

MATRIC NO:17/MHS01/132

LEVEL: 300L

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

The eye is formed by three layers, or tunics. Each of these three layers contributes with parts that have structural / nutritive functions and parts that form the optic and photoreceptive apparatus of the eye. From the outside to the inside of the eyeball the three tunics are the:

- Fibrous tunic, which forms a capsule enclosing and protecting the other components of the eye. It is subdivided into the **sclera**, with primarily structural functions, and the **cornea**, which is part of the optic apparatus.
- Vascular tunic, which forms the **choroid**, **ciliary body** and **iris**. This tunic is also called the **UVEAL TRACT**. The choroid has primarily nutritive functions. The ciliary body generates the aqueous humor of the eye, but the ciliary muscle also functions in the optic apparatus. The iris is part of the optic apparatus in which it functions as a contractile diaphragm, i.e. the aperture of the eye.
- Neural tunic, which consists of the **retina**. The retina proper forms the photoreceptive layer of the eye. As a double-layered epithelium, the retina also covers the ciliary process and the posterior surface of the iris, where it has both nutritive and structural functions.

## **FIBROUS LAYER**

### **1.CORNEA**

This is the transparent front layer of the eye It consists of type I collagen fibers oriented in a uniform parallel direction to maintain transparency. It also comprises five (5) layers: Epithelium (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.

- 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.
- 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.
- Descemet's membrane: An acellular layer made of type IV collagen that serves as a modified basement membrane 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 endothelial cells are lost, neighboring cells stretch to attempt to compensate these losses.

## 2. SCLERA

This is the white of the eye. It 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 no functional cells in this layer.

## VASCULAR LAYER

1. IRIS: This is a thin, circular structure made up a connective tissue and muscle that surrounds the pupil. The colour of our eyes is determined by the amount of pigment in the iris. It comprises two (2) layers:
  - ✓ Stromal layer with pigmented, fibrovascular tissue and,
  - ✓ Pigmented epithelial cells beneath the stroma which block rays of light and ensures that light moves through the pupil to reach the retina.

The muscles here are the sphincter pupil (constriction of the pupil in bright light) and the dilator pupil (dilates the pupil in dim light). 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.

2. CILIARY BODY: This is a tissue surrounding the iris that divides the posterior chamber and vitreous body. It comprises:
  - ✓ Ciliary muscle and
  - ✓ 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.

### 3. CHOROID

This is the posterior portion of the retina. Consists of a dense network of blood vessels supplying nourishment to structures of the eye. It comprises two layers:

- CHORIOCAPILLARY LAYER: It supplies the retina.
- The Bruch Membrane: An extracellular matrix layer situated between the retina and choroid and has significance in age-related macular degeneration, where an accumulation of lipid deposits prevents diffusion of nutrients to the retina.

### THE NEURAL LAYER

RETINA: This is a nervous tissue of the eye where photons of light convert to neurochemical energy via action potentials. It comprises different cells and layers which would be discussed in the next question.

### CLINICAL ANATOMY

- "Glaucoma": Refers to optic nerve damage related to increased intraocular pressure. Drainage of aqueous humor through the trabecular meshwork is often implicated.
- "Age-related macular degeneration": A progressive eye disease causing damage to the macula or central portion of the retina. Accumulation of drusen, or lipid-laden deposits in Bruch's membrane of the retina, is associated with disease severity.
- "Fuchs Dystrophy": A disease of the corneal endothelium, that causes accumulation of excess edema in the corneal stroma. Progression of the disease often causes blisters in the eye, also referred to as bullous keratopathy.
- "Floaters": The sensation of floaters is due to changes that occur in the jelly-like vitreous layer of the eye. They are shadows of debris cast on the retina.
- "Retinal detachment": It occurs when the outer pigment epithelial layer separates from the inner neurosensory layer consisting of rods and cones; this is a vision-threatening condition as the neurosensory layer is unable to receive nutrients from the underlying choriocapillaris and retinal pigment epithelium.

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 nerve tissue layer containing three types of cells and their synapses arranged in the following ten (10) layers.** The light must pass through all layers of the retina before it reaches the cells that systematically absorb the light energy. These basic cells found in the retina are:

1. Photoreceptor cells
2. Bipolar cells
3. Ganglion cells

The retina is further divided into three main functional layers out of the 10 layers by which information penetrates into the eye. They are:

1. Photoreceptive layer
2. Bipolar cell layer
3. Ganglion cell layer

- **PHOTORECEPTIVE LAYER:** This first layer, made up of rods and cones, synapse with the bipolar cells in the second layer of the retina. The receptor cells or rods and cones detect light energy and absorb this energy for use by the nervous system, that is, they convert the light energy to nerve impulses which they pass on to the bipolar cells.
- **BIPOLAR CELL LAYER:** Bipolar cells send appendages or axons to communicate with both the first and third layers. This layer also has other cell groups: Amacrine and Horizontal cells, which contribute to the finer processing of visual information via LATERAL CONNECTIONS. These lateral connections modulate the transmission of information across the synaptic layers of the retina, between the first and second layers and between the second and third layers.
- **GANGLION CELL LAYER:** The axons of the ganglion cells found in the third layer of the retina convey the visual information as encoded by the retina to the next synapse point in the visual pathway via the optic nerve. The axons of the ganglion cells of the third layer extend across the inner surface of the retina on their route to a hole at the rear of the eyeball called the optic disk. Ganglion cell axons exit the eye via the optic disk as the optic nerve (cranial nerve II).

As information is conveyed through the three primary layers of the retina, it moves toward the front of the eye. The three primary retinal layers are further divided into seven layers. The seven layers comprise

- Dark "nuclear/cell" layers containing cell bodies, and
- White "plexiform" layers containing axons and dendrites.

1. The pigment epithelium, which lines the back of the eyeball behind the receptor cells, made of cuboidal cells containing melanin which absorbs light. These cells also establish a blood-retina barrier through tight junctions. It separates the choroid and the retina.
  - **NOTE: This layer is normally fused to the retina, but may separate causing the condition known as a "detached" retina.**
2. The first layer contains the pigment end of the receptor cells.
3. The Outer Limiting Membrane, which is formed by processes of supportive neuroglia cells, the Muller cells.
4. The Outer Nuclear Layer (ONL) contains cell bodies of the receptor cells (rods and cones) and the outer processes of Muller cells.
5. The Outer Plexiform Layer (OPL) contains the axons of the receptor (rods and cones) and its synapse with the dendrites of bipolar and horizontal cells that connect the rods and cones to the ganglion cell layer.
6. The Inner Nuclear Layer (INL) contains the cell bodies of the horizontal, bipolar, and amacrine and neuroglia Muller cells.
7. The Inner Plexiform Layer contains the axons of the bipolar cells and its synapse with the dendrites of the ganglion and amacrine cells.
8. The fifth, Ganglion Cell Layer (GCL) contains the cell bodies of ganglion cells.
9. The Optic Fiber Layer (OFL) contains the axons of ganglion cells as they collect to form the optic nerve.
10. Inner Limiting Membrane: A thin layer of Muller cells and basement membrane which separates the retina from the vitreous body of the eyeball.

