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MACROSCOPIC FEATURES OF ARABIAN CAMELS (DROMEDARIES) EYES

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ABSTRACT

Camel's visual system (Camel's eye) displays a high specific degree of development related to the arid environment. It has unique structures necessary to adapt to the windblown desert and sharp night vision. This study aimed to describe the macroscopical features of a clinically healthy dromedary's eye. Six pairs of camel eyes were collected from the Al-Muthanna province abattoir. Complete macroscopic anatomy and description were done, all observations were reported, and all samples were kept in 10% formalin for further histological study. The camel's eye appeared circular, fully osseous, and bulging laterally. The eyeballs were situated at an identical distance among the nuchal ridge and premaxilla. The long cilia were found on the upper eyelid with a tuft of long cilia and the third eyelid situated dorsally to the medial eye canthus. The outer fibrous membrane comprises an opaque sclera that is outspread in the front of the cornea and covered by thin, transparent conjunctive. The ciliary body was located behind the iris and near the lens. The lens appeared as a transparent, biconvex structure inside the eyeball, while the frontal cavity of the eyeball was filled with intraocular fluids. The muscles in the ciliary body revealed a very open iridocorneal angle. The retina was composed of nerve tissue that outlined the back of the eye. In conclusion, macroscopic ocular features of Arabian camels showed a high degree of development with specific structures associated with adaptation to the arid environment. The authors continue doing the second part, the histological features of the Arabian camel eye.

Keywords: Desert, Camel's eye, Retina, Cornea, Ciliary body, Lens.

Introduction

A dromedary is the largest mammal that lives in an arid area. It is adapted to survive and reproduce in extremely arid conditions, regardless of prolonged dryness, harsh weather, ambient temperature fluctuations, and food shortages (Bouàouda *et al.,* 2014; Al Salihi, 2016). One of the vital sensory organs is the eye, which has an essential function in the interaction between the living creatures and their milieu. The eye is of the sensitive parts of the body, and Its frontal epithelium is exposed to various risks. Moreover, clinical examination of the eyes is important in diagnosing most diseases for any potential changes in appearance (Mc Geady *et al.,* 2006; Dellmann & Eurell, 2006). Therefore, studying the natural structure of different eye parts is necessary to identify diseases. Camel's eye has unique peculiarities to combat desertification. Camels own big eyes, heavy, paired-layered eyelashes, dens eyebrows, and sharp sight. Their orbits are spherical, equidistant, totally osseous, and bulging laterally (Noor *et al.,* 2018). Dromedary's eyes are sheltered by prominent supraorbital ridges and have three eyelids. They shift from side to side rather than up and down. The lenses of their eyes contain

crystallin, which composes 8 to 13% of the protein present (Garland *et al.,* 1991). The eye of the Camelus dromedaries is similar to that of ruminants, particularly cows. A literature review revealed a few studies on the anatomy of the camel's eye between the 1980s and 1990s (Awkati & Al-bagdadi,1971; Abubl-atta *et al.,* 1997). Some researchers have also studied the histological characteristics of the camel's eye(Rahmoun *et al.,* 2020). The most available literature on the anatomy and histology of the camel's eye is scarce (Bareedy *et al.,* 1986; Ibrahim, 2003; Sadeg *et al.,* 2007; Alsafy, 2010). In Iraq, few previous studies have been published on anatomical features of the eye of the local Iraqi camel. Consequently, the current study intends to investigate the anatomical structures of the local Iraqi Dromedary's eye.

Materials and methods

Six pairs of eyes were collected from an apparently healthy adult, one-humped camels of both sexes and different ages which were slaughtered at Almuthanna, abattoir/ Iraq. The complete anatomical description was done for the eyes of the slaughtered camel. Then eyes were extracted from the orbit and transferred freshly to the laboratory of anatomy/ department of anatomy/ college of veterinary Medicine/ Al Muthanna University. Firstly, the eyes were examined anatomically for their appearance. The dissection was done for each eye to study the inner structures. Later, the eyes were fixed in 10 % formalin for further histological study.

Results

The camel's eye was appeared rounded and entirely osseous. It was approximately located at an equal distance among the nuchal crest and premaxilla. The zygomatic process of the frontal bone of the face made the surface of the eye and a part of the medial wall, while the pre- sphenoid bone made the caudomedial portion of the eye. The palatine revealed the formation of a portion of the ventromedial wall of the eye. At the same time, the maxilla participated in the formation of a small area in the rostral ventral part of the eye wall. The eye cornea appeared as a light–blue area surrounded by the lids (Figure.2). Both upper and lower eyelids that guarded the eye were quite thick and located as transverse ridge when seen in the living animal (Figure. 3).

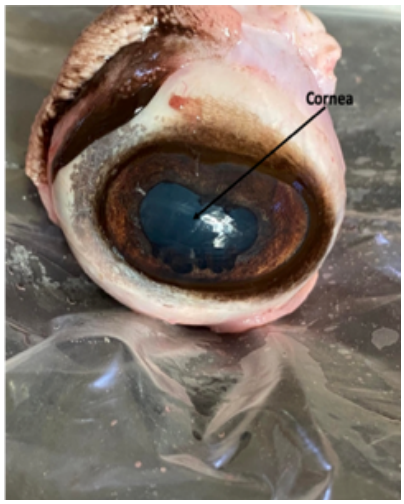

Figure.1: Shows the rounded camel eye in a fresh specimen and the cornea.

Figure. 2: The corner of the eye fenced by the eyelids. It shows the long cilia linked with the upper lid and the tuft of long cilia on medial canthus and lateral canthus.

The nictitating membrane (third eyelid) also appeared in the medial canthus. Long cilia were present in both lids. The upper eyelids showed longer cilia and were thicker than the lower lid. There was a sliding of muscle bundles projected from the orbicularis muscle into the upper and lower lids (Figure.3).

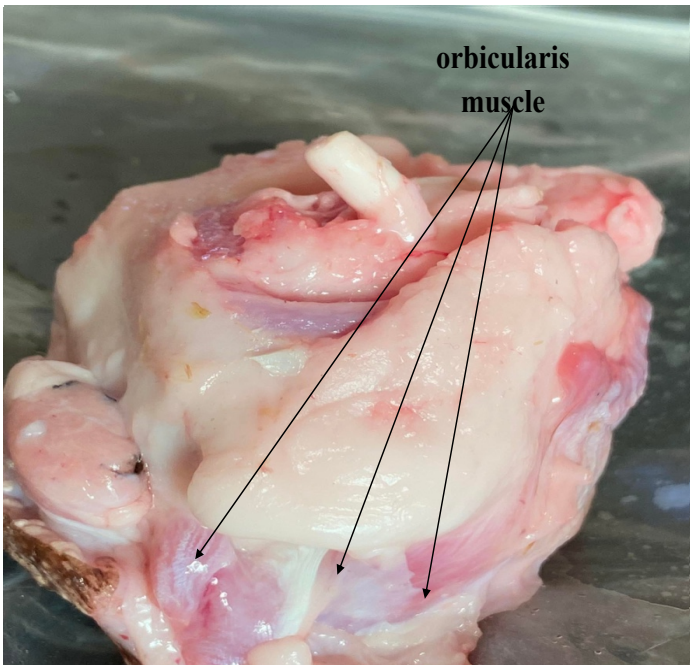

Figure.3: Shows the orbicularis muscle surrounded the eye

The conjunctiva was connected to the lids. There was a pigmented convergence of the conjunctiva and the lids at the lateral angle. However, the medial corner lacked pigment. The palpebra aperture was oval but broadened toward the medial angle. The conjunctiva that protected the third eyelid made a fold covering underlying T-shaped cartilage. A

thick rounded cord-like optic nerve emerged at the ventrolateral aspect of the globe and was surrounded by the retractor muscle. It was overridden or went along the optic foramen (Figure. 4). At the caudo-ventral part of the globe, there was an optic disc or papilla (the nerve origin), which appeared as a circular whitish spot. Additionally, the trochlear nerve was lateral to the dorsal oblique muscle, which invaded the intra-orbital course shortly. At the apex of the eyeball entered the oculomotor nerve that supplied all muscles except the retractor, dorsal oblique, and lateral rectus. There were two main nerve branches; the upper division supplies the levator of the eyeball's upper lid and dorsal straight muscle, while the large lower division goes between the ventral and lateral straight muscle to end in the ventral oblique. Along the lateral straight muscle, the border passed a part of the abducent, but it regressed at a point in the middle of the muscle.

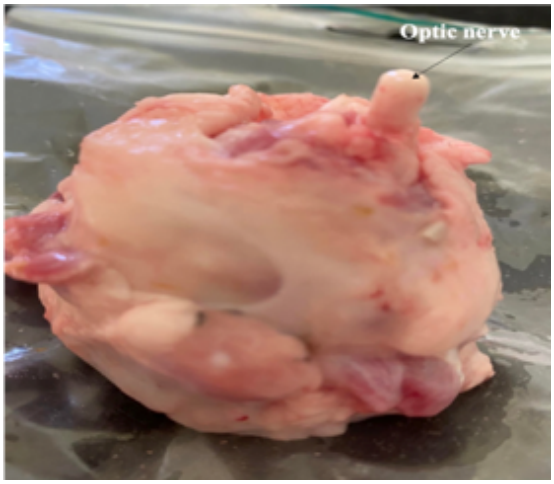

Figure. 4: Shows a thick rounded cord-like appearance optic nerve emerged at the ventro-lateral aspect of the globe

The eyeball of the camel showed a well-developed three layers of tunics. The longitudinal sections revealed the first fibrous layer formed from a large white sclera and a small, transparent cornea. The sclera was attached lightly to the recti muscles and invaded the caudo-ventrally by the optic nerve. Moreover, it revealed black pigmentation along the corneoscleral junction (Figure. 5).

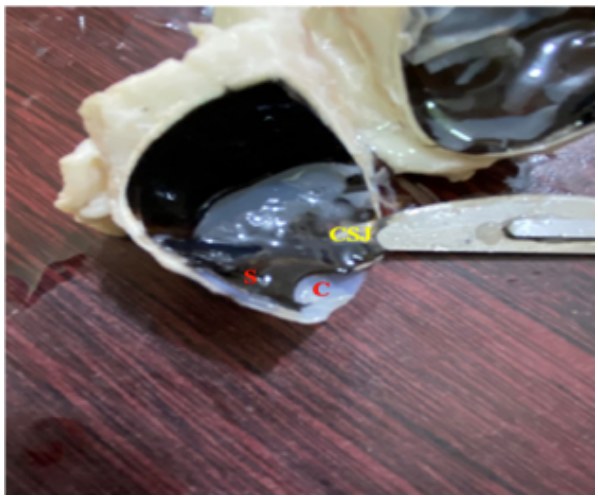

Figure. 5: Shows the corneoscleral junction (CSJ), the sclera (S), and the cornea (C).

The cornea was more curved than the sclera and was transparent with pigmentation, particularly on the cornea-scleral junction. The second vascular layer comprised the choroid, the ciliary body, and the iris. The outer layer of the choroid revealed heavily dark pigmentation accompanied by an inner vascular layer. Caudal to the lens was seen the ciliary body formed of radially arranged ciliary processes and confined the pupil and grooves to the suspensory ligament or zonula of the lens. Cranially to the cornea between the lens caudally interposed the iris that was dark in color and appeared corrugated from both sides. The iris surrounded the pupil. The third nervous tunic (Retina) appeared a gray color and formed the whole inner layer of the eyeball. It was limited caudally by the origin of the optic nerve and cranially by the iris. The camel lens revealed a transparent, non-vascular biconvex shape. It was situated caudally to the iris and attached to the ciliary body at its poles via thin fibrous strands (Zonula). In fresh samples, the lens revealed a jelly-like appearance(Figure. 6).

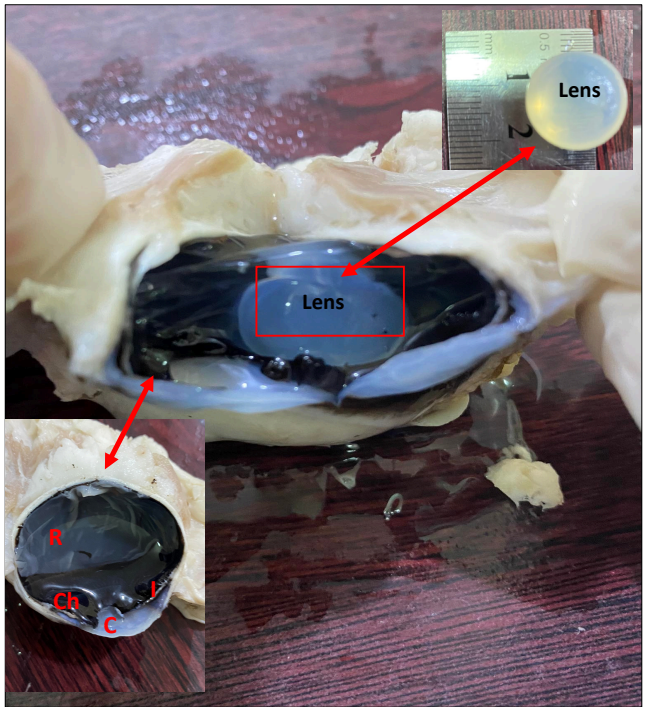

Figure. 6: Shows the tunics of the eyeball: folded retina (R), the cornea (C) , choroid (Ch) & Iris (I). and lens.

Discussion

The camelids are one of the desert animals and entirely adapted to survive and breed in severe arid conditions despite fluctuations in the temperatures, extended droughts, and food poverty (Bouâouda *et al.,* 2014). Camels have sharp vision and large, well-developed eyes to resist the severe desert environment (Bourges *et al.,* 2007). In the current study, the local Iraqi Dromedary's eye revealed a complete osseous circular located at an equal distance. These observations are compatible with the results of previous studies elsewhere in the world (Abuagla *et al.,* 2016; Ibrahim, 2003; Smuts & Benzuidenhout, 1987). The researcher found that the orbit was located at the skull border among the cranium and face and reported colored orbital corners surrounding the lids (Smuts & Benzuidenhout, 1987).

The third eyelid appeared as a large conjunctival semi-lunar fold extending up to 3 cm from the medial canthus above the anterior surface of the eyeball, and this result is

compatible with another researcher (Al- Ramadan and Ali, 2012). In contrast, Ibrahim (1990) reported that the camel's third eyelid was located on the eyeball rostromedial aspect and appeared quadrilateral in the outline of the camel. Moreover, he found a dark pigmentation at the conjunctiva's reflection line, particularly on the superficial gland of the aged dromedaries. The present study showed a pigmentation on the lateral angle of the conjunctiva and lids. However, Ibrahim (1990) and Abuagla *et al.,* (2016) found numerous horizontal lines of dark pigmented areas on the conjunctiva caudal half.

This study also showed the presence of multiple and long cilia of the eyelids on both upper and lower lids. This result disagrees with other studies regarding other domestic animals(Sisson & Grossman, 1975). The previous researcher mentioned that the long cilia and the tuft likely acted as protective tools against dust, foreign bodies, insects, and sunlight (Tayeb, 1962). A triangular hairy area was also found on the eyelid's medial margin suggesting that the long, dense, and strong eyelashes are the essential mechanisms that enable the camel to resist the aid sandy climate (Tayeb, 1962).

The results of this study showed that the distribution of the ocular muscles in the Dromedary's eye is similar to observation reported previously in sheep (May 1954), dogs (Bradley, 1959), equines (Sisson & Grossman, 1975), bovine (Dyce & Wensing, 2010; Habel, 1983) and goat (Constantinescu, 2001). The results of this study are also compatible with previous results on the camel optic nerve (Jain *et al.,* 2010).

Moreover, this study also approved the similarity of the internal structure of the Dromedary's eyeball with other domestic animals (Sisson & Grossman, 1975). It revealed three well-developed layers of tunics, the fibrous, vascular, and the nervous (Retina), and compatible with Bareedy *et al.,* (1986) observations regarding the 85% sclera constitution. One of the important findings of this study was the determination of heavy black pigmentation in the corneoscleral junction. Moreover, the rich pigmentation of the choroid potentially helps in the absorption of harmful ultraviolet. The camel has a sharp vision compared to other herbivores with a broader field vision; according to Reece, (2009), the eyeball of these animals was located laterally. In contrast, the results of this study showed that the camel orbit was situated at an equal distance between the nuchal crest and premaxilla.

In conclusion, this study approved well-developed Dromedary's eye that showed macroscopic differences from other domestic animals, and probably these structural changes fit the severe desert environment.

Competing interests

No competing interests were disclosed

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