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

Introduction.

The human eye is a complex and highly developed photosensitive organ that permits an accurate analysis of the from, light intensity and colour reflected from objects and providing the sense of light. Protected within the orbits of the skull within also contains adipose cushions, each eyeball consists externally of a tough, fibrous globe that maintains its overall shape. Internally the eye contains transparent tissues that reflect light to focus the image, a layer of photo sensitive cells and a system of neurons that collected process and transmit visual information to the brain. The eye is made up of 3 layers ;

● Outermost layer is known as the fibrous tunic and is composed of the cornea and sclera which provides shape to the eye and support the deeper structures.

● The middle layer known as the vascular tunic or uvea, consists of the choroid, ciliary body, pigmented epithelium and iris.

● The innermost layer also know as the sensory layer is the retina, which gets its oxygenation from the blood vessels of the choroid (posteriorly) as well as the retinal vessels (anteriorly).

Not included in the layers are the lens, aqueous humour and vitreous humour. The lens is a transparent convex structure held in place by a circular system of zonular fibres that attach it to the ciliary body and by close apportion to the posterior vitreous body. Partly covering the anterior surface of the lens is an opaque pigmented extension of the middle layer called iris, which surrounds a central opening, the pupil. Located in the anterior portion of the eye, iris and lens are bathed in the clear aqueous humour that fills both the anterior chamber between the cornea and iris and lens. Aqueous humour flows through the pupils that connects these two chambers. The posterior vitreous chamber, surrounded by the retina, lies behind the lens and its zonular fibres and contains a large gelatinous mass of transparent connective tissues called vitreous body.

Histological importance of the eye based on the cellular function.

As it known the eye has various parts which all have important functions, some of this parts are make up the layers of the eye. Under this sub topic the different parts of the eye would be explained histologically (I.e. the layers, cell and fibre composition, etc.) with respect to their cellular function.

1. Sclera; it is also know are white of the eye. The sclera is dense connective tissue made of mainly type 1 collagen fibres (oriented in different directions but parallel to the organ surface), a moderate amount of ground substance and a few fibroblast. 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. Micro vasculature is present near the outer surface. The opaque nature of the sclera prevents the entry of light into the eye except through the pupil, the thickness prevents the permeability of substances into the eye. The four layers of the sclera from external to internal are episclera, stroma, lamina fusca, endothelium.

2. Cornea; in contrast to the sclera it is transparent and completely avascular. The cornea serves a protective role and is responsible for two-thirds of the refractive properties of the eye. Consists of type I collagen fibres oriented in a uniform parallel direction to maintain transparency. Consists of five layers: epithelium (non-keratinized, stratified squamous epithelium), Bowman layer, stroma (also called substantia propria), Descemet’s membrane, corneal endothelium;

Corneal epithelium (an external 5 - 6 cells thick layers): 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, 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 layer made of type IV collagen that serves as a modified basement membrane of the corneal endothelium

Corneal endothelium (an inner layer of simple squamous tissue ): 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.

3. Choroid; it consists of loose, well vascularized connective tissues and contains numerous melanocytes. These forms a characteristic black layer in the choroid and prevent light from entering the eye except through the pupil. Two layers make up the choroid; The inner choroido-capillary lamina has a rich micro-vasculature important for nutrition of the outer retinal layers. Bruch's membrane, a thin extracellular sheet, is composed of collagen and elastic fibers surrounding the adjacent microvasculature and basal lamina of the retina's pigmented layer.

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

5. Iris; Consists of stromal layer with pigmented, fibrovascular tissue and pigmented epithelial cells beneath the stroma. The sphincter pupillae and dilator pupillae 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 meshwork, which drains aqueous humor in the anterior chamber into the venous canal of Schlemm. From here, fluid drains into episcleral veins.

6. Lens; is a transparent biconvex structure suspended immediately behind the iris, which focuses light on the retina. 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 are incorporated peripherally, pushing older lens cells towards the middle. The remaining one-third of refraction is performed by the lens, which is functionally adjustable through the action of the zonular fibers and ciliary muscles.

7. Retina; nervous tissue of the eye where photons of light convert to neurochemical energy via action potentials. It consist of various cells. The retina lines the entire posterior portion of the eye, except for the area of the optic nerve and extends anteriorly to end 360 degrees circumferentially at the ora Serrata, the junction between the retina and the ciliary body. The retina is a layered structure with ten distinct layers of neurons interconnected by synapses. The cells subdivide into three basic cell types: photoreceptor cells, neuronal cells, and glial cells. The layers from the closest to the front anterior of the head towards the posterior of the head are as follows: Inner limiting membrane, Nerve fiber layer (NFL), Ganglion cell layer, Inner plexiform layer, Inner nuclear layer, Middle limiting membrane, Outer plexiform layer, Outer nuclear layer, External limiting membrane, The layer of rods and cones.

Within these layers of the retina, we find multiple different types of cells with specific jobs that help transmit incoming photons into action potentials that the brain's cortices process into three-dimensional vision. The six different cell types in the retina include: Rods, Cones, Retinal Ganglion cells, Bipolar cells, Horizontal cells, Amacrine cells.

2. Layers of the Retina for information penetration.

Inner limiting membrane; The ILM is the retina's inner surface bordering the vitreous humor and thereby forming a diffusion barrier between the neural retina and vitreous humor. The ILM contains laterally contacting Muller cell synaptic boutons and other basement membrane parts.

Nerve fiber layer (NFL); The nerve fiber layer is the second innermost layer of the retina from the vitreous. Containing the ganglionic cell axons that converge at the optic disc and form the optic nerve.

Ganglion cell layer; This layer contains the retinal ganglion cells (RGCs) and displaced amacrine cells. As a rule of thumb, smaller RGCs dendrites arborize in the inner plexiform layer while larger RGCs dendrites arborize in other layers.

Inner plexiform layer; The inner plexiform layer is an area comprised of a dense reticulum of fibrils formed by interlaced dendrites of RGCs and cells of the inner nuclear layer.

Inner nuclear layer; This layer of the retina contains the cell bodies of bipolar cells, horizontal cells, and amacrine cells.

Outer plexiform layer; This layer of the retina 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.

Outer nuclear layer; This layer contains the rod and cone granules that sense photon, extensions from the rod, and cone cell bodies.

External limiting membrane; This layer contains the bases of the rod and cone photoreceptors cell bodies. The ELM forms a barrier between the subretinal space, into which the inner and outer segments of rods and cones project to be in close association with the pigment epithelial layer behind the retina, and the neural retina proper.

Rod and cones layer; which contains the outer segments of these cells where the photoreceptors are located.