Volume-3, Issue-11, Nov-2014 • ISSN No 2277 - 8160

Research Paper | Veterinary Science

Histomorphological and Micrometrical Study of the Retina in Adult Marwari Goat (Capra hircus)

Rakesh Kumar Barhaiya	Department of Veterinary Anatomy and Histology, College of Veterinary Science & A. H. Anand Agricultural University, Anand
Malsawmkima	Department of Veterinary Anatomy and Histology, College of Veterinary Science & A. H. Anand Agricultural University, Anand
D. M.Bhayani	Department of Veterinary Anatomy and Histology, College of Veterinary Science & A. H. Anand Agricultural University, Anand
Y. L. Vyas	Department of Veterinary Anatomy and Histology, College of Veterinary Science & A. H. Anand Agricultural University, Anand

ABSTRACT

The present study was carried out on eye ball of the adult Marwari goat (Capra hircus) irrespective of the sex. The retina was the innermost layer of the tunic of the eye ball. Retina had twoportion, one was sensory (pars optic retinae) and another one was nonsensory. Thesensory part of the retina was composed of ten layer. The retinal pigmented epithelium (RPE) was the outermost single layer of flat cellsof the retina. The cells of the RPE were pigmented except the area where the tapetum fibrosum was present. The next layer was layer of rod and cone cells which comprised of only outer part of the rods and cones i.e. outer and inner segment. Outer limiting membrane separated the layer of rods and cones from the outer nuclear layer.The outer nuclear layer was composed mainly of nuclei of rods and cones.The outer plexiform layer was a thin layer that separated the outer nuclear layer from the inner nuclear layer. The inner nuclear layer comprised of the nuclei of the horizontal cells, bipolar cells, amacrine cells and Muller's cells.The inner plexiform layer was comprised of the bipolar and amacrine cell axon and dendrites of the ganglion cells.The ganglion cell layer was the innermost cell layer of the retina.The nerve fiber layer formed by the axon of ganglion cell. The internal limiting membrane was the innermost layer of the retina.Thickness of the retina found to be varied from region to region, it was thickest at optic disc and tapering towards the ora ciliaris retinae.

KEYWORDS : Goat, Histology, Retina

INTRODUCTION

The retina is a multilayered extension of the brain that play key role in vision (Komaromy, 2010). The retina consists of various cell types arranged in eight layers and two membranes (Shara*et al*., 2013). Visual perception is a sensory process initiated at the retina, and completed in the cerebral cortex. Two main functions are performed by the retina: 1) the initial conversion of light energy into electric signals(photo transduction), which is carried out by photoreceptors; 2) a series of physiological processes performed by retinal interneurons (bipolar, horizontal and amacrine cells), in order to encode the different attributes of the visual stimuli (shape, movement and color) in electrical signals (Germain *et al*., 2010). Any changes in its structure may lead to temporary or permanent blindness.A sound knowledge of normal histological features of retina, including possible individual variations, will greatly assist in recognizing pathology thus providing more accurate diagnosis. This region is of considerable importance considering that it is an area for vision which is important for the well-being and performance of the animal.The information on histomorphology of retina in goat is lacking in reviewed literature. Hence, the present study was undertaken to evaluate the histology and micrometry of the retina.

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 becauseconventional 10% formalin causes artificial cellular shrinkage and poor cellular and nuclear resolution of the retina.It has been advocated and widely used for the preservation of eye ball, maintaining retinal attachment during fixation and processing and providing better preservation of the retinal nuclear layer and sensory specialization of the rods and cones(Latendresse *et al*., 2002).Cornea was incised from the limbus which provide 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 bisected eye ball was again subdivided into 3-4 mm thick segment of tunic 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 trichomestaining (Humason, 1967).

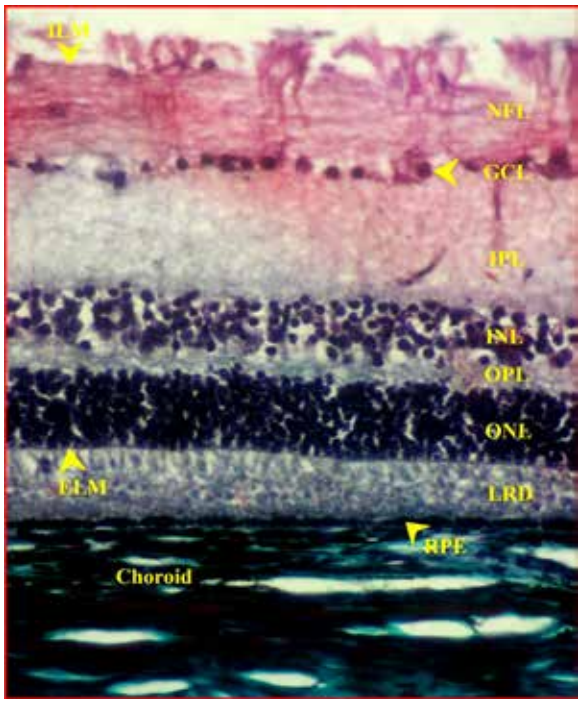
RESULTS AND DISCUSSION

Histology of retina:

The retina was the innermost layer of the tunic of the eye ball. Retina had two portion one was sensory (pars optic retinae) and another one was nonsensory. Non sensory part of the retina started from the ora ciliaris retinae (fig.4) and covered the ciliary body (pars ciliaris retinae) and iris (pars iridis retinae).The sensory part of the retina was composed of ten layers (fig.1) which were from outside to inside as follows: (1) Retinal pigmented epithelium (RPE) (2) Layer of rods and cones (3) External limiting membrane (4) Outer nuclear layer (5) Outer plexiform layer (6) Inner nuclear layer (7) Inner plexiform layer (8) Ganglion cell layer(9) Nerve fiber layer and (10) Internal limiting membrane.

The RPE was the outermost layer of the retina (fig.1). It was a monolayer of flat cells (fig.3). It was the continuation of the outer pigmented epithelium of the ciliary body. The cells of the RPE were pigmented except the area where the tapetum fibrosum was present (fig.2, 3). The basement membrane of the RPE and the endothelium of the choriocapillaris layer formed a basal complex which was known as Bruch's membrane (fig.3). These observations are found to be similar as described by Prince *et al.* (1960) in goat, Dellmann (1993) in domestic animals, Khaled (2003) in bovine and Gelatt (2007) in domestic animals.

The next layer of rod and cones cells was situated just below the RPE. This layer comprised of only outer part of the rods and cones i.e. outer and inner segment. These segments were closely packed together, side by side and they were arranged radially, being parallel to the incoming light through pupil (fig.1). Outer segments of the photoreceptive rod and cone could be readily distinguished with the light microscope in our study, as a layer adjacent to the pigmented epithelium (fig.1).



External limiting membrane separated the layer of rods and cones from the outer nuclear layer (fig.1, 5).The outer nuclear layer was comprised of nuclei of rods and cones which were arranged in 5 to 7 rows (fig.1,2) which is in agreement with the findings of Prince *et al.* (1960) in goat, Dellmann (1993) in domestic animals and Germain *et al.* (2010) in vertebrates. The nuclei of the cones were located in the proximity of this layer and form only a single row and took lighter stain and larger than the rod nuclei, whereas the nuclei of the rods formed several layers in the inner portion of this layer and took dark stain (fig.5) which is similar as described by Gelatt (2007) in domestic animals.

The outer plexiform layer was a thin layer, separated the outer nuclear layer from the inner nuclear layer. It was composed mainly of axons of rods and cones that synapse with dendrite of the horizontal cell and bipolar cells (fig.1, 5). These finding are similar as described by Prince *et al.* (1960) in goat, Dellmann (1993) in domestic animals, Gelatt (2007) in domestic animals and Germain *et al.* (2010) in vertebrates.

The inner nuclear layer was comprised of the nuclei of the horizontal cells, bipolar cells, amacrine cells and Muller's cells (fig.1). In this layer four different types of nuclei were identified (fig.5). The nuclei of horizontal cells were larger and took lighter stain with prominent single nucleolus. It was positioned along the outer margin of the inner nuclear layer. The amacrine cell nuclei were located vitreally in the inner nuclear layer and they were recognized by euchromatic nuclei. The nuclei of thebipolar cells and Muller's cells were situated in the center zone of the inner nuclear layer. Nuclei of the Muller's cell were identified as they were angulated and had dense chromatin than other nuclei in the inner nuclear layer. Bipolar cells formed the largest population in this layer and characterized by euchromatic to somewhat heterochromatic nuclei (fig.5). These observations in present study are similar as described by Gelatt (2007) in domestic animals and Germain *et al.* (2010) in vertebrates.

The inner plexiform layer was comprised of the bipolar and amacrine cell axons and dendrites of the ganglion cells. It was thicker than the inner plexiform layer. Some displaced nuclei of amacrine cell were also identified in this layer (fig.1, 5) which is similar as described by Germain *et al.* (2010) in vertebrates.The ganglion cell layer was the innermost cell layer of the retina. It was consisted of the single layer of ganglion cells but in some area it was 3 to 4 rows of cells (fig.1, 5)

The nerve fiber layer was formed by the axons of ganglion cells (fig.1, 2). The thickness of nerve fiber layer was increased as it goes to the optic disc. Large retinal blood vessels were seen in the nerve fiber layer but it was also present in the ganglion cell layer as well as in the inner plexiform layer (fig.4). These observations in present study are similar as described by Gelatt (2007) in domestic animals and Germain *et al.* (2010) in vertebrates.

The internal limiting membrane was the innermost layer of the retina which was formed by the basal lamina of the Muller's cell (fig.1). These findings in presentstudy are similar as described by the Prince *et al.* (1960) in goat, Dellmann (1993) in domestic animals, Gelatt (2007) in domestic animals and Germain *et al.* (2010) in vertebrates.

Histology of optic disc:

At the posterior side, axons of the ganglion cell leaved the eye ball through the choroid and sclera and form the optic disc. From the optic disc optic nerve entered into the orbit. Optic head was oval in shape (fig.6). At the point of leaving of optic nerve through sclera, scleral collagen fibers become reduce and separated and formed the sieve like partition of connective tissue in sclera i.e. lamina cribrosa (fig.6, 7). Optic nerve fiber of the retina clustered into fascicles or bundles as they crossed the lamina cribrosa and the bundles of optic nerve were are surrounded by collagenous septa and glial cells (fig.7). Lamina cribrosa also provided the passage for retinal blood vessels (fig.6). Similar observations are reported earlier byPrince *et al.* (1960) and Gelatt (2007) in domestic animals.

Micrometry of retina:

Thickness of the retina was found to be varied from region to region. It was thickest at optic disc and tapering towards the ora ciliaris retinae.The mean values of the total thickness of the retina at Anterior/ Ora ciliaris retinae, at equator and at posterior/Optic disc were 113.24 ± 5.68 µm, 139.82 ± 7.49 µm and 213.03 ± 14.45 µm, respectively.

Gelatt (2007) described that most animals had a central retina of approximately 200 to 240 µm and a peripheral retina of 100 to 190 µm which are almost similar to findings of present study on adult Marwari goat. Gelatt (2007) in equine also reported that total thickness of the retina was 80 µm at the ora ciliaris retinae, 250 µm medial to the optic nerve and it was for the most part less than 130 µm. These observations are found to be almost similar as studied presently.

The mean values of the thickness of the different layers of the retina at equator were recorded as below-

	Pigmented epithelium (µm)	Layer of rods and cones (µm)	Outer nuclear layer (µm)	Outer plexiform layer (µm)	Inner nuclear layer (µm)	Inner plexiform layer(µm)	Nerve fiber layer (µm)
Mean	1.94±0.10	18.50±1.34	26.16±2.52	7.49±0.85	17.31±1.50	21.43±1.74	13.65±2.02

Prince *et al.* (1960) in goat asserted that thickness of the pigmented epithelium was 20 µm which is higher than the present study. The outer nuclear layer was consisted of about 5 rows of cells measured 30 µm in goat although at the posterior pole this was slightly increased as there were 6 or 7 rows of cells which was almost similar as present study but the thickness of the outer nuclear in present study was slightly lower. It may be due to breed difference and also size of the animal and individual of animal. They mentioned that thickness of the outer plexiform layer was 14 µm, inner nuclear layer was 26 to 30 µm with 5-6 rows of cells, and inner plexiform layer was 30 µm thick in goat which was found to be higher than the findings of present study. The variation in thickness of the different layer of retina may be due to variation in area of interest where the measurement has taken.

CONLUSIONS

Theretina of goat has no more variance regarding histology compare to the other domestic animals. Central retinal vein is not found in the present study as it is present in carnivores, primates (Gelatt, 2007). In the present study, fovea centralis is not observed. Thickness of the retina was found to be varied from region to region. It was thickest at the posterior pole (213.03 ± 14.45 µm) and thinnest at the beginning of the retina (113.24 ± 5.68 µm). The outer nuclear layer has the highest thickness among all layers of the retina. Lamina cribrosa is well developed and strong which provide better support to the optic disc against extra intraocular pressure. Fig 1

REFERENCES

Dellmann, H. D. (1993). Eye. In: Textbook of Veterinary Histology, 4thedn. Lea and Febiger, Philadelphia, pp. 313-326. | Drury, R. A. B. and E. A.Wallington (1980). Preparation and fixation of tissues. In: Carleton's Histological Technique. 5thedn. Oxford University Press, Oxford, New York, pp. 41–54. | Gelatt, K. N. (2007). Ophthalmic Anatomy. In: Veterinary Ophthalmology. 4thedn., Blackwell Publishing Asia, Victoria, Australia, pp. 37-148. | Germain, F., C. Perez-Rico, J. Vicenteand P. Villa(2010). Functional histology of the retina. A.Méndez-Vilas and J. Díaz., pp. 914-925. | Humason, G. L. (1966). Animal tissue technique. W.H. Freeman and Company. San Francisco and London. | Khaled, A. (2003). Glycohistochemical, Immunohistochemical and Electron Microscopic Examination of the Bovine Eyeball. A thesis submitted for the doctor degree in veterinary medicine, Faculty of Veterinary Medicine, Ludwig-Maximilians-University, Munich. | Komaromy, A.M. (2010). Day blind sheep and the importance of large animal disease models. The Veterinary Journal,185: 241-242. | Latendresse, J. R., A. R.Warbrittion, H.Jonassen, and D. M.Creasy (2002). Fixation of testes and eye using a modified Davidson's fluid: Comparison with Bouin's Fluid and Conventional Davidson's fluid. Toxicologic Pathology,30(4): 524-533. | Prince, J. H., Diesem, C. D., Eglitis, I. and Ruskell, G. L. (1960). Goat. In: Anatomy and Histology of the Eye and Orbit in Domestic Animals. Charles C Thomos. Springfield, U. S. A., pp. 234-259. | Shara, B. M., M. A.Adhami and M.Z. Amr(2013). A comparison of routine fixation and microwave fixation of the retina in Garrarufa. Int J Curr SCI.,5: 101-108. | Singh, U.B. and S. Sulochana(1996). Handbook of Histological and Histochemical techniques. 2ndedn., Premier Publishing House, Hyderabad. |