Eye and Optic Nerve
Lecture Objectives

• Make a list of structures making the eyeball.
• Describe the contents and layers of the eyeball.
• Describe the sensory, sympathetic and parasympathetic nerve supply.
• Define the optic nerve.
• Follow the optic nerve from the eyeball to its point of entry to the brain and its central connections.
• Explain the effect of optic nerve fibers’ injuries on the visual field.
• List the related structures to the eye; eyelids and lacrimal system.
Eyelids

• Upper & lower eyelids
  – Medial & lateral angles (canthi)
  – Palpebral fissure
  – Eyelashes

• Framework
  – Orbital septum
  – Tarsal plates
    • Palpebral ligaments
Eyelids

• Glands
  – Glands of Zeis (oil)- hair follicles
  – Ciliary glands/ glands of Moll (modified sweat)- between eyelashes
  – Tarsal (Meibomian) glands (modified oil)- behind eyelashes

• Muscles
  – Orbicularis oculi
  – Levator palpebrae superioris
Eyelids

- Conjunctiva
  - Palpebral conjunctiva
  - Bulbar conjunctiva
  - Conjunctival blood vessels
  - Conjunctival fornices
  - Conjunctival sac – receive ducts of lacrimal gland
- Medial angle (beginning of the lacrimal apparatus)
  - Lacus lacrimalis (lacrimal lake)
  - Caruncula lacrimalis
  - Papilla lacrimalis
    - Punctum lacrimalis
      - Canaliculus lacrimalis
Lacrimal Apparatus

• Punctum lacrimalis → canaliculus lacrimalis → lacrimal sac → nasolacrimal duct → nasal cavity
• Lacrimal gland
  – Parts
    • Orbital part
    • Palpebral part
  – Location
  – Ducts opens into superior fornix
  – Nerve supply:
    • Sympathetic – internal carotid plexus
    • Parasympathetic – facial nerve
Optic Nerve (II)

- Entirely sensory (SSA) – Vision
  - Rods and cones of the retina → bipolar neurons → ganglion cells
    - Optic nerve fibers via optic foramen
      - Optic chiasm*
        - Optic tracts → Superior colliculi ** (midbrain)
          - Lateral geniculate nuclei (thalamus)
            - Optic radiation
              - Primary visual areas (cerebral cortex)
                - * fibers from the medial half of each retina cross to the opposite side and fibers from the lateral side remain on the same side
                - **control the extrinsic and intrinsic eye muscles
Optic Nerve (II)
Optic Nerve (II): Lesion

- **Right monocular blindness**
  - Visual fields: TN

- **Bitemporal hemianopsia**
  - Visual fields: N N

- **Left homonymous hemianopsia**
  - Visual fields: N T

**Section of right optic nerve**

**Section of optic chiasm**

**Section of right optic tract**
Tunics (Layers, Coats) of Eyeball

- **Fibrous Tunic (outer layer)**
  - Cornea - anterior
  - Sclera - posterior
- **Vascular Pigmented Tunic (middle layer)**
  - Choroid
  - Ciliary body
  - Iris
- **Nervous Tunic (inner layer)**
Fibrous Tunic -- Cornea

- Transparent
- Helps focus light (refraction)
  - Astigmatism
- 3 layers
  - nonkeratinized stratified squamous
  - collagen fibers & fibroblasts
  - simple squamous epithelium
- Transplants
  - common & successful
  - no blood vessels so no antibodies to cause rejection
- Nourished by tears & aqueous humor
- Nerve supply: long ciliary nn. (V1)
Fibrous Tunic -- Sclera

- “White” of the eye
- Dense irregular connective tissue layer -- collagen & fibroblasts
- Provides shape & support
- At the junction (limbus) of the sclera and cornea is an opening (scleral venous sinus)
- Posteriorly pierced by the Optic Nerve (CNII)
  - Lamina cribrosa
Vascular Tunic -- Choroid & Ciliary Body

- **Choroid**
  - pigmented epithelial cells (melanocytes) (outside) & blood vessels (inside)
  - provides nutrients to retina
  - black pigment in melanocytes absorb scattered light

- **Ciliary body**
  - Ciliary ring (posterior)
  - Ciliary processes
    - folds on ciliary body
      - Suspensory ligaments
    - secrete aqueous humor
  - Ciliary muscle
    - smooth muscle that alters shape of lens
Vascular Tunic -- Iris & Pupil

- Colored portion of eye
- Shape of flat donut suspended between cornea & lens
  - Anterior & posterior chambers
- Hole in center is pupil
- Function is to regulate amount of light entering eye
- Autonomic reflexes
  - Circular muscle fibers contract in bright light to shrink pupil
  - Radial muscle fibers contract in dim light to enlarge pupil
Vascular Tunic -- Muscles of the Iris

• Constrictor pupillae (circular) ------parasympathetic fibers
• Dilator pupillae (radial) ------sympathetic fibers.

➤ Response varies with different levels of light
Lens

• Avascular
• Layers
  – Capsule - Clear & perfectly transparent
  – Epithelium - anterior
  – Crystalline proteins - concentric layers
• Lens held in place by suspensory ligaments
• Focuses light on fovea
• Cataract
  – Cloudiness
  – Lens implants
Vascular Tunic -- Suspensory ligament

- Suspensory ligaments attach lens to ciliary process
- Ciliary muscle controls tension on ligaments & lens
Nervous Tunic -- Retina

• Layers
  – Outer pigmented layer
  – Inner nervous layer

• Parts
  – Posterior ¾ is receptor organ
    • Ora serrata
  – Anterior part (nonreceptive)
    • Covers ciliary processes & back of iris

• Macula lutea
  – Fovea centralis

• Optic disc
  – Optic nerve
  – Central artery of the retina
  – Blind spot
Retinal Layers

- Nerve fiber layer
- Ganglion cell layer
- Inner plexiform layer
- Inner nuclear layer
- Outer plexiform layer
- Outer nuclear layer
- Photoreceptor layer
- Pigment epithelium

Cells

- Inner limiting membrane
- Axons at surface of retina passing via optic nerve, chiasm and tract to lateral geniculate body
- Ganglion cell
- Müller cell (supporting glial cell)
- Bipolar cell
- Amacrine cell
- Horizontal cell
- Rod
- Cone
- Pigment cells of choroid

B. Section through retina
Nervous Tunic -- Retina

- Optic disc
  - optic nerve exiting back of eyeball
- Central retinal BV
  - fan out to supply nourishment to retina
  - visible for inspection
    - hypertension & diabetes
- Detached retina
  - trauma (boxing)
    - fluid between layers
    - distortion or blindness

View with Ophthalmoscope
Cavities of the Interior of Eyeball

• Anterior cavity (anterior to lens)
  – filled with aqueous humor
    • produced by ciliary body
    • continually drained
    • replaced every 90 minutes
  – 2 chambers
    • anterior chamber between cornea and iris
    • posterior chamber between iris and lens

• Posterior cavity (posterior to lens)
  – filled with vitreous body (jellylike)
  – formed once during embryonic life
  – floaters are debris in vitreous of older individuals
Aqueous Humor

- Continuously produced by ciliary body
- Flows from posterior chamber into anterior through the pupil
- Scleral venous sinus
  - canal of Schlemm
  - opening in white of eye at junction of cornea & sclera
  - drainage of aqueous humor from eye to bloodstream
- Glaucoma
  - increased intraocular pressure that could produce blindness
  - problem with drainage of aqueous humor