OTUONYE GIFT CHARLES

17/MHS01/277

MEDICINE AND SURGERY

NEAUROHISTOLOGY ASSIGNMENT

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

The eyes are composed of three layers, an outer layer called the fibrous tunic which consists of the sclera and the cornea, a middle layer which is the vascular layer which consists of the choroid, ciliary body and the iris, an inner layer of photoreceptors and neurons called the nervous tunic which consists of the retina.

 **THE OUTER LAYER**

**The sclera**

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. The four layers of the sclera from external to internal are episclera, stroma, lamina fusca, endothelium. The episclera is the external surface of the sclera. It is connected to the Tenon capsule by thin collagen fibers. At the corneoscleral junction, also known as the limbus, the Tenon capsule contacts stroma of the conjunctiva. The exposed front surface of the eye, including the cornea is lined by a thin, non-keratinized stratified squamous epithelium.

**Histological importance of the sclera**

The sclera is the opaque, fibrous, tough, protective outer layer of the eye that is directly continuous with the cornea in front and with the sheath covering the optic nerve behind. The sclera provides protection and form to the eye which is evident from its cellular features.

**CORNEA**

The cornea consists of five 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 sub epithelial basement membrane protecting the underlying stroma. It is composed of type 1 collagen, laminin, and several other heparan sulfate proteoglycans. There are no cells in this layer. Bowman’s membrane contributes greatly to the stability and strength of the cornea

**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, whereby scatter from individual fibrils gets canceled by destructive interference, and the spacing of less than 200 nm allows for transparency.

**Descemet’s membrane**: an acellular homogenous layer made of fine 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 hence is responsible for maintaining the transparency of the cornea.

**Histological importance of the cornea**

The cornea is a transparent avascular tissue that acts as a structural barrier and protects the eye against infections. Along with the tear film, it provides proper anterior refractive surface for the eye. Cornea contributes to two-third of the refractive power of the eye. The cornea's main function is to refract, or bend, light. The cornea is responsible for focusing most of the light that enters the eye, it tends to repair itself quickly from minor abrasions however, and deeper abrasions may cause scars to form on the cornea, which causes the cornea to lose its transparency, leading to visual impairment.

**THE MIDDLE LAYER**

**CILIARY 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 fibers that connect the ciliary muscle and lens. The ciliary epithelium produces aqueous humor which fills the anterior compartment of the eye.

**Histological importance of the ciliary body**

Contains ciliary muscle that is composed of smooth muscle. Contraction and relaxation of the Ciliary muscles changes the tension of the zonular fibers, or suspension ligaments, of the lens. This allows the lens to change shape, a process known as accommodation. The ciliary processes are folds of connective tissue that are covered by two layers of epithelium. There is also a complex vasculature they cannot be seen easily. Fluid from these vessels is processed and transported by the epithelial cells to the posterior chamber as aqueous humor. The epithelial cells constitute the blood- aqueous barrier.

**IRIS**

The iris forms the anterior most component of the uvea, which is the vascular layer of the globe. Posteriorly the ciliary body and, most posteriorly, the choroid complete the uvea. The iris is a ring-shaped structure, secured to the inner aspect of the ciliary body, which encircles it. The iris has a central aperture, the pupil, the variable diameter of which modifies the quantity of light reaching into the eye. Most of the iris comprises vascularized stroma with scattered melanocytes. The coloration of the iris varies with its pigment content. At birth the iris is blue, due to absence of pigment. As the infant grows, pigment cells may proliferate, resulting in darker iridal colors.

**Histological importance of the iris**

Most of the iris comprises markedly vascularized loosely-compacted stroma, with melanocytes dispersed throughout the tissue. The anterior aspect of the iris is uneven, formed by an incomplete layer of fibroblasts and melanocytes. Conversely its posterior aspect is fairly even, formed by an epithelial layer, which originates embryologically in continuity with the double layer of cuboidal epithelium lining the ciliary body.

The superficial layer of this iridal epithelium is so heavily pigmented (cf. non-pigmented in the ciliary body) that the cells can no longer be distinguished from one another. The deeper layer consists of radially-oriented myoepithelial cells which are only lightly colored and constitute the dilator pupillae muscle.

The constrictor pupillae muscle is formed by intrastromal muscle fibers located near the inner margin of the iris, which are laid down concentrically.

The coloration of the iris relates to the quantity of pigment in the anterior stroma, which shows individual variation across the population. The melanocytes of the posterior epithelium exhibit little variation in pigmentation between individuals. People lacking stromal pigment have blue eyes, conversely those whose stroma is hyperpigmented have brown eyes.

**CHOROID**

The choroid is a pigmented, vascular layer, which represents the posterior part of the vascular tunic of the eye called the uvea. The function of the choroid is to provide oxygen and nutrients to the outer layers of the retina. It is delineated from the anterior part of the uvea called the ciliary body at the ora serrata. The choroid has an opening for the optic nerve at its entry point into the posterior aspect of the globe.

It is supplied by the posterior ciliary branches of the ophthalmic artery and drained by the vorticose veins into the ophthalmic veins. Sympathetic innervation to the choroid from the superior cervical ganglion is carried via the long ciliary nerves. It also receives parasympathetic innervation from the pterygopalatine ganglion via the short ciliary nerves, however, these also carry parasympathetic fibers from the ciliary ganglion.

**Histological importance of the choroid**

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. It is part of the uveal tract.

**THE INNER LAYER**

**Retina**

The retina is a thin layer of tissue that lines the back of the eye on the inside. It is located near the optic nerve. The purpose of the retina is to receive light that the lens has focused, convert the light into neural signals, and send these signals on to the brain for visual recognition. The retina processes light through a layer of photoreceptor cells. These are essentially light-sensitive cells, responsible for detecting qualities such as color and light-intensity. The retina processes the information gathered by the photoreceptor cells and sends this information to the brain via the optic nerve. Basically, the retina processes a picture from the focused light, and the brain is left to decide what the picture is.

**Histological importance of the retina**

The retina is a nervous tissue of the eye where photons of light convert to neurochemical energy via action potentials. The retina serves a function analogous to that of the film or image sensor in a camera. The neural retina consists of several layers of neurons interconnected by synapses, and is supported by an outer layer of pigmented epithelial cells.

Due to the retina's vital role in vision, damage to it can cause permanent blindness. Conditions such as retinal detachment, where the retina is abnormally detached from its usual position, can prevent the retina from receiving or processing light. This prevents the brain from receiving this information, thus leading to blindness.

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

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**Histology of the retina.**

The retina can be divided into 10 layers

* the inner limiting membrane (ILM)
* the nerve fiber layer (NFL)
* the ganglion cell layer (GCL)
* the inner plexiform layer (IPL)
* the inner nuclear layer (INL)
* the outer plexiform layer (OPL)
* the outer nuclear layer (ONL)
* the outer limiting membrane (OLM)
* the photoreceptor layer (PL)
* the retinal pigmented epithelium (RPE) monolayer

1. Inner limiting membrane – basement membrane elaborated by Müller cells.

2. Nerve fibre layer – axons of the ganglion cell bodies (note that a thin layer of Müller cell footplates exists between this layer and the inner limiting membrane).

3. Ganglion cell layer – contains nuclei of ganglion cells, the axons of which become the optic nerve fibres, and some displaced amacrine cells.

4. Inner plexiform layer – contains the synapse between the bipolar cellaxons and the dendrites of the ganglion and amacrine cells.

5. Inner nuclear layer – contains the nuclei and surrounding cell bodies (perikarya) of the amacrine cells, bipolar cells, and horizontal cells.

6. Outer plexiform layer – projections of rods and cones ending in the rod spherule and cone pedicle, respectively. These make synapses with dendrites of bipolar cells and horizontal cells. In the macular region, this is known as the Fiber layer of Henle.

7. Outer nuclear layer – cell bodies of rods and cones.

8. External limiting membrane – layer that separates the inner segment portions of the photoreceptors from their cell nuclei.

9. Inner segment / outer segment layer – inner segments and outer segments of rods and cones. The outer segments contain a highly specialized light-sensing apparatus.

10. Retinal pigment epithelium – single layer of cuboidal epithelial cells (with extrusions not shown in diagram). This layer is closest to the choroid, and provides nourishment and a supportive function 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 clear vision.