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HISTOLOGY ASSIGNMENT

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

The eye is divided into external and internal structures. External structures include the eyelashes, lids, muscles, accessory glands, and conjunctiva. Internal structures of the eye consist of three layers of tissue arranged concentrically: The sclera and cornea make up the exterior layers; the uvea is the vascular layer in the middle, subdivided into the iris, ciliary body and choroid. The retina constitutes the innermost layer and is made up of nervous tissue.

**EXTERNAL STRUCTURES OF THE EYE:**

1. CONJUNCTIVA: Lines the inner part of the eyelids. The tarsal plate which lies beneath the conjunctiva and contains meibomian glands, which secretes an oily substance.
2. Tear film: Consists of aqueous mucous and oily secretions.
3. Accessory Glands: Apocrine glands of moll, meibomian glands, lachrymal glands.
4. Muscle: Orbicularis oculae, Levator palpebrae superioris, superior tarsal muscle.
5. Eye lid: Known as cover of the eye. It is a mobile layer made up, of skin and muscular tissue and covers the eyeball.

INTERNAL STRUCTURE OF THE EYE

The inner most structures of the eye are organised into three layers:

1. Outermost layer: Which consist of sclera and cornea

* Scelera: Also called white of the eye. A dense connective tissue made up of mainly type 1 collagen fibres that is oriented in different directions. The lack of parallel orientation of collagen fibres gives the scelera its white appearance. However, the collagen of scelera and cornea are continuous. The four layers of scelera are from external to internal which are episcelera, stroma, lamia fusca and endothelium.

The episcelera is the external surface of the scelera. It is connected to the tenon capsule by thin collagen fibres. At the corneosceleral junction also known as the limbus, the tenon capsule contacts stroma of the conjunctiva.

* Cornea: Also known as the transparent front layer of the eye. It consists of type 1 collagen fibres, oriented in a uniform parallel direction to maintain transparency. It consist of 5 layers which include, epithelium (Non keratinized stratified), Bowman layer, and stroma also called substantia propria, descemets membrane and corneal endothelium.

Cornea epithelium: it is a fast growing, regenerating multicellualar layer which interacts directly with the tear film.

Bowman layer: This is a layer of sub-epithelial basement membrane protecting the underlying stroma.

Stroma: The largest of the cornea. It has collagen fibres arranged in a regular pattern. Keratocytes maintain the integrity of this layer. The function of this layer is to maintain transparency.

Descemets membrane: An acellular layer made up of type iv collagen that serves as a modified basement membrane of the cornea endothelium.

Cornea endothelium: A one cell thick layer made up of either simple squamous or cuboidal cells. Cells in this region do not regenerate and have pumps that maintain fluid balance and prevents swelling of the stroma. When the endothelial cells are lost, neighbouring cells stretch to attempt to compensate these losses.

B. MIDDLE LAYER; Uvea (iris, ciliary body and choroid)

* Iris: It consists of stromal layer with pigmented fibrovascular tissue and pigmented epithelial cells beneath the stroma. The spchinter pupillae and the dilator pulpillae muscles connect to the stroma. The pigmented layer of cells blocks rays of light and ensures that light moves 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 the aqueous homour in the anterior chamber into the venous channel of Schlemm. From here fluid drains into the episceleral veins .
* Ciliary body: the tissue that divides the posterior chamber and the vitreous body. It consists of the ciliary 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 fibres that connect the ciliary muscle and lens. The ciliary epithelium produces aqueous humour which fills the anterior compartment of the eye.
* 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 located between the retina and choroid and has significance in age related macular degeneration, where accumulation of lipid deposits prevents diffusion of nutrients to the retina.

C. INNERMOST LAYER: lens, Vitreous and Retina.

* Lens: it separates the aqueous and vitreous chambers. 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 cell differentiate from the lens epithelium and are incorporated peripherally, pushing the older ones towards the middle.
* Vitreous: it is a jelly like space made up of type II collagen separating the retina and the lens.
* Retina: the nervous tissue of the eye where photons of lights convert to neurochemical energy via action potentials. This layer is composed of 10 layers.

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

Retina is the innermost layer of the wall of the eye. It is in immediate contact with the vitreal cavity on one side and with the choroid on the other side. The neural retina consists of several layers of neurons interconnected by synapses, and it is supported by an outer layer of pigmented epithelial cells. The layers of the retina include:

* Retinal pigment epithelium: single layer of cuboidal epithelial cells. This layer is closest to the choroid, which 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 eye vision.
* The photoreceptor layer contains photosensitive outer segments of rods and cones. Rods function mainly in dim light and provide black-and-white vision. Cones function in well lit conditions and are responsible for the perception of colour, as well as high-acuity vision used for tasks such as reading.
* External limiting membrane: layer that separates the inner segment portions of the photoreceptors from their cell nuclei.
* Outer nuclear layer: it contains cell bodies of rods and cones.
* Outer plexiform layer: This layer contains synapses between axons of photoreceptors and dendrites of intermediate neurons. They make synapses with dendrites of the bipolar cells and horizontal cells. In the macular region, this is known as the Fiber layer of Henle.
* Inner nuclear layer: Contains the nuclei and surrounding cell bodies of the amacrine cells, bipolar cells and horizontal cells.
* Inner plexiform layer: Contains the synapses between the bipolar cell axons and the dendrites of the ganglion and amacrine cells.
* Ganglion cell layer: Contains nuclei of ganglion cells, the axons of which becomes the optic nerve fibre and some displaced amacrine cells.
* Nerve fibre layer: contains axons of the ganglion cell bodies.
* Inner limiting membrane: A basement membrane elaborated by Muller cells.

These layers can be grouped into 4 main processing stages: photoreception transmission to bipolar cells; transmission to ganglion cells, which also contain photoreceptors, the photosensitive ganglion cells and transmission along the optic nerve.

**NOTE:**

* Bipolar cells: Photoreceptors use the neurotransmitter, glutamate, to communicate at the synapse with bipolar cells within the outer plexiform layer. Bipolar cell bodies are just shallow to this layer at the inner nuclear layer. At the inner plexiform layer, bipolar cells are responsible for transmitting an impulse to retinal ganglion cells.
* Retinal ganglion cells: these are final receivers and transmitters of the initial stimulus. They send the information they receive down their axons, which eventually form the optic nerve and project to higher brain centers.
* Amacrine cells: Amacrine cells modulate the excitation of the retinal ganglion cells through contact with ganglion cells dendrites or bipolar cell axon terminal bulbs.
* Horizontal cells: These cells function to modulate the communication between photoreceptors and bipolar cells. Bipolar cells contact ganglion and amacrine cells at the inner plexiform layer.
* Muller cells: These cells are of glial origin and are essential for proper retinal function. They contact almost every cell type in the retina, spanning the entire width from the photoreceptors to the inner retina. They serve to recycle neurotransmitters, prevent glutamate toxicity and regulate nutrient homeostasis in the retina.