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**COURSE: NEUROHISTOLOGY**

**HISTOLOGICAL IMPORTANCE THE EYE**

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The eye is an organ of sight that receives light and visual images in humans and animals. It is a complex and highly developed photosensitive organ. It is located in the orbit of the skull. It has the eyelid which cover the eyeball when closed to protect it from injury and excessive light and also to keep the cornea moist. The conjunctiva covers the internal surface of the eyelid and the anterior surface of the eyeball to keep the eye lubricated and prevent friction. The eye las 6 extaocular muscles that move the eyeball; superior rectus, inferior rectus, lateral rectus, medial rectus, superior oblique and inferior oblique.

The eye is made up of 3 layers;

The outermost or fibrous layer which is composed of cornea and sclera.

The middle or vascular or uvea layer which is composed of the choroid, ciliary body and iris.

The innermost layer which is composed of the retina which consists of an outer pigment epithelium and inner retina proper. The photosensitive retina communicates with the cerebrum through the optic nerve

The spaces of the eye are filled with aqueous humour; this is between the cornea and lens and the vitreous body; behind the lens

Histology of the Eye

1. CONJUNCTIVA: this is a tissue that lines the inside of the eyelid and covers the anterior surface of the eyeball. It is composed of unkeratinized, statified squamous epithelium with goblet cells and stratified columnar epithelium. It helps lubricate the eye by producing mucus and tears. It prevents friction between the eyelid and the eyeball. It prevents the entry of microbes into the eye.

2. EYELID: it consists of four layers: skin and subcutaneous tissue, striated muscle(orbicularis oculi), tarsus and conjunctiva. It is the thinnest skin in the body. The skin is composed of keratinized stratified squamous epithelium. It has melanocytes which are spread in the basal layer of the epithelium. The dermis has fibrous tissue, blood vessels, lymphatic vessels and nerves. It is rich in glandular tissue; sweat glands, accessory lacrimal gland apocrine gland and sebaceous gland. The orbicularis oculi muscle is composed of striated muscle. The posterior eyelid surface is lined by palpebral epithelium composed of cuboidal cells with goblet cells.

3. SCLERA: The sclera is composed of dense connective tissue made mainly of type 1 collagen fibres. These fibres move in different directions and this gives the sclera its white apperance. It has ground substance and a few fibroblasts. The external surface of the sclera which is the episclera is connected by a loose collagen fibres to a dense layer of connective tissue called Tenon''s capsule.

4. CORNEA: It consists of type1 collagen fibres arranged in a uniform parallel direction which gives it the transparent look. It is composed of 5 layers:

* Corneal epithelium: this layer is made up of non-keratinized stratified squamous epithelium. It is composed of 6 cell layers which are shed. In its basal part are mitotic figures that help in the regenerative capacity of the cornea. It is covered by a protective layer of lipid and glycoprotein. It has a rich sensory nerve supply.
* Bowman's capsule: this is a tough layer composed of type 1 collagen fibres which cross at random and they have no cells. It contibutes greatly to the stability and strength of the cornea. It protects the stroma beneath it. It is composed of laminin and several other heparan sulfate proteoglycans. It is 8-14 micrometer thick
* Stroma: this is the largest layer of the cornea, it has collagen fibres(type 1) arranged in a regular pattern. It has keratocytes distributed within the collagen fibres that maintain the integrity of tis layer. This layer maintains transparency.
* Descmet's membrane: it is a thick homogeneous structure composed of fine collagenous filaments(type 4) organized in a 3-dimensional network
* Corneal endothelium: this a 1-cell layer of simple or cuboidal cells. the cells here do not regenerate and have structures that maintain fluid balance and prevent swelling of the stroma.

5. IRIS: it is a thin annular structure in the eye which controlls the diameter and size of the pupil and also the layer. The pigmented layer of cells blocks rays of light and ensures that light must move through the pupil to reach the retina. It is divided into 2 major regions; pupillary zone( inner region whose edge forms the boundary of the pupil) and the cilliary zone( the remaining part of the iris that extends to its origin at the ciliary body)

6. CILIARY BODY: it is the part of the eye that includes the ciliary muscle that controls the shape of the lens and ciliary epithelium. It produces aqueous humor in the non-pigmented portion of the ciliary body. The ciliary muscles is composed of smooth muscle. The contraction and relaxation of the ciliary muscles change the tension of the fibres, or suspensory ligaments of the lens. This allows the lens to change shape, a process known as accomodation.

7. CHOROID: also known as choroidea or choroid coat. It is the vascular layer of the eye which contains loose connective tissues and it lies between the retina and sclera. It is also very thick. It consists of a dense network of blood vessels supplying nourishment to the eye. It's capillaries are arranged in a single layer on the inner surface. It's stroma contains melanocytes. It is divided into 4 layers

* Haller's layer
* Sattler's layer
* Choriocapillaris
* Bruch's membrane

8. RETINA: it is the innermost layer of the wall of the eye made up of cuboidal cellswhich contain melanin to absorb light. It is in intermediate contact with the vitreal cavity on one side and with the choroid. The layers of the retina:

* pigmented epithelium: adjacent to the choroid, absorbs light to reduce back reflection of light onto the retina
* the photoreceptor layer: contains photosensitive outer segments of rods and cones
* outer nuclear layer: contains cell bodies of the rods and cones
* outer plexiform layer: contains synapses between axons of photoreceptors and dendrites of intermediate neurons
* inner nuclear layer: contains cell bodies of intermediate neurones and muller cells.
* inner plexiform layer: contains synapses between intermediate neurones and ganglion cells of the optic tract
* ganglion cell layer: contains cell bodies of ganglion cells
* optic nerve fibre layer: contains axons of ganglion cells

9. LENS: this separates the aqueous and vitreous chambers. It consists of an outer capsule, middle epithelium and inner fibres. The capsule is the basement membrane of the lens epithelium and the lens does not contain blood vessels. The lens capsule is a smooth transparent basement membranethat surrounds the lens. It is composed of type 4 collagen fibres and sulfated glycosaminoglycans. The lens epithelium is made up of simple cuboidal epithelium. The lens fibres are long, thin, transparent cells which are firmly packed.

10: VITREAL BODY: a jelly-like space made of type 2 collagen fibres separating the retina and the lens.

LAYERS OF THE RETINA

The retina is a layer of photoreceptor cells and glial cells in the eye that captures incoming photons and transmits them along neuronal pathways as electrical and chemical signals for the brain to perceive a visual picture. It is located behind the eye. The layers of the retina are:

1. Inner limiting membrane: the innermost layer of the retina that forms a smooth boundary against the vitreous humor. The periphery of this layer consists of Muller glial cells, which function to maintain retinal homeostasis
2. Retinal nerve fiber layer: the layer composed of retnal ganglion cells axons mixed with astrocytes and the processes of the muller cells. The inner linning membrane serves as the basal lamina for the cells of the retinal nerve fiber layer.
3. Gnglion cell layer: the layer of ganglion cell bodies that project their axons eventually to form the optic nerve
4. Inner plexiform layer: this layer is where axons of bipolar cells synapse onto the ganglion cells. The dendrites of amacrine cells also synapse at this zone and function in modulating the electrical conduction between bipolar cells and ganglion cells, preventing lateral potentiation.
5. Inner nuclear layer: the layer composed of the cell bodies of bipolar cells, horizontal cells and amacrine cells. Bipolar cells function as channels that transmit and encode various synaptic inputs from photoreceptor cells onto ganglion cells. Horizontal cells provide feedback modulation onto rod and cone cells.
6. Outer plexiform layer: the region where projections from photoreceptor cells synapse with the dendrites of the cells residing in the inner nuclear layer.
7. Outer nuclear layer: layer containing cell bodies of rods and cones
8. External limiting membrane: the region that is composed of gap junctions between photoreceptor cells and Muller cells. It separates the cell bodies of the rods and cones from their inner segments and outer segments
9. Photoreceptor layer: the region consisting of the inner segments and outer segments of rods and cones. The outer photoreceptor segments consists of membrane bound discs that contain the light sensitive pigments such as rhodopsin that are necessary for phototransduction. The inner segments house the abundance of mitochondria needed to meet the high metabolic demands of the photoreceptor cells
10. Retinal pigment epithelium: the outermost retinal layer is located between the neural retina and the bruch membrane. This layer contributes to the blood retinal barrier in conjunction with the endothelium of the retinal vessels and has so many functions including ion and water transport and secretion of growth factors and cytokines.