NAME: AKANIRO EBUBECHUKWU DEBORAH
MATRIC NO.: 18/MHS01/378
DEPARTMENT: MEDICINE AND SURGERY
COURSE: HISTOLOGY OF SPECIAL SENSES AND NEUROHISTOLOGY
LECTURER: DR. ADESHINA ADEKEYE

QUESTION 1

Write an essay on the histological importance of the eyes in relation to their cellular functions.

ANSWER

The eyes are the peripheral organs responsible for vision. The wall of the eyeball consists of three layers which are:

1. Outer fibrous coat; Sclera and Cornea
2. Middle vascular coat; Choroid, Ciliary body and Iris
3. Inner retina layer

OUTER FIBROUS COAT

SCLERA

The Sclera s the outer wall of the eyeball and is formed by a thick white opaque membrane. It consists of white fibrous tissue, some elastic fibre and connective tissue cells mainly fibroblasts. The sclera collectively forms the fibrous tunic of the eyeball and provides protection to delicate structures within the eye. It resists intraocular pressure and maintains the shape of the eyeballs. It provides sites for muscle insertion; extra ocular muscles which move the eyes attach to the sclera.

CORNEA

The Cornea is a transparent disc that replaces the sclera at the anterior one-sixth portion of the eyeball. Cells on the surface of the **corneal epithelium** show projections in the form of microvilli or folds and they play an important role in retaining a film of fluid over the surface of the cornea by protruding into a protective tear film of lipid, glycoprotein and water which protects the anterior part of the eyes. The **basal cells** of the corneal epithelium have a high proliferative capacity important for renewal and repair of the corneal surface and they emerge from stem cells in the corneoscleral limbus. The **Bowman's membrane** contributes to the stability and strength of the cornea helping to protect against infection of the underlying stroma. The **Stroma** consists of collagen bundles that contribute to the transparency of the cornea. The **Endothelium** maintains the **Descemet's Membrane** and including the most metabolically active cells of the cornea. The K^+ ATpase pumps in the basolateral membrane of the cells are largely responsible for regulating the proper hydration state of the corneal stroma to provide maximal transparency and optimal refraction of light.

MIDDLE VASCULAR COAT

CHOROID

The Choroid is located in the posterior portion of the eyes. It consists of a loose, well vascularized connective tissue and a number of melanocytes. These form a black layer in the choroid preventing light reflection which helps in formation of sharp images on the retina. The rich microvasculature in the inner choroido-capillary lamina is important for nutrition of the outer retinal layer.

CILIARY BODY

The Ciliary is the anterior extension of the uvea that encircles the lens and lies posterior to the limbus. It is made up of the following: The Ciliary muscles, The Ciliary process and The Ciliary zonules.

The **Ciliary Muscles** makes up most of the stroma and consist of three groups of smooth muscle fibres and contraction of these muscles affect the shape of the lens and is important in visual accommodation.

The **Ciliary Processes** has a double layer of low columnar epithelial cells which have extensive basolateral folds with Na^{+}/K^{+} ATpase activity and It is specialized for secretion of aqueous humor.

The **Ciliary Zonules** is a system of fibres produced by non-pigmented epithelial cells on the ciliary4 process. They collectively make up the suspensory ligament of the lens, holding it in place and providing strong attachments between the ciliary muscle and capsule of the lens.

IRIS

The Iris is the most anterior part of the middle vascular part of the eyes. It has a central aperture known as the **pupil** and a stroma of connective tissue containing numerous pigment cells which is embedded by smooth muscle. The pupil with the help of the two layers of smooth muscle (Sphincter pupillae and Dilator pupillae) and connective tissue regulate the amount of light entering the eye.

RETINAL LAYER

RETINA

It is the innermost part of the eye containing photoreceptors essential for vision and a specialized area where vision is most acute called **Fovea Centralis or Macula.** It also has a blind spot where the optic nerve leaves the eye and there are no photoreceptor cells.

The **pigmented layer** of the retina contains pigmented epithelial cells which do the following:

- They absorb and prevent reflection of light that has passed through the neural layers of the retina.
- They form an important part of the protective blood-retina barrier by isolating the retina photoreceptors from the highly vascular choroid and they also regulate ion transport between the compartments.
- They play a key role in the visual cycle of retinal regeneration.
- Phagocytosis of shed components from the adjacent photoreceptors and degradation of these materials.
- They remove free radicals by various protective antioxidant activities and support the neural retina.

The **neural layer of the retina** which consists of photoreceptors, bipolar neurons, ganglion cells and supporting Müller cells detect incoming light rays and these rays are converted to nerve signals and transmitted to the brain.

QUESTION 2

Corona Virus can penetrate the body through the eye and implicate the immune system. Briefly discuss the layers of retina for information penetration.

ANSWER

The retina is the innermost tunic of the eye and the lines the entire posterior portion of the eye. Fundamentally, we have two sub-layers from the inner and outer layers of the embryonic optic cups and they are the: Outer pigmented layer and Inner neural retina region. However, we can say the retina is a layered structure with ten distinct layers of neuron interconnected by synapses and these layers are:

1. Non-neural pigmented layer
2. The rod and cone layer
3. The outer limiting layer
4. The external/outer nuclear layer
5. The external/outer plexiform layer
6. The internal/inner nuclear layer
7. The internal/inner plexiform layer
8. The ganglionic layer
9. The nerve fibre layer
10. The inner limiting layer

The layers of the retina for information penetration are the external nuclear layer, the internal nuclear layer and ganglionic layer.

EXTERNAL/OUTER NUCLEAR LAYER

This layer is found near the **pigmented epithelium** and contains cell bodies and nuclei of photoreceptors i.e. the rod and cone cells. These cells convert stimulus of light into nervous impulses. Each rod or cone cell can be regarded as a modified neuron containing a cell body and peripheral processes. These peripheral processes which are photosensitive lie in the **layer of rod and cones** and their nuclei are arranged in several layers and form the **external/outer nuclear layer.** This layer stains darkly.

INTERNAL/INNER NUCLEAR LAYER

This layer contains 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.

- **Bipolar cells** give off dendrites that enter the external plexiform layer to synapse with the axons of the rode and cone cells and axons that enter the internal plexiform layer where they synapse with dendrites of the ganglion cells. They receive visual input from the photoreceptors and project their axons onto the retinal ganglion cells.
- **Amacrine cells** lie horizontally in the retina. Their processes enter the inner plexiform layer where they synapse with axons of bipolar and with the dendrite of ganglion cells. They act as an interneuron between bipolar and ganglion cells. They receive signals from bipolar cells and are involved in the regulation and integration of activity in bipolar and ganglion cells.

- **Horizontal cells** lie horizontally in the retina. Their processes enter the inner plexiform layer where they synapse with axons of bipolar and with the dendrite of ganglion cells. They are involved in modulating information transfer between bipolar cells and photoreceptors and are involved with helping the eyes adjust to both bright light and low light conditions. They provide inhibitory feedback to rod and cone receptors.

Apart from the above mentioned cells, the inner nuclear layer also contains the **nuclei of retinal gliocytes or cells of Müller.** These cells give off numerous protoplasmic processes that extend through almost the whole thickness of the retina. Externally, they extend to the junction of the layers of the rod and cones with the external nuclear layer where they meet to from a thin **external limiting membrane.** They also extend to the inner surface of the retina where they form an **internal limiting membrane.** These retinal gliocytes are neuroglial in nature, supporting all the neurons of the retina.

THE GANGLIONIC LAYER

This layer is located near the vitreous body and contains the cell bodies of the ganglion cells. Their axons are much longer making up the **nerve fibre layer** and they converge to form the optic nerve which leaves the eye and passes to the brain. The dendrites of these cells (ganglion cells) enter the internal plexifrom layer to synapse with processes of bipolar cells and of amacrine cells. The ganglionic layer is thickest near the central macular region of the retina, but it thins out peripherally to only one layer of cells.