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ASSIGNMENT

Histology of special senses and neurohistology

1. **Write an essay on the histological importance of the eye in relation to their cellular function.**

The eye is a complex highly developed photosensitive organ responsible for light reception.

Histologically, the eye consists of three concentric layers:

1. External (fibrous) layer: the tunica fibrosa.

2. Middle (vascular) layer: the tunica vascoulosa.

3. Internal (nervous) layer: the retina

An eye has three chambers:

1. The anterior chamber lies between the cornea and the iris.

2. The posterior chamber lies between the iris and the lens.

3. The vitreous chamber lies between the posterior surface of the lens and the neural retina.

**The external layer (tunica fibrosa)**

The external layer (tunica fibrosa) is subdivided into sclera and cornea, Cornea is a transparent layer and covers the anterior one-sixth of the eye.

* **The sclera**: It is the white part of the eye, an opaque layer of dense connective tissue that protects delicate internal structures and gives the eye its shape.

It is relatively avascular, consisting of: flattened bundles of type I collagen fibers running in different directions parallel to the eyeball surface, moderate amount of ground substance, & few fibroblasts. The innermost layer of sclera (adjacent to the choroid) is less dense, with thinner collagen fibers, more fibroblasts, melanocytes, & elastic fibers.

* **The cornea**: The most anterior part of the eye, a highly transparent convex structure made of 5 layers:

1. The Anterior Epithelium (Pavement Epithelium): stratified squamous epithelium (nonkeratinized) consisting of 5-6 cell layers. The basal layer regenerates other cells (corneal epithelial turnover occurs each 7 days) & mitotic figures are seen especially at the periphery. The surface cells have microvilli protruding into the tearfilm. The epithelium has a very rich sensory nerve supply.
2. Anterior limiting (Bowmann's) membrane: the very thick basement membrane of the epithelium, consisting of randomly running collagen fibers, it is responsible for corneal strength.
3. The Corneal stroma (Substantia Propria): about 60 layers of parallel highly organized collagen bundles crossing at right angles to each other. The uniform orthogonal array of these collagen fibrils contributes to the corneal transparency. Fibroblast-like cells (keratocytes) have flattened cytoplasmic extensions (like butterfly wings) between collagen fibrills, with proteoglycan-rich extracellular substance.
4. Posterior limiting (Descemet’s) membrane: thick homogenous layer composed of fine interwoven collagen fibers organized in a 3D network.
5. The Posterior epithelium (Corneal Endothelium): a simple squamous epithelium, with the cells showing the features of active transport & protein synthesis.

The cornea is said to have 3 cellular layers (epithelial layers and stroma) and the two non-cellular layers (Bowman’s membrane and descement membrane)

**Tunica vasculosa (uveal tract)**

The tunica vasculosa consists of three parts: choroid, ciliary body and iris.

* **The Choroid**: The choroid is a highly vascularized thin layer, with a loose C.T between its blood vessels. It lines the posterior 3/4s of sclera (approximately to the level of ora serrata).

The choroid is rich in C.T cells, collagen, elastic fibers and melanocytes (that give the choroid its dark colour). The outer layer of choroid beneath the sclera is the suprachoroidal lamina.

The inner layer (the choriocapillary lamina) is richer in small blood vessels and has a major role in the nutrition of the retina, from which it is separated by the hyalin Bruch's membrane.

This membrane consists of three layers: elastic fibers network in the middle, & collagen layers on each side. Bruch's membrane is covered externally by basement membrane of choriocapillary vessels, & internally by basement membrane of the pigmented epithelium of retina.

* **The Ciliary Body**: This middle part of the uveal tract extends from ora serrata to the root of iris. It is a thick ring with a triangular cross section, having one surface in contact with the sclera, one with the vitreous body & the third irregular surface facing the posterior chamber of the eye. Histologically, ciliary body consists of loose C.T rich in blood vessels, elastic fibers & melanocytes.

Apart from the surface adjacent to the sclera, the ciliary body is covered by 2 layers of simple columnar epithelium; both are derived from the retina. The first (inner) layer (directly adjacent to ciliary stroma) consists of melanin-rich (pigmented) cells and represents the anterior continuation of the pigment epithelium of the retina. The second layer covers the first & consists of non-pigmented cells that represent the anterior continuation of the sensory layer of the retina.

The ciliary body is divided into:

1. Ciliary muscles: 2 bundles of smooth muscle fibers divided into thick inner circular &thin outer longitudinal layers, they are important in visual accommodation.

2. Ciliary processes: about 75 ridge-like or finger-like projections from the ciliary body, each consists of a loose connective tissue core rich in fenestrated capillaries & covered by 2 layers of epithelium.

Ciliary processes serve two functions:

a) Give attachment to the fibers of suspensory ligament of the lens (that extends from the basement membrane of the pigmented epithelium to the capsule of the lens).

b) Secrete the aqueous humor (by the non-pigmented epithelium) into the posterior chamber.

* **The Iris**: It is the anterior part of the uveal tract (the coloured part of the eye), a disc-like structure attached to the ciliary body peripherally and having a rounded aperture (the pupil) centrally.

It has the following layers:

1. Anterior Iridal border (anterior surface of the iris): this is not covered by epithelium, but formed by a discontinuous layer of fibroblasts & melanocytes, with interdigitating processes giving an irregular, rough grooved appearance.
2. The Iris Stroma (stroma iridis): a loose C.T with an anterior zone poorly vascularized & rich in fibroblasts & melanocytes, and a highly vascularized posterior zone. Around the pupil, the stroma contains circularly-arranged smooth muscle fibers.
3. Posterior surface of the iris: a smooth surface covered by the same two epithelial layers covering the ciliary body.

i. The posterior layer (facing the posterior chamber) cells are heavily pigmented, preventing light from entering the eye except via the pupil. ii. The anterior layer (adjacent to the stroma) consists of less pigmented myoepithelial cells that havs radially arranged processes forming the dilator papillae muscle (innervated sympathetically).

**The refractive media of the eye**

The eye has four refractive structures: Cornea, Aqueous humor, Lens, and Viterous body.

* **The Lens**: The lens is a biconvex transparent structure with great elasticity (that decreases with age).

The lens has three components:

1. Lens capsule: a thick homogenous refractile external layer that represents the basement membrane of the lens epithelium.
2. Subcapsular epithelium: simple cuboidal or columnar cells lining the anterior half of lens capsule. Cells at the lens periphery divide to give new lens fibers.
3. Lens fibers: extremely elongated highly differentiated epithelial cells that fill the lens.

They originate from the subcapsular epithelium and lose their nuclei and organelles to become very long, thin, flattened structures filled with proteins (crystallins).

The suspensary ligament of the lens (Zonule): a group of radially oriented fibers extending from the ciliary processes to the lens capsule. Zonular fibers are similar to the microfibrills of elastic fibers.

* **The Vitreous Body**: It is a transparent gelatinous medium filling the vitreous space between the lens & retina. It consists of water (99%) with hyaluronate & small amounts of collagen. Vitreous body is surrounded by the vitreous membrane, made by type IV collagen. The only cells in the vitreous body are few macrophages & a small number of hyaluronate-producing cells (hyalocytes) near the membrane.

**2.Corona virus can penetrate the body through eye and implicate the immune system, briefly discuss the layers of retina for information penetration.**

**THE RETINA**

The retina consists of two basic layers:

1) The neural retina or retina proper is the inner layer that contains the photoreceptor cells.

2) The retinal pigementary epithelium (RPE) is the outer layer that rests on and is firmly attached through the Bruch’s membrane to the choriocapillary layer of the choroid.

In the neural retina, two regions or portions that differ in function are recognized:

a) The non-photosensitive region (nonvisual part), located anterior to the ora serrata, lines the inner aspect of the ciliary body and the posterior surface of the iris.

b) The photosensitive region (optic part) lines the inner surface of the eye posterior to the ora serrata except where it is pierced by the optic nerve.

Before discussing the ten layers of the retina, it is important to identify the types of cells found there.

1. Photoreceptor cells—the retinal rods and cones
2. Conducting neurons—bipolar neurons and ganglion cells
3. Association neurons and others—horizontal and amacrine neurons
4. Supporting (neuroglial) cells—Müller’s cells

The specific arrangement and associations of the nuclei and processes of these cells result in the retina being organized in ten layers that are seen with the light microscope.

The ten layers of the retina, from outside inward, are:

1. Retinal pigment epithelium (RPE).
2. **Photoreceptor layer**: contains the outer and inner segments of photoreceptor cells.
3. **Outer limiting membrane**: the apical boundary of Müller’s cells.
4. **Outer nuclear layer**: contains the cell bodies (nuclei) of retinal rods and cones.
5. **Outer plexiform layer**: contains the processes of retinal rods and cones and processes of the horizontal, amacrine, and bipolar cells that connect to them.
6. **Inner nuclear layer**: contains the nuclei of horizontal, amacrine, bipolar, and Müller’s cells.
7. **Inner plexiform layer**: contains the processes of horizontal, amacrine, bipolar, and ganglion cells that connect to each other.
8. **Ganglion cell layer**: contains the cell bodies (nuclei) of ganglion cells
9. **Optic nerve ﬁbers layer**: contains ganglion cells processes that lead from the retina to the brain.
10. **Inner limiting membrane**: composed of the basal lamina of Müller’scells.