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**17/mhs01/032**

**300l MBBS**

**Question**

**1. Write an essay on the histological importance of eye in relation to their cellular functions.**

The eye is a complex and highly developed photosensitive organ that permits an accurate analysis of the form, light intensity, and colour reflected from an object.

Histologically, understanding these layers of the eyes is important In disease pathophysiology and in some certain therapeutic approaches. Anatomically, the eyes can be defined as a series of of overlapping layers of tissues.

The eye has both external and internal features.

The external structures of the eye include;

1. The eyelashes

2. The eyelids

3. Muscles

4. Accessory Glands

5. Conjunctiva

The internal structures of the eye(three layers of tissue arranged concentrically) includes;

1. The sclera and cornea which makes up the exterior layers

2. The uvea is a vascular layer in the middle and it is subdivided into iris, ciliary body, and choroid.

3. The retina which makes up the innermost layer and it is made up of nervous tissues.

**EXTERNAL STRUCTURES OF THE EYE**

**1. Conjunctiva**

The conjunctiva lines the inner part of the eyelids.The tarsal plate(are two comparatively thick, elongated plates of dense connective tissue, about 10 mm in length for the upper eyelid and 5 mm for the lower eyelid; one is found in each eyelid, and contributes to its form and support)lies beneath the conjunctiva and contains meibomian glands(holocrine type exocrine glands along the rims of the eyelid inside the tarsal plate) which secrete an oily substance(meibum) to decrease the evaporation of the tear film.

**2. Tear Film**

The tear film consists of aqueous, mucus, and oily secretions.

**3. Accessory Glands**

Apocrine glands of Moll, meibomian glands, lacrimal glands.

**4. Muscles**

Orbicularis oculi, levator palpebrae superioris, superior tarsal muscle.

**5. Eyelids**

The eyelid likewise known as the cover of the eye, a mobile layer made up of skin and also muscular tissue and also covers the eyeball.

**INTERNAL STRUCTURES OF THE EYE**

**The outermost layer**

**1. The sclera(white of the eye)**

The sclera is dense connective tissue made of mainly type 1 collagen fibers oriented in different directions. The lack of parallel orientation of collagen fibers gives the sclera its white appearance as opposed to the transparent nature of the cornea. However, the collagen of the sclera and cornea are continuous.The four layers of the sclera from external to internal are episclera, stroma, lamina fusca, endothelium.The episclera is the external surface of the sclera. It is connected to the Tenon capsule by thin collagen fibers. At the corneoscleral junction, also known as the limbus, the Tenon capsule contacts stroma of the conjunctiva. Between the sclera and the choroid is the Suprachoroidal lamina, a thin layer of loose connective tissues rich in melanocytes, fibroblasts and elastic fibers.

**Histological importance**: The sclera is the opaque, fibrous, tough, protective outer layer of the eye that is directly continuous with the cornea in front and with the sheath covering the optic nerve behind. The sclera provides protection and form to the eye which is evident from its cellular features.

**2. The cornea(transparent front layer of the eye).**

The cornea consists of type I collagen fibers oriented in a uniform parallel direction to maintain transparency. It consists of five layers: epithelium layer (non-keratinized, stratified squamous epithelium), Bowman layer, stroma (also called substantia propria), Descemet’s membrane, corneal endothelium.

\* Corneal epithelium: fast growing, regenerating multicellular layer which interacts directly with the tear film. The corneal epithelium consists of 5-6 layers of cells. The surface corneal cells show microvilli protruding into the space filled by precorneal tear film.

\* Bowman layer: This is a layer of subepithelial basement membrane protecting the underlying stroma. It is composed of type 1 collagen, laminin, and several other heparan sulfate proteoglycans. It contributes greatly to the stability and strength of the cornea.

\* Stroma: The largest layer of the cornea, the stroma has collagen fibers arranged in a regular pattern. Keratocytes maintain the integrity of this layer. The function of this layer is to maintain transparency, which occurs by the regular arrangement, and lattice structure of the fibrils, whereby scatter from individual fibrils gets canceled by destructive interference, and the spacing of less than 200 nm allows for transparency.

\* Descemet’s membrane: an acellular layer made of type IV collagen that serves as a modified basement membrane of the corneal endothelium. It is a thick homogenous structure composed of collagenous filaments organized in a 3-dimensional network.

\* Corneal endothelium: a one cell thick layer made of either simple squamous or cuboidal cells. Cells in this region do not regenerate and have pumps that maintain fluid balance and prevent swelling of the stroma. When corneal endothelial cells are lost, neighboring cells stretch to attempt to compensate these losses.

The corneal endothelium and epithelium are responsible for maintaining the transparency of the cornea. Both layers are capable of transporting sodium ions towards their apical surfaces. Chloride ions and water flow passively, maintaining the corneal stroma in a relatively hydrated state. This state,along with the regular orientation of the very thin collagen fibrils of the stroma, accounts for the transparency of the cornea.

**Histological importance**: The cornea is a transparent avascular tissue that acts as a structural barrier and protects the eye against infection. Along with the tear Film it provides proper anterior refractive surface for the eye. Cornea contributes to 2/3rd of the refractive power of the eye. The cornea’s main function is to refract, or bend light. The cornea is responsible for focusing most of the light that enters the eye. The cornea tends to repair itself quickly from minor abrasions. However, deeper abrasions may cause scars to form on the cornea, which causes the cornea to loose it’s transparency, leading to visual impairment.

**The middle layer**

**1. The Iris**

The Iris consists of: (1) stromal layer with pigmented, fibrovascular tissue and (2) pigmented epithelial cells beneath the stroma. The sphincter pupillae and dilator pupillae muscles connect to the stroma. The pigmented layer of cells blocks rays of light and ensures that light must move through the pupil to reach the retina. The angle formed by the iris and cornea contains connective tissue with endothelial channels called the trabecular meshwork, which drains aqueous humor in the anterior chamber into the venous canal of Schlemm. From here, fluid drains into episcleral veins.

**Histological importance:** The anterior surface of the Iris contains loose, variably pigmented stroma. It is open to the circulating aqueous humor within the anterior chamber. Two layers of heavily pigmented epithelium cover the posterior surface of the Iris. Note that the sphincter pupillae muscle can be easily seen near the pupil margin. It is smooth muscle controlled by parasympathetics. The dilator pupillae muscle is more difficult to identify, but it dilates the pupil upon sympathetic innervation.

**2. The ciliary Body**

The tissue that divides the posterior chamber and vitreous body. Consists of the ciliary muscle(smooth muscles) and the ciliary epithelium. The ciliary muscle, via the lens zonules, controls the structure of the lens, which is vital for accommodation. Zonules are connective tissue fibers that connect the ciliary muscle and lens. The ciliary epithelium produces aqueous humor which fills the anterior compartment of the eye.

**Histological importance:** It contains Ciliary Muscles that is composed of smooth muscles. Contraction and relaxation of the ciliary muscles change the tension of the zonular fibers or suspensory ligaments of the lens. This allows the lens to change shape a process known as accommodation.

**3. The Choroid**

The choroid consists of a dense network of blood vessels supplying nourishment to structures of the eye, housed in loose connective tissue. The choriocapillary layer is located in the innermost part of the choroid and supplies the retina.The Bruch membrane is an extracellular matrix layer situated between the retina and choroid and has significance in age-related macular degeneration, where an accumulation of lipid deposits prevent diffusion of nutrients to the retina.

**Histological importance:** it provides nourishment to the outer layer of the retina through blood vessels. It is part of the uveal tract.

**The innermost layer**

**1. The lens**

It separates the aqueous and vitreous chambers. It consists of an outer capsule, a middle layer called cortex, and an inner layer called the nucleus. The capsule is the basement membrane of the lens epithelium which lies below. New lens cells differentiate from the lens epithelium and are incorporated peripherally, pushing older lens cells towards the middle.

**Histological importance:** The lens is a transparent and flexible biconvex structure in the eye that, along with the cornea, helps to refract light to be focused on the retina. The flexibility allows the lens to be easily manipulated by the Ciliary Muscles. By changing the curvature of the lens one can focus the eyes on objects at different distances from it.

**2. The Vitreous**

It is a jelly-like space made of type II collagen separating the retina and the lens.

**Histological importance:** The vitreous body provides physical support holding the retina In place next to the choroid, the blood supply for the outer retina.

**3. The Retina**

The retina is the nervous tissue of the eye where photons of light convert to neurochemical energy via action potentials.

**Question**

**2. Corona virus can penetrate the body through eye and implicate the immune system , briefly discuss the layers of retina for information penetration**

The retina is a thin layer of tissue that lines the back of the eye on the inside. It is located near the optic nerve. The purpose of the retina is to receive light that the lens has focused, covert the light into neural signals, and send these signals to the brain for visual.

The vertebrate retina has ten distinct layers. From closest to farthest from the vitreous body:

1. Inner limiting membrane – basement membrane elaborated by Müller cells.

2. Nerve fibre layer – axons of the ganglion cell bodies (note that a thin layer of Müller cell footplates exists between this layer and the inner limiting membrane).

3. Ganglion cell layer – contains nuclei of ganglion cells, the axons of which become the optic nerve fibres, and some displaced amacrine cells.

4. Inner plexiform layer – contains the synapse between the bipolar cell axons and the dendrites of the ganglion and amacrine cells.

5. Inner nuclear layer – contains the nuclei and surrounding cell bodies (perikarya) of the amacrine cells, bipolar cells, and horizontal cells.

6. Outer plexiform layer – projections of rods and cones ending in the rod spherule and cone pedicle, respectively. These make synapses with dendrites of bipolar cells and horizontal cells. In the macular region, this is known as the Fiber layer of Henle.

7. Outer nuclear layer – cell bodies of rods and cones.

8. External limiting membrane – layer that separates the inner segment portions of the photoreceptors from their cell nuclei.

9. Inner segment / outer segment layer – inner segments and outer segments of rods and cones. The outer segments contain a highly specialized light-sensing apparatus.

10. Retinal pigment epithelium – single layer of cuboidal epithelial cells (with extrusions not shown in diagram). This layer is closest to the choroid, and provides nourishment and supportive functions to the neural retina, The black pigment melanin in the pigment layer prevents light reflection throughout the globe of the eyeball; this is extremely important for clear vision