Ophthalmology Final

🔊 **Podcast Style Review (Experimental Feature)**

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- **NOTE:** Highlighted in **bold** are the important key info!
- Topics are arranged in order of most to least commonly tested
- Check the table of contents below for easier navigation
- Good luck 🍀

Diabetic Retinopathy (DR)

- **Most common cause of impaired vision worldwide in the working-age group.**
- Pathophysiology: Microangiopathy due to chronic hyperglycemia → vessel leakage, ischemia.
  - Loss of pericytes, thickening of basement membrane.
- **Non-Proliferative DR (NPDR)**
  - Signs:
    - **Microaneurysms (earliest sign)**
    - Dot-and-blot hemorrhages
    - Hard exudates
    - Cotton-wool spots (nerve infarctions, also seen in HTN)
    - Venous beading
    - Intraretinal microvascular abnormalities (IRMA)
  - Severity Assessment (NPDR):
    - Mild: Microaneurysms only.
    - Severe: (4-2-1 Rule) - Microaneurysms in 4 quadrants OR Venous beading in 2 quadrants OR IRMA in 1 quadrant.
- **Proliferative DR (PDR)**
  - Cause: Progressive retinal ischemia → VEGF release → abnormal new vessel growth.
  - **Hallmark: Neovascularization** (NVD - on disc, NVE - elsewhere, NVI - on iris).
  - Complications: **Vitreous hemorrhage**, tractional retinal detachment, neovascular glaucoma.
  - Treatment: **Pan-retinal photocoagulation (PRP)**, Anti-VEGF injections.
- **Diabetic Macular Edema (DME)**
  - **Most common cause of decreased vision in patients with DR.**

    - Cause: Vascular leakage leading to retinal thickening/swelling at the macula.
    - Can occur at any stage of DR (NPDR or PDR).
    - Treatment: **Anti-VEGF injections**, focal/grid laser photocoagulation.
- Management Principles:
    - Non-proliferative with macular edema: Treat macular edema (e.g., **Anti-VEGF**).
    - Proliferative DR: Treat with PRP +/- Anti-VEGF.
- Risk Factors:
    - **Duration of DM (most important)**
    - Poor glycemic control
    - Hypertension (HTN)
    - Nephropathy
    - Pregnancy

Glaucoma

- Definition: Group of diseases causing characteristic **optic neuropathy** (optic disc cupping) and characteristic **visual field defects**, +/- increased Intraocular Pressure (IOP).
- **Primary Open-Angle Glaucoma (POAG)**
    - **Most common type of glaucoma.**
    - Often **asymptomatic** until late stages.
    - Signs: Open iridocorneal angle on gonioscopy, progressive **peripheral visual field loss**, characteristic optic disc cupping.
    - Treatment Aim: Lower IOP (medications - e.g., prostaglandin analogs first line, laser, surgery).
- **Angle-Closure Glaucoma (ACG)**
    - Mechanism: Peripheral iris obstructs the trabecular meshwork (TM).
    - **Acute Angle-Closure Glaucoma (AACG):**
        - **Ophthalmic emergency.**
        - Symptoms: Sudden painful vision loss, halos, nausea/vomiting.
        - Signs: High IOP, corneal edema, mid-dilated pupil, shallow anterior chamber.
        - Treatment: **Lower IOP immediately** (IV Acetazolamide, topical beta-blockers, osmotic agents like Mannitol), **Topical Pilocarpine** (miotic - after IOP lowers), Laser Peripheral Iridotomy (definitive).
    - Chronic Angle-Closure Glaucoma: Gradual angle closure, scarring, fewer symptoms initially, presents later with vision loss/optic nerve damage.
    - Angle closure can be precipitated by pupillary dilation (e.g., **contraindicated cycloplegics like atropine**).
- **Congenital Glaucoma**
    - Presents early, often within the first year.
    - Cause: Improper development of aqueous outflow structures (TM).
    - Signs: **Buphthalmos** (enlarged eye), **large corneal diameter**, corneal clouding, excessive tearing (epiphora), photophobia.
    - Treatment: **Surgery**.
- **Secondary Glaucoma**
    - Neovascular Glaucoma: Can result from PDR (NVI).
- Diagnosis:
    - Tonometry (IOP measurement, normal 10-21 mmHg, but not required for Dx).
    - Gonioscopy (visualize angle).

- Fundoscopy (assess optic disc cupping).
- Perimetry (visual field testing).

Cataract and Cataract Surgery

- Definition: Opacification of the crystalline lens.
- Symptoms: Gradual blurring of vision.
- Signs: Lens opacity, **absent red reflex** (in mature/dense cataract).
- Types: Nuclear, Cortical, Posterior Subcapsular, Mature, Hypermature.
- Treatment: **Surgery** (lens extraction and intraocular lens - IOL - implantation).
  - **Phacoemulsification:** Most common method, small incision, **earliest visual rehabilitation**.
  - Extracapsular Cataract Extraction (ECCE): Larger incision.
  - Intracapsular Cataract Extraction (ICCE): Rarely performed now.
- **Cataract Surgery Complications:**
  - **Posterior Capsular Opacification (PCO): Most common complication.**
    - Symptoms: Blurred vision months to years post-op.
    - Treatment: **Nd:YAG laser capsulotomy.**
  - **Endophthalmitis:**
    - **Serious intraocular infection.** Ophthalmic emergency.
    - Presents days post-op (usually 3rd-5th day) with pain, decreased vision, redness, hypopyon.
    - Most common organism: **Staphylococcus epidermidis.**
    - Treatment: Intravitreal antibiotics +/- vitrectomy.
  - Cystoid Macular Edema (CMO): Weeks post-op, painless vision drop.
  - Retinal Detachment (RD): Increased risk, especially if posterior capsule ruptures.
  - Suprachoroidal Hemorrhage: Rare, serious intraoperative complication.
  - Iris Prolapse.
  - Incorrect IOL power / Refractive surprise.
- Note: Leukocoria (white pupil) can be caused by cataract, but is a sign, not a complication *of* surgery.

Uveitis

- Definition: Inflammation of the uveal tract (iris, ciliary body, choroid).
- Classification:
  - Anterior: Iris and/or ciliary body (Iritis, Iridocyclitis).
  - Intermediate: Vitreous.
  - Posterior: Choroid and/or retina (Choroiditis, Chorioretinitis).
  - Panuveitis: All parts involved.
- Symptoms:
  - Anterior: **Pain, photophobia, redness**, blurred vision.
  - Posterior/Intermediate: **Blurred vision, floaters**, less pain/redness.
- Signs:
  - Anterior: Ciliary injection, **Keratic Precipitates (KPs)** on endothelium (fine or "mutton-fat"), **cells and flare** in anterior chamber, hypopyon (severe), posterior synechiae (iris to lens), PAS (peripheral anterior synechiae - iris to cornea/TM → glaucoma), miosis.
  - Intermediate: Vitreous cells/haze ("snowballs," "snowbanking").
  - Posterior: Retinal/choroidal lesions, vasculitis, optic disc edema.

- Causes/Associations:
  - **Anterior Uveitis:** Often **Idiopathic**. Associated with HLA-B27 conditions (Ankylosing Spondylitis), JIA, Sarcoidosis, Herpes.
  - **Posterior Uveitis: Toxoplasmosis (most common cause)**. Also CMV (in HIV), Sarcoidosis, Syphilis, TB.
  - Systemic Disease: Sarcoidosis (bilateral anterior uveitis, posterior uveitis - "candle wax drippings"), JIA (often asymptomatic "white eye" anterior uveitis in oligoarticular type, risk of cataract/glaucoma), Crohn's disease, Behcet's disease.
- Complications: Cataract, Glaucoma, Cystoid Macular Edema (CMO), Synechiae, Retinal Detachment.
- Treatment:
  - **Corticosteroids: Topical** (anterior), Periocular/Intravitreal injections, **Systemic** (posterior/severe/bilateral).
  - **Cycloplegics/Mydriatics:** (e.g., cyclopentolate) for anterior uveitis to prevent posterior synechiae and relieve ciliary spasm/pain.
  - Treat underlying cause if identified.

Cornea and External Disease

- **Anatomy:** Transparent, avascular. Layers (anterior to posterior):
  - Epithelium (stratified squamous, regenerates)
  - Bowman's Layer (acellular, does not regenerate well - scars)
  - **Stroma (90% of thickness**, collagen lamellae, keratocytes)
  - Descemet's Membrane (basement membrane of endothelium, regenerates)
  - Endothelium (single layer, hexagonal cells, **does not regenerate** - cell density decreases with age/disease, maintains dehydration via pump)
  - Function: **Major refractive component (approx. 2/3 of eye's power).** Diameter ~11.5mm horizontal.
- **Keratoconus:**
  - Progressive thinning and conical protrusion of the cornea.
  - Causes **irregular myopic astigmatism** (most common cause of vision loss in KC).
  - Signs: Central thinning, Vogt's striae, Fleischer ring (iron), Munson's sign, hydrops (acute rupture of Descemet's - painful edema).
  - Management: **Stop eye rubbing**, Rigid Gas Permeable (RGP) contact lenses, Corneal Cross-Linking (CXL), Intrastromal corneal rings (ICRS), Corneal Transplant (PK/DALK). **LASIK is contraindicated.**
- **Corneal Dystrophies:** Inherited, bilateral disorders.
  - Stromal Dystrophies: Cause **corneal opacity** due to deposits.
  - Endothelial Dystrophies (e.g., Fuchs): Cause **corneal edema** due to endothelial pump failure → vision loss.
- **Corneal Transplantation (Keratoplasty):**
  - Indications: **Keratoconus**, **Pseudophakic Bullous Keratopathy (PBK)** (most common indication worldwide/developed countries), corneal scarring, dystrophies, infections.
  - Types: Penetrating (PK - full thickness), Lamellar (DALK, DSEK/DMEK - partial thickness).
  - Complications: Rejection, astigmatism, infection (endophthalmitis), glaucoma, cataract.
- **Keratitis (Corneal Inflammation):**
  - **Acanthamoeba Keratitis:**
    - Protozoan, found in soil/water. Risk factor: **Contact lens wear (especially with tap water exposure)**.
    - Symptoms: **Severe pain disproportionate to signs**.
    - Signs: Pseudodendrites, **radial keratoneuritis (pathognomonic)**, ring infiltrate/abscess.
    - Treatment: Prolonged course of anti-amoebic agents (e.g., PHMB, chlorhexidine), *not* pyrimethamine. Topical antibiotics for superimposed bacterial infection.

- **Herpes Simplex Virus (HSV) Keratitis:**
  - Epithelial: Dendritic ulcer (stains with fluorescein). Treatment: Topical antivirals.
  - Stromal/Endothelitis: Requires steroids + antiviral cover.
- **Herpes Zoster Ophthalmicus (HZO):** VZV in V1 distribution. Hutchinson's sign (tip of nose) indicates higher ocular involvement risk. Can cause keratitis, uveitis, neurotrophic issues. Treatment: Systemic antivirals.

- **Chemical Injury:**
  - **Ophthalmic emergency.**
  - **Immediate copious irrigation** is the first step.
  - **Alkali burns are generally worse** than acid burns (penetrate deeper).

Refractive Errors and Optics

- **Refractive Power:** Cornea (~43D, **2/3 total power**) + Lens (~20D, **1/3 total power**).
- **Accommodation:** Ability to increase eye's focus for near vision, achieved by contraction of the **ciliary body/muscle**, relaxing zonules, allowing lens to become more convex. Decreases with age (Presbyopia).
- **Emmetropia:** No refractive error, light focuses on retina.
- **Ametropia (Refractive Errors):**
  - **Myopia (Nearsightedness):** Light focuses in front of retina (long eye/too much power). Corrected with **concave (minus) lenses**.
  - **Hypermetropia (Farsightedness):** Light focuses behind retina (short eye/too little power). Corrected with **convex (plus) lenses**. Can lead to accommodative esotropia, angle-closure glaucoma risk.
  - **Astigmatism:** Cornea has different curvatures in different meridians, light focuses at multiple points. Corrected with **cylindrical lenses**.
  - **Presbyopia:** Age-related loss of accommodation. Corrected with reading glasses (convex lenses).

Orbital Conditions

- **Orbital Walls:** Roof (Frontal), Floor (Maxilla, Zygomatic, Palatine), Medial (Ethmoid, Lacrimal, Sphenoid, Maxilla - thinnest), Lateral (Zygomatic, Sphenoid - strongest). Nasal bone is *not* part of orbit.
- **Blowout Fracture:** Trauma causes fracture of orbital walls.
  - Most common sites: **Floor (Maxillary sinus)** and **Medial wall (Ethmoid sinus)**.
  - Signs: Diplopia (especially on upgaze due to **inferior rectus/oblique entrapment**), restricted eye movements, infraorbital nerve anesthesia (floor fracture), subcutaneous emphysema (medial wall fracture).
  - **Enophthalmos (sunken eye) is a late sign**, not early.
  - Surgery indicated for significant entrapment or large fractures causing enophthalmos.
- **Orbital Cellulitis:**
  - **Infection posterior to orbital septum.** Serious, potential vision/life threat.
  - Cause: Often sinus infection spread (ethmoid). Common pathogens: Strep, Staph.
  - Signs: **Proptosis**, **painful/restricted eye movements**, **decreased vision**, fever, eyelid edema/erythema, conjunctival hyperemia/chemosis.
  - **Must differentiate from Preseptal Cellulitis** (infection anterior to septum, typically no proptosis, normal EOMs/vision).
  - Management: **Hospital admission, IV antibiotics**. CT scan to assess sinuses/abscess.
- **Thyroid Eye Disease (TED):**
  - Autoimmune disorder affecting orbital tissues (muscles, fat). Associated with Graves' disease (hyperthyroidism), but can occur in eu/hypothyroid states.
  - **Most common cause of unilateral or bilateral proptosis in adults.**
  - **Smoking is major risk factor.**

- Signs: Proptosis, lid retraction, lid lag, restrictive myopathy (diplopia, **inferior rectus most commonly affected** → restricted upgaze), optic neuropathy (compressive).

- **Orbital Tumors:**
  - Children: **Capillary hemangioma (most common benign)**, **Rhabdomyosarcoma (most common primary malignant)**.
  - Metastasis Source in Children: **Retinoblastoma**, Neuroblastoma (sympathetic chain), others.
- **Carotid-Cavernous Fistula (CCF):** Abnormal connection between carotid artery and cavernous sinus. Can occur post-trauma. Signs: Pulsatile proptosis, orbital bruit, chemosis, dilated conjunctival vessels, increased IOP.

Neuro-Ophthalmology

- **Visual Pathway & Field Defects:** Lesions produce predictable field defects.
  - Optic Nerve: Monocular vision loss / ipsilateral field defect.
  - Optic Chiasm: **Bitemporal hemianopia** (e.g., pituitary adenoma).
  - Optic Tract: Contralateral **homonymous hemianopia** (often incongruous).
  - Optic Radiation: Contralateral **homonymous hemianopia** or quadrantanopia (more congruous). Left radiation lesion → right hemianopia.
  - Visual Cortex: Contralateral **homonymous hemianopia**, often with **macular sparing**.
- **Pupils:**
  - Relative Afferent Pupillary Defect (RAPD): Sign of unilateral or asymmetric optic nerve disease (e.g., optic neuritis) or extensive retinal disease. Detected by swinging flashlight test.
  - Light-Near Dissociation: Pupils constrict better to near stimulus than light (e.g., **Argyll Robertson pupil** - syphilis).
- **Ptosis (Drooping Eyelid):**
  - Causes:
    - Neurogenic: **Third nerve palsy**, **Horner's syndrome** (sympathetic dysfunction - mild ptosis, miosis, anhydrosis).
    - Myogenic: Myasthenia gravis.
    - Aponeurotic: Dehiscence of levator aponeurosis (age-related).
    - Mechanical: Tumor, swelling.
    - Congenital.
  - **Facial nerve (7th) palsy does NOT cause ptosis** (causes inability to close eye - lagophthalmos).
- **Optic Neuritis:** Inflammation of the optic nerve.
  - Often associated with Multiple Sclerosis.
  - Symptoms: Subacute vision loss, **pain on eye movement**, dyschromatopsia (impaired color vision).
  - Signs: **RAPD**, visual field defect. Fundoscopy often normal (**retrobulbar neuritis** - no disc swelling), but papilledema can occur (papillitis).
- **Cranial Nerve Palsies:**
  - Third Nerve (Oculomotor): Eye deviates "down and out," ptosis, pupil dilation (if parasympathetics involved).
  - Fourth Nerve (Trochlear): Vertical diplopia worse on contralateral gaze and head tilt towards affected side (superior oblique paralysis).
  - Sixth Nerve (Abducens): Inability to abduct eye (lateral rectus paralysis), horizontal diplopia worse on gaze towards affected side.
  - Seventh Nerve (Facial): Facial muscle weakness, inability to close eye (lagophthalmos), brow ptosis, epiphora. *Does not cause upper lid ptosis.*

Strabismus and Amblyopia

- **Strabismus:** Misalignment of the eyes.

    - Esotropia: Eye turns inward.
    - Exotropia: Eye turns outward.
    - Hypertropia: Eye turns upward.
    - Hypotropia: Eye turns downward.
- **Esotropia Causes:**
    - **Accommodative Esotropia: Most common cause in children < 1 year old.** Associated with **hypermetropia**. Treat with glasses.
    - Infantile Esotropia: Presents within first 6 months, large angle, often requires surgery. **Not associated with hypermetropia.** Ocular fixation assessment and fundoscopy are important.
    - Sixth Nerve Palsy.
    - Refractive error (hypermetropia).
- **Amblyopia ("Lazy Eye"):** Reduced visual acuity in one or both eyes due to abnormal visual development during childhood.
    - Causes:
        - **Strabismic:** Misaligned eye is suppressed.
        - **Refractive:** Unequal refractive error (anisometropia) or high bilateral error.
        - **Deprivation:** Obstruction of vision (e.g., **congenital cataract**, ptosis, corneal opacity, upper lid hemangioma).
    - Treatment: Correct underlying cause (e.g., glasses, cataract surgery), **Patching** the better eye to force use of the amblyopic eye. Patching is treatment, *not* a cause.
- Assessment: Visual acuity, cover/uncover test, alignment measurement, cycloplegic refraction, **fundoscopy** (to rule out pathology like retinoblastoma).

Eyelid Disorders

- **Blepharitis:** Eyelid margin inflammation.
    - Signs: Redness, scaling ("dandruff"), crusting, thick Meibomian secretions, lash loss (madarosis).
- **Entropion:** Inward turning of eyelid margin.
    - Causes: Age-related (involutional - orbicularis weakness/override), cicatricial (scarring, e.g., trachoma).
    - Symptoms: Foreign body sensation, irritation, tearing (epiphora) due to lash abrasion.
- **Ectropion:** Outward turning of eyelid margin.
    - Causes: Age-related (involutional - lid laxity), cicatricial, paralytic (**7th nerve palsy**), mechanical.
    - Symptoms: Tearing (epiphora), dryness, irritation. *Does not involve medial canthal weakness specifically in this context.*

Miscellaneous Ocular Conditions

- **Leukocoria (White Pupil):**
    - **Requires urgent evaluation** to rule out serious pathology.
    - Differential Diagnosis: **Retinoblastoma**, **Congenital Cataract**, Coats' disease, Retinopathy of Prematurity (ROP), Persistent Fetal Vasculature (PFV), Ocular toxocariasis. *Gout is not a cause.*
- **Hyphema:** Blood in the anterior chamber.
    - Cause: Usually trauma, can be spontaneous (neovascularization, tumor). Source is often iris or ciliary body vessels.
    - Complications: Increased IOP, corneal blood staining, **re-bleeding** (often worse than initial bleed, typically days 2-5).
    - Management: Rest, shield, head elevation, monitor IOP. **Avoid miotics like Pilocarpine.**
- **Hypopyon:** Layer of white blood cells (pus) in the anterior chamber. Sign of severe inflammation (e.g., endophthalmitis, severe uveitis, infectious keratitis).

- **Lacrimal System:**
  - Lacrimal gland located in supero-**lateral** orbit.
  - Tears drain via puncta → canaliculi → lacrimal sac → **nasolacrimal duct** → **inferior nasal meatus**.
  - Congenital Nasolacrimal Duct Obstruction: Common cause of infant tearing, often resolves spontaneously, may require massage/probing/surgery.
- **Red Reflex:** Assessed with ophthalmoscope. Should be present and clear. Absence/abnormality indicates media opacity (e.g., **cataract**, corneal scar, **vitreous hemorrhage**, tumor like retinoblastoma).
- **Fuchs Heterochromic Iridocyclitis:** Chronic, mild uveitis with iris heterochromia (affected eye lighter), fine KPs, associated with **cataract** and glaucoma.
