures 2, 3, and 4)

Discussion:

The os cordis, the camel's heart skeleton, is a lengthy, nearly triangular bone resembling a braided protrusion. A cartilage-like structure surrounds the os cordis on both sides, located within the heart wall. This structure connects with the heart muscles at the base of the aorta, between the right and left atria. In this location, the os cordis serves as a supportive bone. As described by researcher L, the camel acts as an electrical insulator for the AS node. The bone's connection to the heart muscles provides a supportive environment for the heart valves and the papillary muscles, aligning with the researcher's findings (9). The physiological role of bones is to provide structural support and protection for the heart.

The device connects to the heart valves, helping to prevent their obstruction during blood circulation. Thus, we regard it as a crucial component of the camel's cardiovascular system, aiding in the proper

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functioning of the heart. The camel heart's ossa cordis consisted of fibrous connective tissue, as observed under a microscope. The results aligned with the findings reported by (10,11) regarding Otter (Lutra lutra). A lot of blood vessels are found in connective tissues with many adipocytes. These tissues surround and support the cartilage and bone structures.

Furthermore, fully formed calcified hyaline cartilage was observed as a protective coating over the porous bone. The cartilage cordis was made up of many chondrocytes surrounded by gaps and, in some cases, cell nests in the basophilic matrix. In addition, the matrix material underwent calcification near the core of the hyaline cartilage. The minerals that had built up were deeply stained with hematoxylin, resulting in a blue colour. The chondrocytes in the calcified regions were morphologically inconspicuous yet essential cells. During the bone development stages, normal hyaline cartilage with a basophilic matrix changes into calcified cartilage. The calcified cartilage slowly transformed into spongy bone characterized by irregular bone lamellae. In addition, the cancellous bone contains hematopoietic red and white bone marrow abundant in erythrocytes, adipocytes, and osteocytes. The accelerated rate of calcium ion precipitation can influence the rate of ossification. These findings corroborated the findings of (12,13), who said that, apart from bones, otters (Lutra lutra) often showed the presence of 1-3 fragments of cartilage and cartilage with early ossification. The os cordis was firmly attached to the adjacent cardiac muscles through a dense fibrous connective tissue consisting mainly of collagen fibres. Our analysis revealed no correlation between camel sex and size regarding calcification rate or skeletal structure formation. This Study corroborated the conclusions of (14,15), which stated that the cardiac connective tissue skeleton varied depending on the species and age.

Conclusion: The ossa cordis of one-humped camels is located in the heart. The organ is in the central region of the mature camel's body. It is positioned at the foundation of the main artery, between the right and left chambers of the heart. Therefore, it has similarities with certain ruminants while exhibiting differences from others. In terms of its histological components, it closely resembles those found in other animals.

Acknowledgment

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the current study.

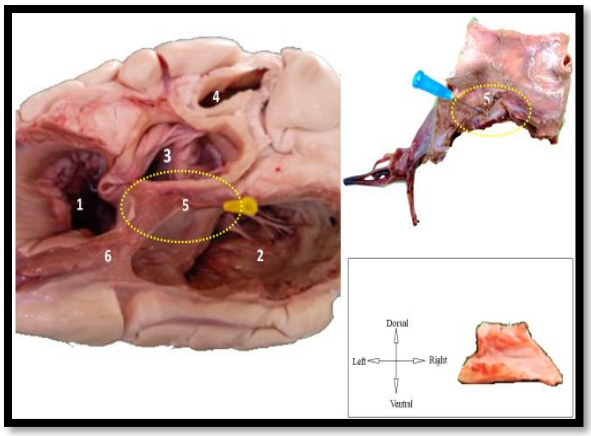

Fig.1 Morphological section of adult heart of camel ,1: ostium of R. atrio-ventricular ,2: ostium of L. atrio-ventricular, 3: ostum of aorta, 4: ostum of pulmonary artery, O.C: os cordis , A.V.S: atrio-ventricular septum. B: aorta with ring and leaflet of valve, O.C: os cordis. C:(a,b,c) shape of o.c bones in heart of camel.

Fig.2 histological section of ossa cordis of adult male camel shows: cavities (C),spongy bone (black head arrow),trabeculae (yellow head arrow),adipose connective tissue ,hyaline cartilage (black arrow) and collagen fibers(yellow star) H&E stain 40 X.

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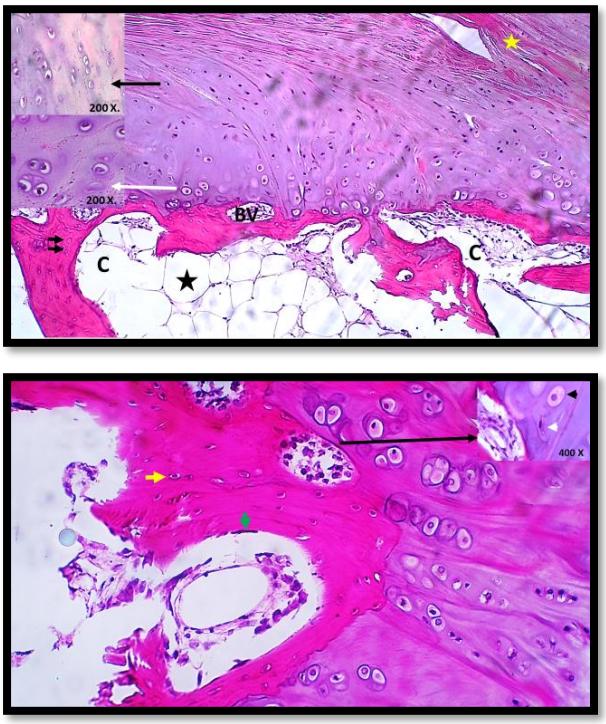

Fig.3 histological section of ossa cordis of adult male camels shows: fibrocartilage (black arrow), hyaline cartilage (white arrow), blood vessels (BV), cavities of bone marrow(C), and adipose tissue (black star) H&E stain 100 x

Conflict of interest

No conflict of interest is found for the present study.

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