

MATRIC NUMBER: 18/MHS01/382

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DEPARTMENT: MEDICINE AND SURGERY

COURSE CODE: ANA 305

## HISTOLOGY ASSIGNMENT

QUESTION 1: WRITE AN ESSAY ON THE HISTOLOGICAL IMPORTANCE OF THE EYE IN RELATION TO THEIR CELLULAR FUNCTION.

Answer: the eye is a highly development photosensitive organ for analyzing the form, intensity, and color of light reflected from objects and providing the sense of sight. It is protected within the orbits of the skull. Internally it contains transparent tissues that refract light to focus the image, a layer of photosensitive cells and a system of neurons that collect, process, and transmit visual information to the brain. The eye has three tunics/layers:

- I. External fibrous layer: sclera and transparent cornea
- II. Middle vascular layer: choroid, ciliary body and iris
- III. Inner sensory layer, the retina: communicates with cerebrum through optic nerve

Asides from these layers, the eye has a biconvex transparent structure, the lens attached to the ciliary body by zonular fibers; an opening bounded by the iris, the pupil; the aqueous humor which fills the anterior chamber (between the cornea and iris) and the posterior chamber (between the iris and lens); the posterior vitreous chamber which contains the vitreous body.

### FIBROUS LAYER

The sclera and the cornea are joined at the limbus.

- 1) The posterior sclera: it is made up of mainly dense connective tissue and type I collagen fibers, these fibers have no definite orientation thus the giving the sclera a white appearance. The sclera has 4 layers; episclera, stroma, lamina fusca, endothelium. Where the screw surrounds the choroid, it has inner suprachoroid lamina, with less collagen, more fibroblasts, elastic fibers and melanocytes.
- 2) The limbus: it is also called corneoscleral junction as it is where the cornea and sclera merge. It contains stem cells which aids the sustenance of both tissues.
- 3) The cornea: it is transparent and avascular with five distinct layers:
  - i. External stratified squamous epithelium: non-keratinized stratified squamous epithelium, a regenerative layer.
  - ii. Anterior limiting membrane (Bowman's membrane): aids stability and strength of cornea. It also protects the stroma.

- iii. Thick stroma: its uniform orthogonal area of collagen contributes to the transparent of the tissue. Keratocytes are between the collagen lamellae. It also has ground substances like keratan sulfate and chondroitin sulfate.
- iv. Posterior limiting membrane (Descemet's membrane): supports the inner simple squamous corneal endothelium.
- v. Inner simple squamous endothelium: contains metabolically active cells. They help to maintain fluid balance and prevent swelling of the stroma.

### **VASCULAR LAYER**

This region is called the uvea. Posteriorly to anterior region, its parts include: choroid, ciliary body and iris.

- 1) Choroid: contains loose well vascularized connective tissue and numerous melanocytes which causes black pigmentation and prevents light passage except through the pupil. It had two layers- inner choroidocapillary lamina for nutrition of retina and Bruch's membrane which has collagen and elastic fibers and acts as basal lamina of retina's pigmented layer.
- 2) Ciliary body: tissue that divides the posterior chamber and vitreous body, it consists of the ciliary muscles ciliary processes and ciliary zonule. Ciliary muscles affect the shape of the lens by contraction. It consists of three groups of smooth muscles. Ciliary processes are covered by double layer of low columnar epithelial cells which is called the ciliary epithelium, these cells secrete aqueous humor into the posterior chamber and anterior chamber through the pupil. Ciliary zonule is composed of fibrillin-1 and 2 which attach to the lens to keep it in place.
- 3) Iris: this is the most anterior portion of uvea which covers part of the lens, leaving a central pupil. It consists of anterior surface which lacks epithelial covering but has dense layer of melanocytes and fibroblasts. Deeper into the iris is the stroma consisting of loose connective tissues with melanocytes and sparse microvasculature. The posterior end has a double layered epithelium that is continuous with the covering of ciliary process and rich in melanin. Dilator pupillae muscles are myoepithelial cells which extend contractile processes. Sphincter pupillae muscles are a circular bundle of smooth muscle fibers near the pupil. The pupillae have sympathetic and parasympathetic innervation for enlarging and constricting the pupil respectively.

### **RETINA**

This is a nervous tissue of the eye where photons of light are converted to neurochemical energy via action potentials. It is the innermost tunic of the eye which contains various cells such as ganglionic neurons, amacrine neurons, bipolar neurons, horizontal cells supporting Müller cells and the photoreceptor cells (rods and cones). The human retina has an average of 92 million rod cells. They are

extremely sensitive to light. They are thin and elongated. Their outer segment is shaped like a rod and a modified primary cilium. The inner segment contains glycogen, mitochondria and polyribosomes for the cell's biosynthetic activity. The rod shaped segment has 600-1000 flattened membranous discs with rhodopsin (or visual purple) on their surface which initiates visual stimulus. The human retina has an average of 4.6 million cone cells. They are less sensitive than rod cells. It contains visual pigment iodopsin (or photopsins). They have conical outer segments along with polyribosomes and mitochondria.

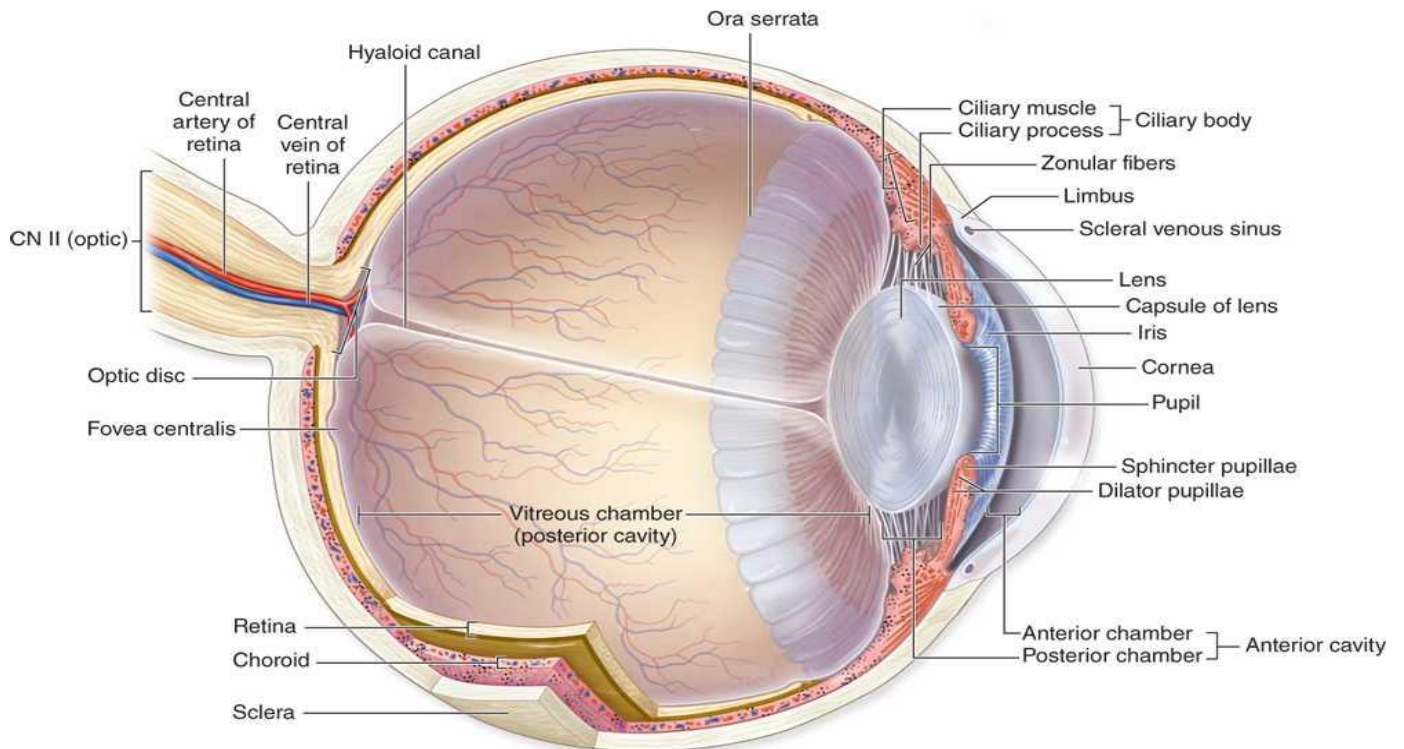
## LENS

The lens is held in place by ciliary zonules and it separates the aqueous humor from the vitreous humor. It has three principal components:

- 1) Thick homogenous lens capsule with proteoglycans and type IV collagen which surrounds the lens and is a surface for attachment of ciliary zone.
- 2) Subcapsular lens epithelium consists of a single layer of cuboidal cells which aid the proliferation of new lens fibers for sustenance of the lens. This proliferation decreases with age.
- 3) Lens fibers are elongated, flattened structures development from lens epithelium. They are packed together to form a transparent tissue for light refraction.

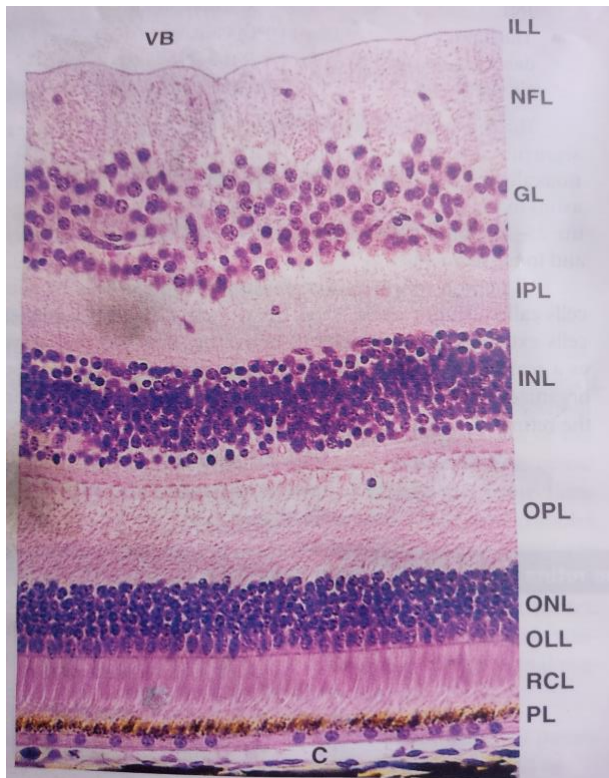
## VITREOUS BODY

It occupies the vitreous chamber behind the lens. It is a transparent gel-like connective tissue that is 99% water (vitreous humor) with collagen fibrils and hyaluronate contained within a vitreous membrane. It contains hyalocytes which synthesize hyaluronate, collagen and a few macrophages.



**QUESTION 2:** CORONA VIRUS CAN PENETRATE THE BODY THROUGH THE EYE AND IMPLICATE THE IMMUNE SYSTEM, BRIEFLY DISCUSS THE LAYERS OF THE RETINA FOR INFORMATION PENETRATION.

Answer: the layers of the retina are divided mainly into two, the outer pigmented epithelium and the inner photosensitive neural layer.



- I. The outer pigmented layer consists of cuboidal or low columnar cells with basal nuclei and surrounds the neural layer of the retina. It is attached to the Bruch's membrane and choroidocapillary lamina of the choroid. It has several supportive functions important for the function and maintenance of the neural retina such as phagocytosis of shed components from adjacent photoreceptors, secretion of ATP, various polypeptide growth factors and immunomodulatory factors.
- II. The inner photosensitive neural layer is thick and stratified with various neurons and photoreceptors. It has nine distinct layers as follows:
  - i. Outer nuclear layer (ONL) contains cell bodies and nuclei of photoreceptors (rods and cones). It is near the pigmented epithelium.
  - ii. Inner nuclear layer (INL) contains cell bodies of several types of bipolar neurons, amacrine neurons and horizontal cells which integrate signals from the rod and cone cells. They also contain the nuclei of Müller cells which support this layer of the retina.
  - iii. Ganglionic layer (GL) is near the vitreous body and thickest near the central and macular region of the retina. It thins peripherally to one layer of cells. It contains the cell bodies of ganglion cells.

- iv. Nerve fiber layer (NFL) contains the axons of the ganglionic cells that converge at the optic disc and form the optic nerve which leaves the eye and passes to the brain. It is also near the vitreous body.
- v. Outer plexiform layer (OPL) contains axons of photoreceptors and dendrites of association neurons in the INL
- vi. Inner plexiform layer (IPL) contains axons and dendrites connecting neurons of the INL with the ganglion cells. It also contains the axons of the rod and cone cells.
- vii. Rod and cone layer (RCL) contains the outer segments of rods and cones neurons. These outer segments give the name of the cells due to their shape.
- viii. Outer limiting layer (OLL) is a faint but well defined series of junction complexes that hold the inner segment of the rod and cone cells to the Müller cell processes.
- ix. Inner limiting layer (ILL) consists of terminal expansions of other Müller cell processes that cover the collagenous membrane of the vitreous body.