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NEUROHISTOLOGY

QUESTION 1:

The histological understanding of the layers of the eye is essential for appreciating disease pathophysiology and also understanding certain therapeutic approaches. Broadly, from an anatomical perspective, the eye can be viewed as a series of overlapping layers of tissue.

External structures of the eye include:

- the eyelashes, lids, muscles, accessory glands, and conjunctiva.

The internal structures of the eye consist of three layers of tissue arranged concentrically:

-The sclera and cornea make up the exterior layers.

-The uvea is the vascular layer in the middle, subdivided into the iris, ciliary body, and choroid.

-The retina constitutes the innermost layer and is made up of nervous tissue.

Structure of the eye

The external structures are as folows :

1. Conjunctiva:

The conjunctiva lines the inner part of the eyelids.

The tarsal plate lies beneath the conjunctiva and contains meibomian glands, which secrete an oily substance to decrease the evaporation of the tear film.

2. Tear film: The tear film consists of aqueous, mucus, and oily secretions.

3. Accessory glands: Apocrine glands of Moll, meibomian glands, lacrimal glands.

4. Muscles: Orbicularis oculi, levator palpebrae superioris, superior tarsal muscle.

5. Eyelid: The eyelid, likewise known as the cover of the eye, a mobile layer made up of skin and also muscular tissue and also covers the eyeball.

The Internal Structures of the eye are as follows:

1. the Sclera and Cornea:

The sclera is the "white of the eye". The sclera is composed primarily of collagen fibers.

The cornea is transparent. The cornea is avascular. The cornea is composed primarily of collagen fibers. There are five layers to the cornea: epithelium, Bowman's membrane, substantia propria, Descemet's membrane, and endothelium. Bowman's membrane and Descemet's membrane are acellular. The majority of the cornea is from the substantia propria. The endothelium is a simple epithelium. The surface of the cornea is covered by a non keratinized stratified squamous epithelium.

The lamina cribrosa are small openings within the sclera where the fibers forming the optic nerve travel through.

2. the Uvea

The uvea is the middle layer of the eyeball. It consists of the iris, choroid and ciliary body.

The most anterior portion of the uvea is the iris. The iris is the colored part of the eyes.

The vascular pigmented structure of the uvea is the choroid. The inner layer of the choroid is the lamina vitrea. The lamina vitrea is also referred to as Bruch's membrane.

The ciliary body is a thickening in the uvea. It contains the ciliary muscle. The ciliary muscle is within the ciliary body. The ciliary muscle adjusts the shape of the lens.

3. the Retina

There are ten layers to the retina.

The retina contains receptor cells, neurons, pigmented epithelium and supporting cells. The retina consists of the rods, cones, bipolar cells, ganglion cells, horizontal cells, and amacrine cells. The receptors for vision are the rods and cones. The rods are located on the periphery, and are not color sensitive. The cones are the receptors for color.

Muller's cells are part of the retina.

The anterior pigmented portion of the retina is called the ora serrata.

The nervous element in the retina consists of bipolar cells and ganglion cells. The neurons in the retina are bipolar. A bipolar neuron has two process that branch from it: an axon and a dendrite. Bipolar neurons are not very common and are found in some of the organs for special senses. Bipolar neurons are found in the retina, inner ear, and the region of the nose involved with smell.

The fovea centralis is part of the retina. There are only cone cells in the fovea centralis. It is the site for maximal visual acuity.

QUESTION 2:

1.THE INNER LIMITING MEMBRANE:

The inner limiting membrane is the boundary between the retina and the vitreous body, formed by astrocytes and the end feet of Müller cells. It is separated from the vitreous humor by a basal lamina.

2.NERVE FIBRE LAYER:

The nerve fiber layer consists of the axons of the ganglion neurons coursing on the vitreal surface of the retina to the optic disk. These axons are unmyelinated until they penetrate the sclera at the optic disk. Their myelination by oligodendrocytes at this point accounts for the white color of the optic disk. The nerve fiber layer is most thick in the vicinity of the optic disk. The separation of scleral collagen fibers at the point where the axons of ganglion neurons penetrate the sclera to form the optic nerve is called the area cribrosa. Stellate astrocytes are located in this nerve fiber layer.

3.GANGLION CELL LAYER:

In humans, the optic nerve consists of the 1–1.2 million axons that originate in the ganglion cell layer and terminate in the lateral geniculate nucleus of the thalamus. The portion of the optic nerve visible by ophthalmoscopy is termed the optic disc. In humans, the optic disc measures approximately 1.5 mm horizontally and 1.75 mm vertically. A normal optic disc has a temporally-displaced depression termed the optic cup. The central retinal artery and vein traverse through the center of the cup. As ganglion cell axons enter the optic disc, they are divided into fascicles by intervening astrocytic glial cells. When the optic nerve sustains physiologic damage, supporting glial cells may be lost; this may manifest as an enlargement of the optic cup. Immediately posterior to the optic nerve head is the lamina cribrosa, a collection of connective tissue plates composed of collagen, elastin, laminin, and fibronectin, with pores that transmit the optic nerve axons. Posterior to the lamina cribrosa, the optic nerve becomes myelinated by oligodendrocytes.

4. THE INNER PLEXIFORM LAYER:

The inner plexiform layer is an area of the retina that is made up of a dense reticulum of fibrils formed by interlaced dendrites of retinal ganglion cells and cells of the inner nuclear layer. Within this reticulum a few branched spongioblasts are sometimes embedded.

5.INNER NUCEAR LAYER:

The inner nuclear layer or layer of inner granules, of the retina, is made up of a number of closely packed cells, of which there are three varieties, viz.: bipolar cells, horizontal cells, and amacrine cells.

6.THE OUTER PLEXIFORM LAYER:

The outer plexiform layer (OPL) includes axons of the photoreceptors and dendrites of association neurons in INL

7.THE OUTER NUCLEAR LAYER:

The outer nuclear layer (ONL) contains cell bodies of photoreceptors (the rod and cone cells). These cell, like the pigmented epithelial cells, receive O2 and nutrients by diffusion from the choroidocapillary lamina of the choroid

8.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.

9.PHOTORECEPTOR LAYER:

A photoreceptor cell is a specialized type of neuroepithelial cell found in the retina that is capable of visual phototransduction. The great biological importance of photoreceptors is that they convert light (visible electromagnetic radiation) into signals that can stimulate biological processes. To be more specific, photoreceptor proteins in the cell absorb photons, triggering a change in the cell's membrane potential.

10.RETINAL PIGMENT EPITHELIUM:

The pigmented epithelial layer consists of cuboidal or low columnar cells with basal nuclei and surrounds the neural layer of the retina. The cells have well-developed junctional complexes, gap junctions, and numerous invaginations of the basal membranes associated with mitochondria. The

apical ends of the cells extend processes and sheath-like projections that surround the tips of the photoreceptors.

Melanin granules are numerous in these extensions and in the apical cytoplasm. This cellular region also contains numerous phagocytic vacuoles and secondary lysosomes, peroxisomes, and abundant smooth ER (SER) specialized for retinal (vitamin A) isomerization.

The diverse functions of the retinal pigmented epithelium include the following:

■ The pigmented layer absorbs scattered light that passes through the neural layer, supplementing the choroid in this regard.

■ With many tight junctions, cells of the pigmented epithelium form an important part of the protective blood retina barrier isolating retina photoreceptors from the highly vascular choroid and regulating ion transport between these compartments.

■ The cells play key roles in the visual cycle of retinal regeneration, having enzyme systems that isomerize all-trans-retinal released from photoreceptors and produce 11-cis-retinal that is then transferred back to the photoreceptors.

■ Phagocytosis of shed components from the adjacent photoreceptors and degradation of this material occurs in these epithelial cells.

■ Cells of pigmented epithelium remove free radical by various protective antioxidant activities and support the neural retina by secretion of ATP, various polypeptide growth factors, and immunomodulatory factors.