Overview

The eye (Fig. 2.1) is approximately 24 mm long and is composed of three layers (outer to inner): (1) cornea/sclera; (2) uveal tract consisting of choroid, ciliary body, and iris; and (3) neurosensory retina (contiguous with ciliary nonpigmented epithelium and posterior pigment epithelium of iris). The anterior chamber is filled with aqueous (1 cc), and the posterior compartment is filled with vitreous (4 cc) (volumes in adult eye).

Cornea

The cornea is the transparent outer layer of the anterior portion of the eye that measures 11 × 10 mm in adult. It is composed of five layers (outer to inner): (1) nonkeratinized stratified squamous epithelium, (2) Bowman’s layer (collagenous layer), (3) stroma (parallel lamellae of collagen and keratocytes), (4) Descemet’s membrane (basement membrane), and (5) endothelium monolayer of hexagonal cells that pump water out of stroma via Na/K ATPase pump. The cornea is avascular and receives nutrition from the tear film and aqueous. It is approximately 500 μ thick centrally and 700 μ thick peripherally. The epithelium may give rise to squamous neoplasia (dysplasia) arising in the limbus and extending onto the corneal surface. Corneal stromal tumors are rare.

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Conjunctiva

The surface of the conjunctiva is composed of nonkeratinized stratified squamous epithelium with goblet cells. The substantia propria underlying epithelium is composed of fibrovascular tissue with occasional interspersed lymphocytes. The palpebral conjunctiva lines the inner surface of eyelids. The bulbar conjunctiva covers the exposed sclera. The fornix is where palpebral and bulbar conjunctivas meet. Goblet cells provide the mucinous component of tear film and increase in density further from the limbus. The conjunctiva receives its nutrition from the vascular supply in substantia propria. Conjunctival epithelium may give rise to squamous neoplasia. Conjunctival melanocytes may give rise to nevus, PAM, and melanoma. The substantia propria may give rise to a variety of tumors including hematopoietic (lymphoma), neural (schwannoma, neurofibroma), fibrocytic (fibrous histiocytoma), vascular (hemangioma), and others.

Lens

The lens is of surface ectodermal origin. It is composed of a capsule, cortex, and nucleus. The lens epithelium is inside the capsule and divides at the equator (lens bow), and the more mature lens cells toward the center of the lens are anucleate.
Lens cells contain proteins known as lens crystallins. The lens is suspended by zonular fibers (suspensory ligament) from the pars plicata of ciliary body. There is no known primary neoplasia of the lens in humans. The lens may become cataractous secondary to irradiation and/or intraocular surgery for ocular tumors. In general, it is safe to perform cataract surgery on an eye treated for an intraocular malignancy 6 months after the tumor has favorably responded to therapy.

**Uveal Tract**

The uveal tract is composed of the choroid, ciliary body, and iris. It contains an anterior opening (pupil) and a posterior opening through which the optic nerve fibers pass. The venous drainage of the uveal tract is via vortex veins—avoid these during brachytherapy. The choroid consists of fibrocytes, melanocytes, and vascular channels, larger vessels in outer layer (Sattler’s layer), medium-sized vessels in middle (Haller’s layer), and capillaries in inner layer (choriocapillaris). The ciliary body consists of two regions—pars plicata anteriorly and pars plana posteriorly; it is also consists of five layers—(outer to inner) supraciliary space, muscular layer (longitudinal, circular, and transverse smooth muscles), stroma (fibrovascular tissue including melanocytes), pigment epithelium, and nonpigmented epithelium (produces aqueous). The iris is composed of five layers—(anterior to posterior) anterior border layer, stroma (fibrovascular tissue including melanocytes), muscular layer (sphincter and dilator muscles), anterior pigment epithelium, and posterior pigment epithelium. A uveal melanoma arises from melanocytes in choroid, ciliary body, or iris. Other uveal tumors may occur—smooth muscle tumors (leiomyoma, leiomyosarcoma), neural tumors (schwannoma, neurofibroma), vascular tumors (hemangioma), neuroepithelial tumors (ciliary body adenoma/adenocarcinoma, medulloepithelioma), and metastases.

**Neurosensorial Retina**

The neurosensorial retina has nine layers—internal limiting membrane, nerve fiber layer, ganglion cell layer, inner plexiform layer, inner nuclear layer, outer plexiform layer, outer nuclear layer, photoreceptor cell layer, and external limiting membrane. Retinoblastoma is the most common primary intraocular tumor of childhood; heritable form due to 13q14 mutation arises from cells in inner or outer nuclear layer of retina. Retinocytoma is the benign variant of retinoblastoma.

**Retinal Pigment Epithelium (RPE)**

The RPE is a monolayer of pigmented hexagonal cells overlying Bruch’s membrane. The RPE often contains lipofuscin and gives the red/orange color to fundus. These cells are very metabolically active and supply vitamin A to photoreceptors. RPE tumors include pseudoadenomatous hyperplasia, adenoma, and low-grade adenocarcinoma.
Vitreous

The vitreous occupies 4/5 of the eye, is 4 cc in volume, and is 4 g in weight. It is composed of water, collagen, and hyaluronic acid. Primary intraocular lymphoma (PIOL) seeds into vitreous from retinal blood vessels. Metastatic tumors rarely present in vitreous, such as melanoma, lung, and breast carcinoma.

Sclera

The sclera is the white part of eye composed of episclera, stroma, and lamina fusca. Vascular channels, nerves, and accompanying cells may pass through holes in sclera (i.e., Axenfeld’s loop—not to be confused with a tumor). Calcific plaques may occur anterior to the insertions of recti muscles.

Optic Nerve

The optic nerve is 40 mm long and contains nerve fibers that arise from ganglion cell layer of retina. Nerve fiber bundles in the optic nerve head pass through holes in sclera (lamina cribrosa). Fibrovascular pial septa supply nutrition to the optic nerve. Glial cells are present in nerve fiber bundles. The optic nerve is surrounded by arachnoid, pia mater, and dura mater (meninges). Primary optic nerve tumors include astrocytoma (pilocytic astrocytoma) which arises from glial cells and meningioma which arises from the arachnoid layer of the meninges.
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