Original Article

Histomorphological Study of Ciliary body, Iris and Irido-corneal angle in Adult Marwari Goat (Capra hircus)
R. K. Barhaiya*, Malsawmkima, D. M. Bhayani and Y. L. Vyas

Department of Veterinary Anatomy and Histology, College of Veterinary Science & A. H. Anand Agricultural University, Anand-388 001 (Gujarat), INDIA
*Corresponding author: R. K. Barhaiya

Abstract
The present study was carried out on eye ball of the adult Marwari goat (Capra hircus) irrespective of the sex. The ciliary body was the anterior continuation of the choroid and it joined anteriorly with the iris. It was made up of the two ring shaped components: the pars plicata and pars plana. Both portion of the ciliary body consisted of the epithelium, stroma and smooth muscles. Iris was extended from the ciliary body and cover the anterior surface. It was mainly consisted of the stroma and the posterior epithelial lining. The stroma was comprised of the loose connective tissue with smooth muscles, blood vessels, melanocytes and fibroblasts. The irido-corneal angle located at the periphery of the anterior chamber. The irido-corneal angle of the eye of the goat was large and triangular and it was comprised of the pectinate ligament, the ciliary cleft, the trabecular meshwork (uveal and corneoscleral) and the angular aqueous plexus.

Key words: Goat, Irido-corneal angle, Histomorphology

Introduction
Vision is one of the most important sensory abilities of human as well as animals. Disorders in the region of the ciliary body, iris and the irido-corneal angle are associated with changes in accommodation power of lens, intra ocular pressure (IOP) etc. The anatomical features of irido-corneal angle are clinically important in animals as a way to understand the etiology and pathogenesis of the many forms of glaucoma (Kassab, 2010). The information on histomorphology of ciliary body, iris and irido-corneal angle in goat is lacking in reviewed literature thus the present study was undertaken.

Materials and methods
The present study was carried out on eye ball of ten adult Marwari goats (Capra hircus). Eye balls were collected from the abattoir and immediately subjected for Fixation in Davidson’s fluid. Davidson’s fluid is
an excellent fixative for fixation of whole eye ball (Latendresse et al., 2002). Cornea was incised from the limbus which provides good penetration of fixative into the eye ball to ensure proper fixation of internal structure. After fixation, eye ball was bisected at the meridional plan. The anterior half of the bisected eye ball was again subdivided into 3-4 mm thick segment of eye. Then samples were processed by routine paraffin embedding technique (Drury and Wallington, 1980) and paraffin sections of 5 to 7 μm were subjected for hematoxylin and eosin (Singh and Sulochana, 1996) and Masson’s trichome staining (Humason, 1967).

Results and Discussion

The ciliary body was the anterior continuation of the choroid and it joined anteriorly with the iris (fig.1, 5). It was attached to the internal surface of the sclera. It was made up of the two ring shaped components: the pars plicata and pars plana. The pars plicata was the anterior most part of the ciliary body which consisted of the number of ciliary process (fig.1, 2). The flat pars plana started from this posterior termination of the process (fig.4) and merged with anterior termination of the retina (ora ciliaris retinae). Both portion of the ciliary body consisted of the epithelium, stroma and smooth muscles (fig.2). The ciliary epithelium had two cell layer. The inner epithelium layer was non pigmented and was continuous with the aqueous humor of the posterior chamber (fig.3). At the ora ciliaris retinae, the sensory retina was converged into the single layer of non pigmented ciliary epithelium which extended anteriorly until it become the posterior epithelial layer of the iris (fig.4, 6). The outer ciliary epithelium was pigmented (fig.3) and united with retinal pigmented epithelium at the ora ciliaris retinae. It was continued as the posterior pigmented epithelial layer of the iris (fig.6). Each ciliary process was consisted of the central core of stroma and blood vessels covered by bilayer of epithelium. The stroma of the ciliary body was composed of the fibroblast, blood vessels and melanocytes and it was most abundant in the pars plicata. The smooth muscles of the ciliary body were mostly oriented along the meridional plane and they were also associated with melanocytes (fig.2). Similar observations were reported earlier by Prince et al. (1960) in goat, Dellmann (1993) in domestic animals, Ramkrishna et al. (1997) in Indian water buffalo, Khaled (2003) in bovine and Gelatt (2007) in domestic animals.

Iris was extended from the ciliary body and covered the anterior surface of the lens, except for central opening i.e. pupil. It was mainly consisted of the stroma and the posterior epithelial lining (fig.5). The stroma was comprised of the loose connective tissue with smooth muscles, blood vessels, melanocytes and fibroblasts. The iridial sphincter muscles which was located as circularly arranged bundle of smooth muscles within the posterior stroma of the pupillary zone. The anterior surface of the iris was formed by sheet of fibroblast and melanocyte and in direct contact with aqueous humor of the anterior chamber.
The posterior epithelium was formed by the two layer of the pigmented epithelium. The anterior layer was direct continuing with the pigment epithelium of the ciliary body whereas the posterior layer which was densely pigmented continues with the non pigmented epithelium of the ciliary body (fig.6). At the pupillary margin, different size of round black masses were present i.e. corpora nigra or granula iridica (fig.10). These were the extension of the posterior pigment epithelium. The present histological observations of the iris are in accordance with those reported by Khaled (2003) in bovine, Ramkrishna et al. (1997) in Indian water buffalo, Gelatt (2007) in domestic animals and Zayed et al. (2012) in buffaloes. However, granula iridica in the pupillary margin of the iris was not present as earlier reported by Ramkrishna et al. (1997) in Indian water buffalo and Gelatt (2007) in carnivore which is contrary to the present study.

The irido-corneal angle was the area, located at the periphery of the anterior chamber. The irido-corneal angle was formed by the junction of the corneoscleral tunic (Limbic zone), base of the iris and anterior ciliary body (fig.7). The irido-corneal angle of the eye of the goat was large and triangular. It was comprised of the pectinate ligament, the ciliary cleft, the trabecular meshwork (uveal and corneoscleral) and the angular aqueous plexus (AAP). The pectinate ligament was located on the anterior part of the irido corneal angle (fig.7). It was a strong, band-like structure extending from the iridal base to the limbic zone (fig.9). The ciliary cleft was the space, which was bordered by the pectinate ligament anteriorly, the limbal zone from the outer aspect, and the base of the iris and the ciliary body from the inner aspect. The ciliary cleft contained large amount of trabecular tissue. Trabecular tissue had two parts: the uveal part and the corneoscleral part (fig.7). The uveal meshwork was the inner part of the trabecular meshwork. It was composed of numerous strands of trabeculae. There were large inter trabecular spaces between the trabeculae which were known as space of Fontana. The corneoscleral meshwork was the external part of the trabecular meshwork and characterized by small trabeculae that in turn small inter trabecular spaces (8). The observations of present study are similar as described by Kassab et al. (2001) in buffalo, Gelatt (2007) in domestic animal and Kassab and Zoghby et al. (2010) in goat.
**Figure 1:** Photomicrograph of the ciliary body showing, the flat pars plana and the pars plicata having ciliary process. **PC:** Palpebral conjunctiva, **BC:** Bulbar conjunctiva. (H. & E. 30X)

**Figure 2:** Photomicrograph of the pars plicata of ciliary body showing, ciliary process and stroma having smooth muscle fibers (**SM**), blood vessels (**BV**) and melanocytes (H. & E. 75X)

**Figure 3:** Photomicrograph of the ciliary process showing stroma having blood vessels (**BV**) and two layered epithelium. Inner layer was non pigmented epithelium (**NPE**) and outerlayer was pigmented epithelium (**PE**). (Masson’s trichome, 300X)

**Figure 4:** Photomicrograph of the pars plana of the ciliary body, lined by pars ciliaris retinae (non pigmented epithelium) and pigmented epithelium (**PE**). (H. & E. 300X)

**Figure 5:** Photomicrograph showing, iris extended from the anterior margin of the ciliary body cover the posterior surface of the cornea. Anterior surface (**AS**) and posterior surface (**PS**) of the iris facing towards the anterior chamber (**AC**) and posterior chamber (**PC**) respectively. **ICA:** Irido-cornea angle. (H. & E. 30X)

**Figure 6:** Photomicrograph showing the anterior surface of iris formed by the sheet of the fibrocyte and melanocytes (**M**) and posterior surface lined by highly pigmented posterior epithelium. Stroma comprised of loose connective tissue, melanocytes, fibrocyte and smooth muscles fibers (**SM**) within the posterior stroma (iridial sphincter muscles). (H. & E. 150X)
The present observation explains the features of the ciliary body, iris and irido-corneal angle in adult Marwari goat, which helps consequently in understanding the pathogenesis of some diseases like glaucoma in goats. The ciliary cleft of irido-corneal angle was large which facilitate the proper drainage of aqueous humor.

**Conclusion**

The present observation explains the features of the ciliary body, iris and irido-corneal angle in adult Marwari goat, which helps consequently in understanding the pathogenesis of some diseases like glaucoma in goats. The ciliary cleft of irido-corneal angle was large which facilitate the proper drainage.
of aqueous humor whereas primates and carnivores are prone to glaucoma due to smaller irido-corneal angles. Pectinate ligament was also thick, compact and strong which support the iridal base and prevent the collapse of the ciliary cleft. The present results also revealed that the uveal meshwork and corneoscleral meshwork came in contact with the posterior surface of the pectinate ligament which also support the pectinate ligament. These histomorphological study of irido-corneal angle prevail that incidence of glaucoma is very rare.

References