MICROANATOMY OF THE EYE STRUCTURES IN MERINO CROSSBREED LAMBS

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Abstract

The information concerning the microanatomy of sensorial organs in mammals is scarce. The goal of our study was to present the microanatomy of the eye in Merino crossbreed lambs. The structure of eye was histologically evaluated in lambs (2 months old lambs, Merino crossbreed). The harvested samples were processed with the typical paraffin technique. Thus, the harvested samples were immersed in 10% buffered formalin, and then embedded in histological wax, sectioned at 5-µm thickness and mounted on microscopic slides. The obtained slides were stained using Goldner's trichrome staining procedure. The overall structure of the eye in lamb respects the general microanatomy of the human eye, with few differences. Thus, a similar distribution of melanocytes throughout the sclera, without observing a higher number of melanocytes in the inner part of sclera (lamina fusca) was noticed. The posterior epithelium of the ciliary body is simple squamous with few melanin granules in the cytoplasm, aspect somehow different from other species, where no melanin granules were noticed in the inner cellular epithelium of the ciliary body.

Keywords: *eye, melanin, melanosomes, melanocytes, histology.*

Introduction

The eye is an organ responsible with vision and it distinguishes light. A number of light-sensitive structures are found in a range of animals. The modest eyes do nothing but distinguish whether the environments are dark or light, whereas complex eyes can discern colors and shapes. Several animals, along with some mammals, birds, fish and reptiles, have two eyes, whose image basically overlap in order to permit better depth discernment (aspect known as binocular vision that occurs in humans). In some other species, for instance in rabbits and chameleons, eyes are positioned in such a way to minimalize the overlap (Moran and Rowley, 1988; Bacha W.J., Bacha L.M., 2000; Mills, 2007). Even if mammalian vision is not as exceptional as bird vision, in most of mammalian species it is at least dichromatic or even trichromatic in Hominidae (Bacha W.J., Bacha L.M., 2000; Ross and Pawlina, 2011).

The information concerning the microanatomy of sensorial organs in mammals is scarce. Most of histological details of the eye were attained from humans or a number of laboratory animals used in experiments (e.g. rats, mice etc.). According to that, the goal of our study was to present the microanatomy of the eye in Merino crossbreed lambs.

Materials and methods

The structure of eye was histologically evaluated in lambs (i.e., 2 months old lambs, Merino crossbreed). The harvested samples were processed using the typical paraffin technique. Thus, the harvested samples were immersed in 10% buffered formalin for 3 days. Afterwards, the obtained samples were embedded in histological wax, sectioned at 5-µm thickness and mounted on microscopic slides. The obtained slides were stained using Goldner's trichrome staining procedure. The photographs were obtained using the Olympus E-330 photocamera attached to an Olympus BX41 light microscope.

Results and discussion

In the present paper, the main histological features of the eyeball will be approached on each of the three layers, which are the fibrous tunic, vascular tunic, and neural tunic (Fig. 1).

As known, the fibrous tunic includes the sclera and cornea. The sclera displays a similar histological arrangement throughout its structure that is an irregular dense connective tissue made of collagenous fibers. Histologically, there is not a clear delimitation between the three layers of the sclera (i.e. episclera, stroma and lamina fusca). Melanocytes are scarce throughout the sclera, without observing a higher number of melanocytes in the inner part of sclera (lamina fusca) as suggested in some reports (Moran and Rowley, 1988; Bacha W.J., Bacha L.M., 2000; Kühnel and Kuhnel, 2003; Mills, 2007; Gal and Miclăuş, 2013). Melanocytes adopt here a spindle or dendritic shape appearance in the minute spaces created by the collagen fibers. Melanosomes have a granular or dot-like appearance in all the cytoplasm of melanocytes (Fig. 2). Concerning the cornea, it has a standard histological structure without any noticeable major differences. Accordingly, there is a non-keratinized squamous stratified epithelium (i.e. the anterior surface of the cornea), followed by a highly ordered avascular stroma (Fig. 3). The posterior corneal epithelium is simple squamous with a prominent basal membrane (or Descemet's membrane).

Concerning the vascular tunic (or uveal tract), we assessed the choroid, iris and ciliary body. As a comparison, while the epichoroid is an avascular structure with few melanocytes, the inner layers of choroid (i.e. vascular and choriocapillary layers) are highly pigmented and vascularized (Fig. 4). Melanocytes contain tiny granular melanosomes that often mask the nucleus of melanocytes. The melanocytes in choroid resemble the melanocytes located in sclera. Regarding the iris and ciliary processes of the ciliary body, they consist of the surface epithelium and the bulk of the iris and ciliary processes. The anterior epithelium is bistratified cuboidal to low columnar, but with no pigmentation in the upper epithelium and a highly pigmented basal epithelium (Fig. 5). In the pigmented epithelium, melanosomes have a granular or rod-like appearance, but are much bigger than the ones located in the sclera and choroid (Fig. 6). The sustaining stroma of the ciliary processes include large vascular spaces with young endothelial cells and discreet melanocytes in the connective tissue. The main bulk of ciliary body is made of dense irregular connective tissue, with some smooth muscle fibers, quite a number of dendritic or spindle shaped melanocytes and large blood vessels (Fig. 5). The posterior epithelium of the ciliary body and iris is simple squamous with melanin granules in the cytoplasm. However, there is a reduction concerning the number of melanin granules in the posterior epithelium of the iris and ciliary body in comparison to the one in the anterior epithelium (Fig. 7). The former aspect is different in comparison to some other reports in other species, which suggest no pigmentation in the posterior or inner cellular epithelium of the iris and ciliary body (Moran and Rowley, 1988; Bacha W.J., Bacha L.M., 2000; Kühnel and Kuhnel, 2003; Mills, 2007).

As regards the neural tunic represented by the retina (i.e. photosensitive part), no significant differences were noticed in comparison to the standard structure of the photosensitive retina in other mammals. As observed in Fig. 8, all ten layers are present (i.e. the pigmented epithelium, photoreceptor layer with cones and rods, external limiting membrane, outer nuclear layer, outer plexiform layer, inner nuclear layer, inner plexiform layer, ganglion cell layer, optic nerve fiber layer, and internal limiting membrane).

Fig. 1. Histological section of the eye in mix breed Merino lamb (A – sclera, B – choroid, C – retina); Goldner's tricrome stain.

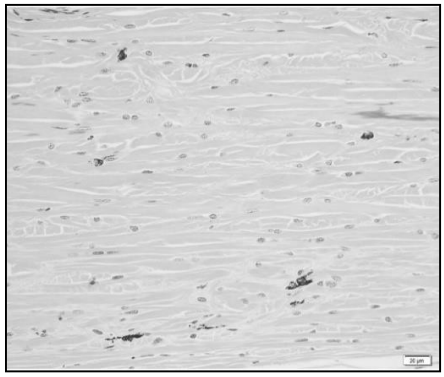

Fig. 2. Distribution of melanocytes in the sclera and the aspect of melanocytes and melanosomes; mix breed Merino lamb; Goldner's tricrome stain.

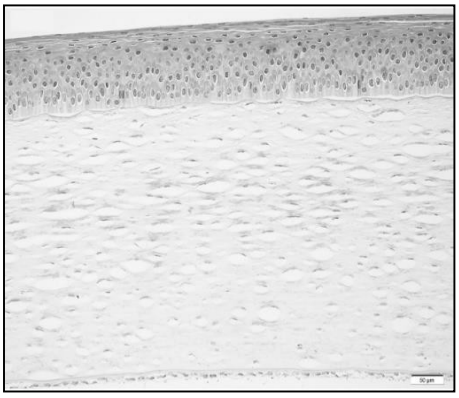

Fig. 3. The structure of cornea in mix breed Merino lamb; Goldner's tricrome stain.

Fig. 4. The inner layers of choroid (vascular and choriocapillary layers) include a high number of melanocytes (bottom); mix breed Merino lamb, Goldner's tricrome stain.

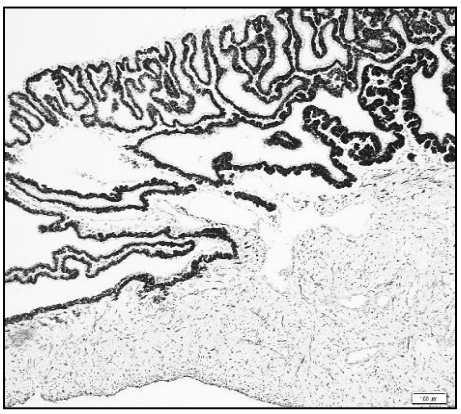

Fig. 5. General aspect of the ciliary processes and iris (bottom-left) that is highly pigmented, while the pigmentation degree decreases towards the posterior part of iris and ciliary body; Goldner's tricrome stain.

Fig. 6. The bistratified epithelium of the ciliary processes, with large melanin granules only in the basal layer; Goldner's tricrome stain.

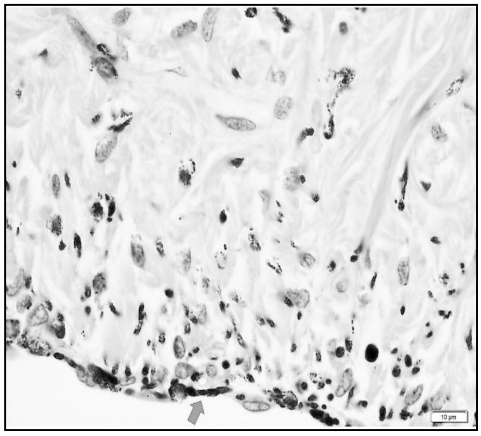

Fig. 7. The number of melanin granules in the posterior epithelium of the iris and ciliary body (arrow) diminish significantly in comparison to the anterior epithelium; Goldner's tricrome stain.

Fig. 8. Retina in lamb – the presence of all ten layers starting with the pigmentary cell layer (top); Goldner's tricrome stain.

The eye is a sensory organ that is composed of a lens and a wall that is divided into three layers, such as an outer fibrous tunic (corneoscleral layer), a central vascular tunic (uvea), and an internal retinal tunic (Moran and Rowley, 1988; Bacha W.J., Bacha L.M., 2000; Mills S.E., 2007).

The sclera includes compactly interwoven fascicles of collagenous fibers arranged parallel to the outer surface of the wall of the eye. There are also fibroblasts, some discreet elastic fibers, and disseminated melanocytes, especially in the deepest region of the sclera (Bacha W.J., Bacha L.M., 2000; Kühnel and Kuhnel, 2003; Mills, 2007). As observed in our paper, in lambs the melanocytes are somehow uniformly dispersed throughout the sclera, without observing a higher number of melanocytes in the inner part of sclera.

The cornea is an avascular structure, which has the anterior surface covered by non-keratinized stratified squamous epithelium. Below this coat is Bowman's membrane that is not evident in domestic mammals. The substantia propria (also called the stroma) is made of thin lamellae of collagen fibers set parallel to the corneal surface, with fibroblasts between fibers. Descemet's membrane is a thick membrane that splits the stroma from the posterior epithelium. The posterior epithelium is made of a single layer of squamous to low cuboidal cells (Bacha W.J., Bacha L.M., 2000; Mills, 2007; Miclăuş and Gal, 2010). In lambs, the cornea resembles the general histological features described above.

The ciliary body is a frontal extension of the choroid. The loose connective tissue of the stroma consists of smooth muscle, also called the ciliary muscle, which lies peripheral to an inner vascularized area. The epithelium of the ciliary body is called pars ciliaris retinae. It is a bilayer of cells containing a basal layer of pigmented cells and a superficial layer of non-pigmented columnar cells. Small folds of the posterior surface of the ciliary body become longer toward the iris and form ciliary processes, which project toward the lens. Zonular fibers spread from the processes to the capsule of lens near the equator of the lens (Moran and Rowley, 1988; Bacha W.J., Bacha L.M., 2000; Kühnel and Kuhnel, 2003; Mills, 2007). In lambs, the ciliary body presents a bistratified cuboidal to columnar epithelium. Additionally,

the basal pigmented epithelium encloses the largest melanin granules from all structures of the eye.

Retina is the deepest layer of the wall of the eye. The photosensitive zone lines the internal surface of the eye from the ora ciliaris retinae to the optic disc. The last one is the point of transition from the non-photosensitive retina to the photosensitive retina. From the ora ciliaris retinae, the non-photosensitive zone continues anteriorly as a bistratified epithelium, forming the pars ciliaris retinae and the pars iridica retinae (which cover the ciliary body and the rear surface of the iris). From the choroid to the cavity of the vitreous humor, the 10 layers of the photosensitive retina are (as in presented in lambs) the following: pigment epithelium, layer of rods and cones, outer limiting membrane, outer nuclear layer, outer plexiform layer, inner nuclear layer, inner plexiform layer, ganglion cell layer, nerve fiber layer and the inner limiting membrane (Moran and Rowley, 1988; Bacha W.J., Bacha L.M., 2000; Kühnel and Kuhnel, 2003; Mills, 2007; Gal and Miclăuş, 2013). No differences were noticed between the photosensitive retina in lambs and other mammals.

Conclusion

The overall structure of the eye in lamb respects the general microanatomy of the human eye, with few differences. Thus, a similar distribution of melanocytes throughout the sclera, without observing a higher number of melanocytes in the inner part of sclera (lamina fusca). The posterior epithelium of the iris and ciliary body is simple squamous with few melanin granules in the cytoplasm, aspect somehow different from other species where no melanin granules were noticed in the inner cellular epithelium of the ciliary body.

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