BIOS222
Pathology and Clinical Science 2

- Session 2
- Ocular Disorders
- Bioscience Department
Session Learning Outcomes

At the end of the session, you should be able to
- Revise and review anatomy and physiology of Human Eye.
- Identify and analyse the common ocular disorders.
- Analyse and identify the probable causes of the Red Eye, Glaucoma, Cataract, age related macular degeneration, and retinal detachment, their clinical manifestations, pathophysiology and complications.
- Analyse and identify the clinical manifestations, and management of various lumps and bumps affecting the eye.
- Make a probable diagnosis and also make the probable differential diagnosis on the basis of symptomatology and investigations.
- Plan the management of the case by considering prevention, active and supportive treatment of the patient.
- Conceptualise how the cause of the condition governs the management.
Session Plan

- Anatomy and function of a normal human Eye
- Red Eye
  - Conjunctivitis
  - Blepharitis
  - Keratitis
- Lumps and bumps
  - Chalazion
  - Hordeolum
  - Malignancies
  - Pterygium
  - Xanthelasma
  - Molluscum
Session Plan

- Glaucoma
- Cataract
- Age related macular degeneration
- Retinal detachment
Anatomy and Function of a Normal Human Eye
Structure of The Human Eye

- Anatomy of the eye ball
  - The wall of Eye ball:
    - Fibrous tunic
    - Vascular tunic
    - Retina
  - Lens
  - Interior of the eye ball:
    - Anterior cavity
    - Posterior cavity
Structure of The Human Eye

- Accessory structures of the eye:
  - Eye lids
    - Meibomian glands
    - Conjunctiva
  - Eye lashes and Eye brows
    - Sebaceous ciliary glands
  - Lacrimal apparatus
Function of The Human Eye

- Formation of the image and vision:
  - The refraction or bending of light by the lens and cornea
  - Accommodation, the change in shape of the lens
  - Constriction or narrowing of the pupil.

(a) Sagittal section of eye and its accessory structures

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## Common Symptoms in Ocular Diseases

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<td>Sore, dry, itchy eyes</td>
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<td>Lacrimation</td>
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<td>Discharge from the eyes</td>
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</table>
The Red Eye
The Red Eye

Red eye includes a group of conditions that present with inflammation of various eye structures including conjunctiva, cornea, iris, sclera or even the eyelids.

Common causes of red eye:

- Conjunctivitis (inflammation of conjunctiva)
  - Bacterial, Viral, Allergic
- Blepharitis (inflammation of eyelids)
- Keratitis (inflammation of cornea)
- Iritis (inflammation of Iris)
The Red Eye

Pathophysiology: Mainly inflammation.

Causes:
- Infection from bacteria or viruses
- Injury
- Allergies

Triggers inflammation:
- Release of chemical mediators
- Activation of cellular mediators

- Vasodilation
- Increase capillary permeability in various structures of the eye - conjunctiva, cornea, iris or the lids

- Pain in the eyes
- Difficult vision
- Lacrimation
- Redness
- Swelling

- Swelling
- Redness
- Heat (fever)
- Pain

- Increased blood flow
- Collection of fluid and proteins
- Action of WBCs
Conjunctivitis

- **Definition:** An inflammation of the conjunctivae usually due to viral or bacterial infections or allergic causes. Can be acute or chronic.

- **Types:**
  - **Bacterial conjunctivitis**
    - Acute
    - Chronic
    - Chlamydial
    - Ophthalmia Neonatorum
  - **Viral conjunctivitis**
  - **Allergic conjunctivitis**
  - **Contact irritant conjunctivitis**
Conjunctivitis

- **Aetiology:**
  - **Bacterial:**
    - Acute bacterial: *Streptococcus pneumoniae*, *S. aureus*, and *Haemophilus influenzae*
    - Chronic bacterial: *Staphylococcus* species
    - Chlamydial: *Chlamydia trachomatis*
    - Ophthalmia Neonatorum: *N. gonorrhoeae*, *Pseudomonas*, *Chlamydia trachomatis*
  - **Viral:** adenoviruses, herpesviruses, and enteroviruses.
  - **Allergic:** Seasonal allergens
  - **Contact irritant:** chemical agents, physical irritants, or radiant energy
Conjunctivitis

- Clinical features:
  - Redness of eye
  - Foreign body sensation
  - Scratching or burning sensation
  - Itching
  - Excessive lacrimation
  - Photophobia
  - Discharge, or exudate
  - Crust formation and sticky eyelids
  - Papillary hypertrophy

Images from: Grossman, S, Porth, CM 2013, Porth’s pathophysiology, Concepts of Altered Health States, 9th edn, Lippincott Williams & Wilkins
Conjunctivitis

○ Diagnosis:
  • Clinical features
  • Physical examination
  • Microscopic and culture studies to identify the cause

○ Management:
  • Topical antibiotics
  • Avoid allergens, topical antihistamines and topical NSAIDs
  • Systemic antihistamines and a short course of topical corticosteroids
  • Patient education to prevent the spread of infection
Blepharitis

- **Definition:** Bilateral inflammation of the anterior or posterior structures of eyelid margins.

- **Aetiology:**
  - Seborrhoea of the scalp or eyebrows
  - Staphylococcus epidermidis
  - Staphylococcus aureus
  - Dysfunction of the meibomian glands

Inflammation of margin of eyelid with swelling and redness of eyelid.

Image from: Grossman, S, Porth, CM 2013, Porth’s pathophysiology, Concepts of Altered Health States, 9th edn, Lippincott Williams & Wilkins
Blepharitis

- Clinical features:
  - Irritation, burning, redness, and itching of the eyelid margins
  - Inflammation of meibomian glands and their orifices
  - Plugging of meibomian glands orifices, and abnormal secretions.
  - Frothy and abnormally greasy tears

- Management:
  - Removal of scales and warm compression
  - Flaxseed or fish oil tablets
  - Topical antibiotics or steroid treatment
  - Low-dose systemic antibiotic
Keratitis

- Definition: Keratitis refers to inflammation of the cornea.

- Aetiology:
  - Infections: Staphylococcus, S. pneumoniae, Chlamydia, HSV type 1, 2, 3, Acanthamoeba
  - Misuse of contact lenses,
  - Hypersensitivity reactions
  - Trauma and ischemia
  - Defects in tearing,
  - Interruption in sensory innervation, as occurs with local anesthesia
Keratitis

- Clinical features:
  - Redness
  - Pain
  - Watering
  - Sticky discharge or rash
  - Photophobia
  - Redness around edge of cornea and a small pupil
  - Blurring of vision, reduced vision
  - Corneal scarring and opacity leading to blindness

The vascularized macular scar is formed due to herpes simplex keratitis. However, it is not in the visual axis of this eye. Redness around edge of cornea is also present.

Lumps and Bumps
Lumps and Bumps

- Chalazion (Meibomian Cyst)
- Hordeolum (Stye)
- Malignancies
  - Basal cell carcinoma
  - Squamous cell carcinoma
- Pterygium
- Xanthelasma
- Molluscum
Chalazion (Meibomian cyst)

- **Definition:** A lump in the eyelid that is caused by chronic inflammatory granuloma of a meibomian gland.

- **Clinical features:**
  - Small, non-tender nodule on the upper or lower lid.
  - Occasionally red, warm, or painful
  - Red and elevated conjunctiva around the chalazion
  - Sensitivity to light
  - Pressure on the eyeball and distorted vision

- **Complications:**
  - Astigmatism due to pressure on cornea
Chalazion (Meibomian cyst)

- **Management:**
  - Warm compresses
  - Antibiotic eye drops or ointments
  - Steroid injections
  - Surgical removal

- Repeated cleansing of the eye prevents the condition.

Image from: http://www.faceandeye.co.uk/file-manager/Photos/chalazion-264.jpg
Hordeolum (Stye)

- Definition: Infection of the sebaceous glands of the eyelid and can be internal or external.

- Clinical features:
  - Pain, redness and swelling in the affected area.
  - A yellowish bump in the affected area.
  - Watering of the eye
  - Sensitivity to light,
  - Discomfort during blinking
Hordeolum (Stye)

- Complications:
  - Cyst of Moll
  - Chalazion

- Management:
  - Warm compresses
  - Pulling out the eyelashes
  - Antibiotics
  - Incision or expression of the infectious contents

Malignancies

- Basal cell carcinoma
  - Commonest malignancy and arises most often in the lower inner eye
  - Grow into a pearly nodule and can ulcerate and bleed
  - Difficult to treat due to closeness of the tear duct
  - Treatment: Radiotherapy or excision

Malignancies

- Squamous cell carcinoma
  - It can appear in any form.
  - It usually forms irregularly shaped ulcer that spreads more quickly and horizontally.
  - Metastasis is very common in Squamous cell carcinoma

Pterygium

- **Definition:** It is a conjunctive epithelial overgrowth, triangular in most cases, which proliferates from the bulbar conjunctiva over the cornea, surpassing the anterior end, thus causing severe vision impairment.

- **Aetiology:** Chronic UV exposure especially in tropics

Growth, development and differentiation of the conjunctivo-epithelial structures of the sclerocorneal limbus, characterized by the appearance of a new fleshy, translucent triangular formation on the surface of the cornea.

Pterygium

Clinical features:
- Generally slow growing with periods of active growth
- Often asymptomatic
- Pain, Redeye
- Dry eye and itching
- Visual impairment, if encroachment onto visual field

Management:
- No treatment necessary if it is asymptomatic
- Topical lubricating eye drops
- Topical steroids for pain
- Surgery, if encroachment onto visual field
Xanthelasma

- Definition: A sharply demarcated yellowish collection of cholesterol underneath the skin, usually on or around the eyelids, may be hereditary with or without high cholesterol.

- Associated conditions
  - Familial hypercholesterolemia
  - Primary biliary cirrhosis
  - Menopause
  - Diabetes

- Management: Removal using trichloroacetic acid peel, surgery, lasers or cryotherapy

Molluscum contagiosum

- **Definition:** It is a viral infection of the skin or occasionally of the mucous membranes.

- **Aetiology:** molluscum contagiosum virus - A pox family virus

- **Transmission:**
  - sexual and non sexual contact

- **Site of infection:**
  - Any body site, usually affect the genitals, lower abdomen, buttocks, and inner thighs.
  - Sometimes on the lips, mouth, and eyelids.

Images from:
http://www.ophthnotes.com/eye-lid-molluscom-contagiousm/
http://www.dermnetnz.org/viral/molluscum-contagiosum.html
Molluscum Contagiosum

- Clinical features:
  - Flesh-colored, dome-shaped, and pearly lesions
  - Often 1-5 millimeters in diameter, with a dimpled centre
  - Generally painless, may itch or become irritated.
  - Picking or scratching the bumps may lead to further infection or scarring.

- Complications:
  - Eczema around the lesions in about 10% of the cases
  - Secondary bacterial infections.
Glaucoma
Cataract
Age related macular degeneration
Retinal detachment
Glaucoma

- **Definition:** It is a progressive optic neuropathy associated with raised intraocular pressure, optic disc “Cupping” and loss of visual field.

- **Aetiology:** congenital or acquired lesions of the anterior segment of the eye that diminish or obstruct aqueous outflow.

- **Types:**
  - Chronic Open angle
  - Acute closed angle
  - Secondary
  - Congenital

Glaucoma

- Pathophysiology:
  - Diminished or obstructed aqueous outflow $\rightarrow$ an elevated IOP $\rightarrow$ irreversible damage to the optic nerve and retinal fibers resulting in a progressive, permanent loss of vision
    - Chronic Open angle: Increase in resistance to flow at trabecular meshwork and canal of Schlemm.
    - Acute closed angle: Increase in the resistance to flow between the iris and the ciliary body. Blockage of outflow occurs due to apposition lens to the back of iris.
    - Secondary: Blockage of outflow occurs due to other ocular diseases
    - Congenital: Diminished outflow due to congenitally narrow anterior chamber or blocked canal of Schlemm.
Glaucoma

Normal drainage

open-angle glaucoma

Closed angle glaucoma

Images from: Grossman, S, Porth, CM 2013, Porth's pathophysiology, Concepts of Altered Health States, 9th edn, Lippincott Williams & Wilkins
Glaucoma

Clinical features:
- Rise in intraocular pressure
- Distention of eyeball, Buphthalmos in infants
- Loss of visual field due to cupping of the optic disc
- Corneal oedema
- Rapid increase in IOP results in a red painful lacrimous eye, with disturbance of vision and vomiting
- “haloes” around brighter objects, like street lights
- “Arcuate Scotomata” – peripheral vision affected, central vision normal initially.
- Venous occlusion of the Episcleral veins
Glaucoma

- Management:
  - Medication to control IOP
    - Topical Beta-blockers like Timolol
    - Parasympathomimetic agents like Pilocarpine
    - Carbonic Anhydrase Inhibitors
  - Surgery when medication fails
    - Iridectomy
    - Drainage Operation
  - Laser
    - Laser Trabeculoplasty
    - Laser Iridotomy
Glaucoma: a progressive optic neuropathy associated with raised intraocular pressure, optic disc “Cupping” and loss of visual field.

**congenital or acquired lesions of the anterior segment of the eye**

**Increase in resistance to flow at trabecular meshwork and canal of schlemm - Chronic Open angle**

- Blockage of outflow occurs due to apposition lens to the back of iris - Acute closed angle
- Blockage of outflow occurs due to other ocular diseases - Secondary
- Diminished outflow due to congenitally narrow anterior chamber or blocked canal of Schlemm - Congenital

**Diminished or obstructed aqueous outflow**

- An increase in intraocular pressure

**Irreversible damage to the optic nerve and retinal fibres**

**Loss of eye structure:**
- Distension of eyeball
- Optic disc cupping
- Corneal oedema

**Loss of eye function:**
- Loss of visual field
- Red painful lacrimonious eye, with disturbance of vision and vomiting
- “Haloes” around brighter objects, like street lights
- “Arcuate Scotomata”

**Management:**
- Medication to control IOP
- Laser treatments
- Surgery

**Colour Key:**
- Clinical features
- Definition
- Aetiology
- Pathophysiology
- Diagnosis
- Management
- Complications
**Cataract**

- Definition: A cataract is a lens opacity that interferes with the transmission of light to the retina.

- Aetiological classification:
  - Senile cataract:
    - Normal ageing
  - Traumatic:
    - Foreign body injury to the lens
    - Blunt trauma to the eye
    - Overexposure to heat or ionizing radiation
Cataract

- Aetiological classification (cont.):
  - Congenital:
    - Genetic defects
    - Toxic environmental agents
    - Viruses such as rubella
  - Metabolically induced cataracts:
    - Diabetes Mellitus
    - Inborn errors of metabolism
  - Drug induced:
    - Systemic and inhaled corticosteroids
Cataract

- Clinical features:
  - Blurred vision and visual distortion.
  - Decreased visual acuity for far and near objects.
  - Glare or the abnormal presence of light in the visual field.
  - Decreased colour perception.

National Eye Institute, National Institutes of Health, 2015, A scene as it might be viewed by a person with cataract, accessed 26 Oct 2015, https://nei.nih.gov/photo/cataract
Cataract

- **Diagnosis:**
  - Ophthalmoscopic examination
  - Snellen vision test

- **Management:**
  - Management of underlying cause
  - Strong bifocals, magnification, appropriate lighting, and visual aids
  - Surgery: lens extraction and intraocular lens implantation.
Age Related Macular Degeneration (AMD)

- Definition: Macular degeneration is characterized by degenerative changes in the central portion of the retina (the macula) that result primarily in loss of central vision.

- Risk factors:
  - Older age
  - Female sex
  - White race
  - Cigarette smoking
  - High cholesterol

- Types:
  - An atrophic nonexudative or “dry” AMD
  - An exudative or “wet” AMD
Age Related Macular Degeneration

Pathophysiology:

- Dry AMD: Atrophy and degeneration of the outer retina, Bruch membrane, and the choriocapillaris → decrease in sub-retinal pigment epithelial (RPE) cells function → gradual build up of waste deposits appear on retina as yellow tiny ‘Drusen bodies’ → gradual loss of RPE cells → ↓ in photoreceptor function

- Wet AMD: Thickening of Bruch membrane → formation of choroidal neovascular membrane with fragile blood vessels → leakage of blood and fluid into subretinal space → rapid damage to photoreceptors → scar tissue formation and death of underlying retinal tissue
Age Related Macular Degeneration

Images from: http://www.angio.org/learn/multimedia/
Age Related Macular Degeneration

- Clinical features:
  - Blurred vision
  - Visual acuity drastically decreasing (two levels or more)
  - Trouble discerning colours
  - Slow recovery of visual function after exposure to bright light
  - Metamorphopsia: Distorted vision of straight lines
  - Central Scotomas
  - Exudative changes: hemorrhages in the eye, hard exudates, sub-RPE/ intra retinal fluid
Age Related Macular Degeneration

- Management:
  - No treatment for dry macular degeneration
  - Laser surgery can help to slow down the vision loss in wet type.

http://www.macu-clear.com/userfiles/image/MacuCLEAR%E2%80%99s%20Technology%20Objective.jpg
AMD: Degenerative changes in the central portion of the retina (the macula) that result primarily in loss of central vision.

Risk factors: Older age, Female sex, White race, Cigarette smoking, High cholesterol

**DRY AMD**
- Atrophy and degeneration of the outer retina, Bruch membrane, and the choriocapillaris
- Decrease in RPE cells function
- Gradual build up of waste deposits appear on retina as yellow tiny 'Drusen bodies'
- Gradual loss of RPE cells
- Gradual loss of photoreceptors function

**Management:**
No treatment for dry macular degeneration

**WET AMD**
- Thickening of Bruch membrane
- Oxygen and nutrients supply to photoreceptors decreases
- Formation of choroidal neovascular membrane with fragile blood vessels
- Leakage of blood and fluid into sub-retinal space
- Scar tissue formation and death of underlying retinal tissue
- Rapid damage of photoreceptors

**Management:**
Laser surgery in wet type

**Clinical features**
- Blurred vision
- Visual acuity drastically decreasing
- Trouble discerning colours
- Slow recovery of visual function after exposure to bright light
- Metamorphopsia
- Central Scotomas
- Haemorrhages in the eye, hard exudates, sub-RPE/ intra retinal fluid

**Definition**
- Aetiology
- Pathophysiology

**Diagnosis**
- Management
- Complications
Retinal Detachment

- **Definition:** Retinal detachment involves the separation of the neurosensory retina from the pigment epithelium.

- **Risk factors:**
  - Advancing age
  - Myopia

- **Types:**
  - Exudative
  - Traction
  - Rhegmatogenous

A) Changes in the vitreous structure cause it to shrink and separate from the retina, causing posterior vitreous detachment; (B) sustained fluid collection and tractional forces cause the retina to tear (rhegmatogenous retinal detachment). (C) Ophthalmoscopic photograph of retinal detachment.
Retinal Detachment

- Clinical features:
  - Flashing lights or sparks
  - Small floaters or spots in the field of vision
  - A shadow or dark curtain progressing across the visual field
  - Initial visual disturbances may involve only one quadrant of the visual field

- Management:
  - Laser or cryotherapy to seal the retinal tears
  - Vitreoretinal surgery
Reading and Resources

- Crowley LV, 2012, *An Introduction to Human Diseases – Pathology and Pathophysiology Correlations*, 9th edn, Jones and Bartlett Learning
Reading and Resources

- Mosby’s dictionary of medicine, nursing and health professions 2013, 9th edn, Elsevier, St. Louis, MO.
- VanMeter, KC & Hubert, RJ 2014, *Gould's pathophysiology for the health professions*, 5th edn, Elsevier, St Louis, MO.
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