MATRIC NO: 17/MHS01/044

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COURSE TITLE: HISTOLOGY OF SPECIAL SENSES AND NEUROHISTOLOGY

COURSE CODE: ANA305

ASSIGNMENT

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

**The internal structures of the eye consists 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**

1. **Outermost Layer : Sclera and Cornea**
2. **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.**
* **There are four layers of the sclera from external to internal are episclera, stroma, lamina fusca, endothelium**
* **The sclera provides protection and form**

1. **Cornea (transparent front layer of the eye)**

* **Consists of type 1 collagen fibers oriented in a uniform parallel direction to maintain transparency**
* **Consists of five layers : Stratified squamous non-keratinized epithelium, Bowman layer, Stroma, Descemet’s membrane, Corneal endothelium.**
* **Corneal epithelium: fast growing regenerating multicellular layer which interacts directly with the tear film**
* **Bowman layer: This is a layer of sub epithelial basement membrane protecting the underlying stroma. It is composed of type 1 collagen, laminin, and several other heparin sulfate proteoglycans.**
* **Stroma: The largest layer of the cornea, the stroma has collagen fibers arranged in a regular pattern. Keratinocytes maintain the integrity of this layer. The function of this layer is to maintain transparency.**
* **Descemet’s membrane: an acellular layer made of type IV collagen that serves as a modified basement of the corneal endothelium**
* **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 endothelium are lost, neighbouring cells stretch to attempt to compensate these loses.**
* **The function of the cornea is to let light rays enter the eye and converge the light rays.**

1. **Middle Layer : Uvea (Iris, Ciliary body, Choroid)**
2. **Iris:**

* **Consists of 1 stromal layer with pigmented, fibrovascular tissue and 2 pigmented epithelial cells beneath the stroma**
* **The sphincter papillae and dilator papillae 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 network, which drains aqueous humor in the anterior chamber into the venous canal of Sclemm. From here, fluid drains into the episcleral veins.**
* **The iris is the pigmented tissue lying behind the cornea that gives color to the eye and controls the amount of light entering the eye by varying the size of the papillary opening.**

1. **Ciliary body : The tissue that divides the posterior chamber and vitreous body**

* **Consists of the ciliary muscle 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 the lens.**
* **The ciliary epithelium produces aqueous humor which fills the anterior compartment of the eye.**
* **It is involved in lens accommodation and control of intraocular pressure and thus the shape of the lens.**

1. **Choroid:**

* **Consists of a dense network of blood vessels supplying nourishment to structures of the eye, housed in a loose connective tissue.**
* **The choriocapillary layer is located in the innermost part of the choroid and supplies the retina.**
* **The choroid is the vascular (major blood vessel), central layer of the eye lying between the retina and sclera. Its function is to provide nourishment to the outer layers of the retina through blood vessels.**

1. **Innermost Layer: Lens, Vitreous, Retina**
2. **Lens: 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 cells differentiate from the lens epithelium and incorporated peripherally, pushing older lens cells toward the middle.**
* **It is a transparent biconvex intraocular tissue that that helps bring rays of light to focus on the retina.**

1. **Vitreous: a jelly-like space made of type II collagen, separating the retina and the lens**
2. **Retina : nervous tissue of the eye where photons of light convert to neurochemical energy via action potentials**

* **Retina pigment epithelium: made of cuboidal cells containing melanin which absorbs light. These cells establish a blood-retina barrier through tight junctions.**
* **Rod and cone cells: the layer of cells with photoreceptors and glial cells. Rods are located peripherally and are more sensitive to light and motion than cones. Cones have higher visual acuity and specificity for colour vision.**

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

**The retina, the innermost tunic of the eye, develops with two fundamental sub layers from the inner and outer layers of embryonic optic cup.**

* **The outer pigmented layer is a simple cuboidal epithelium attached to Bruch’s membrane and the choroido-capillary lamina of the choroid. This heavily pigmented layer forms the other part of the dual epithelium covering the ciliary body and posterior iris.**
* **The inner retinal region, the neural layer is thick and stratified with various neurons and photoreceptors. Although its neural structure and visual function extend anterior only as far as the ora serreta, this layer continues as part of the dual cuboidal epithelium that covers the surface of the ciliary body and posterior iris.**

1. **Inner Limiting Membrane (ILM): This consist of terminal expansions of Muller cell processes that cover the collagenous membrane of the vitreous body that form the inner surface of the retina. The ILM is the retina’s inner surface bordering the vitreous humour and thereby forming a diffusion barrier between the neural retina and vitreous humour. It contains laterally contacting Muller cell synaptic boutons and other basement membrane parts.**
2. **Nerve Fiber layer(NFL): This is the second innermost layer of the retinafrom the vitreous. This layer contains axons of retinal ganglion cells and the astroglia which support them. Collectively these axons constitute the optic nerve.**
3. **The Ganglionic layer(GL):This layer is located near the vitreous and has neurons (ganglion cells) with much longer axons. The GL is thickest near the central, macular region of the retina but it thins peripherally to only one layer of cells.**
4. **Inner Plexiform Layer(IPL): It consists of axons and dendrites connecting neurons of the INL with the ganglion cells. The area consists of dense reticulum of fibrils formed by interlaced dendrites of RCG’s and cells of the inner nuclear layer. This layer relays information from cells of the inner nuclear layer.**
5. **The Inner Nuclear Layer(INL): contains the nuclei of various neurons, notably the bipolar cells, amacrine cells, and horizontal cells, all of which make specific connections with other neurons and integrate signals from rods and cones over a wide area of the retina.**
6. **Outer Plexiform Layer(OPL): It includes axons of the photoreceptors and dendrites of association neurons in the INL. It contains a neuronal synapse of between rods and cones with the footplate of horizontal cells. Capillaries are also found to be primarily running through the outer plexiform layer.**
7. **Outer Nuclear Layer(ONL): contains cell bodies of photoreceptors(the rod and cone cells). These cells like the pigmented epithelial cells receive O2 and nutrients by diffusion from the choroidocapillary lamina of the choroid.**
8. **Outer Limiting Layer(OLL): This is a series of adherent junctions(zonula adherents) between the photoreceptors and Muller cells(radial glial cells of the retina). The Muller cells are in the outer limiting membrane(OLM) of the retina and form adherents junctions between Muller cells and rods and cones in the inner segments which serves to separate the photosensitive regions of the retina from the areas that transmit the electrical signals.**
9. **Rod and Cone cells layer: This layer is named for the shape of their outer segments. They are polarized neurons with their photosensitive portions aligned in the retina’s rod and cone layer and their axons in the OPL.**
10. **Retina Pigmented Epithelium Layer: consists of cuboidal or low columnar cells with basal nuclei and surrounds the neural layer of the retina. The cells have well developed junctional complexes, gap junctions, and numerous invaginations of the basal membrane associated with mitochondria.**

**The diverse function of the retinal pigmented layer absorbs scattered light that passes through the passes through the neural layer, supplementing the choroid in this regard.**

**The cells play key roles in the visual cycle of the retinal regeneration, having enzyme systems that isomerize all trans-retinal released from photoreceptors and produce 11-cis-retinal that is then transferred back to the photoreceptors.**

**With many tight junctions, cells of the pigmented epithelium form an important part of the protective blood-retina barrier isolating retina photoreceptors from the highly vascular choroid and regulating ion transport between these compartments.**