Reading Material for
Ophthalmic Technique-I

Compiled By:

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Preface

In the ever-evolving landscape of healthcare, the role of Allied Health Professionals (AHPs) has become increasingly pivotal, necessitating a dynamic response in education and training. The culmination of Dr. Nasir Ahmad Chaudhry's extensive experience and expertise, marked by the authorship of three prior books for MBBS students and postgraduate residents, is reflected in this curriculum for Ophthalmic Technician Training—a timely and crucial resource for the evolving needs of healthcare.

This revised curriculum addresses the shifting demands of the field, linking pre-service education with real-world tasks, modernizing training, and emphasizing integration of tasks and multi-skilling. The Core Course serves as a foundational knowledge base, fostering technical proficiency and facilitating advanced studies in Allied Health Sciences.

As the Associate Professor of Ophthalmology at King Edward Medical University, Lahore, Dr. Nasir Chaudhry brings a wealth of experience as a leading surgeon, educator, and academician. His commitment to excellence is evident in his numerous accolades, including prestigious awards for teaching and training services.

This resource is not merely a textbook but a comprehensive tool designed to nurture a generation of skilled Ophthalmic Technicians. Dr. Chaudhry's foresight in balancing practicality, exam orientation, and updated clinical knowledge ensures its relevance for postgraduate residents, aspiring professionals, and practitioners seeking to stay abreast of modern healthcare challenges.

In the spirit of progress and knowledge-sharing, this book stands as a guide, inspiring a deep interest in the pursuit of excellence in Allied Health Sciences.

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UNIT 1: FIRST AID MANAGEMENT OF OCULAR EMERGENCIES

1.1 Definition

An ocular emergency can be defined as any condition, in which early action is necessary to prevent severe or permanent damage to the eye such as chemical burns, penetrating trauma, foreign body, thermal injuries etc.

1.2 Removal of Corneal Foreign Body

A corneal foreign body (FB) is an object that is superficially adherent or embedded in the cornea such as glass, metal, sand, plastic, or wood. Symptoms include foreign body sensation, pain, tearing, light sensitivity and decreased vision.

1.2.1 Prevention:

- Use protective goggles during risky activities such as wielding to prevent foreign bodied entering the eye.
- Tools must be handled properly to avoid contact with the eyes
- Public awareness campaigns about the importance of eye protection and safe practices.

1.2.2 First Aid Management:

General guidelines for the first aid management of a corneal foreign body;

1. **Wash your hands:** before touching the eye, make sure your hands are clean to prevent introducing any additional contaminants.
1. **Avoid rubbing the eye:** instruct the person not to rub their eye, as this could make the situation worse.
2. **Assess the situation:** if you suspect there is a foreign object on the cornea, the person might experience pain, tearing redness or blurred vision. They might also describe a feeling that something is in their eye.
3. **Do not remove with fingers or cotton swabs:** avoid using your fingers tweezers or cotton swabs to remove the foreign object, as this can potentially cause more damage.
4. **Blinking and tearing:** blinking and tearing may help remove small particles from the eye naturally.
5. **Use clean water or flush with saline solution:** if the foreign object is not embedded, you can try to flush the eye gently with clean water or sterile saline solution.

6. **Protect the eye:** If the foreign body is large or embedded, protect the eye by placing a clean, sterile dressing or loosely taped patch over the eye. Avoid applying pressure.
7. **Seek medical attention:** if the foreign body is not easily removed or if the person experiences persistent pain, discomfort redness or vision problems then it is important to seek professional medical assistance. An eye care professional such as an Ophthalmologist can assess the severity of the injury and provide appropriate treatment.

1.3 Penetrating Injury of the Eyeball

Ocular penetrating and perforating injuries (commonly referred to as open globe injuries) can result in severe vision loss or loss of the eye. Penetrating injuries by definition penetrate into the eye but not through and through--there is no exit wound. Perforating injuries have both entrance and exit wounds. These are mainly caused by sharp or high velocity objects.

1.3.1 First Aid Management:

Penetrating or perforating injuries should be evaluated and treated immediately. First aid of penetrating ocular injuries includes:

- Do not attempt to remove penetrating foreign body unless patient is undergoing surgery
- Do not press or rub an injured eye.
- Do not wash out injured eye with water or any other fluid.
- Do not remove contact lens
- Administer systemic analgesics.
- Administer prophylactic broad-spectrum systemic antibiotics.
- Administer anti-emetics if the patient has nausea or vomiting
- Update tetanus prophylaxis.
- Recommend ‘nil by mouth’ status in preparation for surgery.
- Carefully document all findings
- Inform the surgeon for repair of the injury.

1.3.2 Prevention:

Wearing the proper protective eyewear (safety goggles, visors and eye protection) greatly reduces risk of an eye injury and vision loss.

1.3.3 Result:

Early and prompt first aid and primary repairs restores the structural integrity of the eye and reduces the chances of infection and severe vision loss.

1.4 Laceration of the Cornea

A cornea laceration, also known as a corneal injury, refers to a deep cut or tear in the cornea of the eye. The cornea is the clear, dome-shaped front surface of the eye that covers the iris and the pupil. It plays a crucial role in focusing light onto the retina at the back of the eye, which allows us to see. Corneal lacerations can be caused by various factors, such as:

1. **Trauma:** Accidents, sharp objects, or foreign bodies can penetrate or lacerate the cornea.
2. **Eye injuries:** Sports-related injuries, workplace accidents, or any situation where the eye is exposed to high-velocity objects can lead to corneal lacerations.
3. **Surgical complications:** In some- cases, corneal lacerations can occur during eye surgeries, such as cataract surgery or corneal transplantation.
4. **Contact lens misuse:** Wearing contact lenses improperly or for extended periods can increase the risk of corneal injuries.

The severity of a corneal laceration can vary, ranging from minor cuts that may heal on their own to more severe injuries that require immediate medical attention. Symptoms of a corneal laceration may include eye pain, redness, tearing, blurred vision, sensitivity to light, and the sensation of something foreign in the eye.

Treatment for a corneal laceration depends on the size, depth, and location of the injury. Small lacerations may be managed with antibiotic eye drops, a protective eye patch, and follow up care. More significant injuries may require surgical repair, often performed by an ophthalmologist, to ensure proper healing and prevent complications like infection or scarring.

1.4.1 First Aid management:

1. **Do not rub or touch the eye:** Avoid or rubbing the injured eye, as this can worsen the damage.
2. **Protect the eye:** If possible place a protective shield over the injured eye to prevent further damage. You can use the bottom of a paper cup or similar object to gently cover the eye without putting pressure on it.
3. **Do not rinse:** Avoid rinsing the eye with water or any other fluid as this could exacerbate the injury.
4. **Avoid pressure:** Do not apply the pressure to the injured eye. This includes avoiding any tight bandages or patches that could increase pressure on the eye.
5. **Minimize movement:** Try to keep away the injured person from moving their eye too much. Limiting eye movement can help to prevent additional damage.
6. **Cover both eyes:** If one eye is injured, it’s a good idea to cover both eyes. This can help to prevent the injured eye from moving too much and potentially causing further harm.

7. **Pain management:** If the injured person is experiencing pain, over-the-counter pain relievers might help. However you should consult a medical professional before giving any medication.
8. **Seek medical help:** Corneal lacerations are serious injuries that require immediate medical attention. You should contact an eye specialist (ophthalmologist) or vist the nearest emergency as soon as possible.

a) Injuries of the Eyelids

1.5.1 Contusion injury – blunt trauma

- Sign and symptoms: Swelling, bruising, and discoloration of the eyelid (black eye), Pain and tenderness, subconjunctival hemorrhage

1.5.1.1Management:

- Ice packs or cold compresses to reduce swelling.
- Analgesics for pain relief

1.5.2 Eyelid laceration:

Eyelid lacerations refer to partial- or full-thickness defects in the eyelid. Lid lacerations occur as a result of two general mechanisms including:

1. contact with sharp objects moving at high velocities that either penetrate superficial structures (skin, subcutaneous tissues) and result in a partial-thickness defect or that penetrate deeper structures (posterior layers, tarsus, conjunctiva) resulting in a full-thickness defect
2. Avulsion injuries from blunt trauma.

1.5.2.1 First aid management:

1. **Stay Calm:** Keep the injured person as calm as possible, and reassure them that help is on the way. Do your best to prevent any further injury or panic.
2. **Wash Your Hands:** Before touching the injured area or the eye, wash your hands thoroughly with soap and water to reduce the risk of infection.
3. **Assessment:** Gently examine the injured eyelid and the eye. Look for signs of bleeding, swelling, foreign objects, or obvious injuries. Do not put pressure on the eye or rub it.
4. **Remove Foreign Objects:** If there is a visible foreign object (like dirt or debris) on the eyelid or under the eyelid, do not attempt to remove it with your fingers or any sharp object. Instead, try to flush it out gently with clean, lukewarm water. Tilt the person's head to the side with the injured eye down and use a clean cup or a saline solution to pour water over the eye to rinse out the object continue rinsing until the object is removed.
5. **Control Bleeding:** If there is bleeding, use clean and sterile gauze or a clean cloth to apply gentle pressure to the eyelid without putting direct pressure on the eye. Do not Use adhesive bandages directly on the eyelid.
6. **Keep the Eye Closed:** Encourage the injured person to keep the injured eye closed to minimize movement and prevent further damage.
7. **Cold Compress:** Apply a cold compress or ice pack wrapped in a clean cloth to the iniured eyelid. This can help to reduce swelling and relieve pain. Apply it for 15-20 minutes at a time with breaks in between.
8. **Do Not Apply Pressure:** Do not apply any pressure or attempt to push the eyelid back into place if it appears to be out of position due to trauma. Leave this to medical professionals.
9. **Seek Medical Help:** Eyelid injuries often require professional evaluation and treatment to assess the extent of damage and prevent complications. Call for emergency medical assistance or take the person to the nearest hospital or eye clinic.
10. **Protect the Eye:** If the eyelid is partially or completely torn away (avulsion), try to keep it moist by placing it in a clean, moist cloth or sterile saline solution, and place it in a sealed plastic bag. Do not put the eyelid directly in contact with ice or water.

1.6 Chemical injuries of the eye

Chemical injuries due to either acid or alkali getting into the eye resulting in potentially devastating effects. Alkalis are typically worse than acid burns.

1.6.1 Indications

- Trauma to eye with acid or alkali

1.6.2 Equipment:

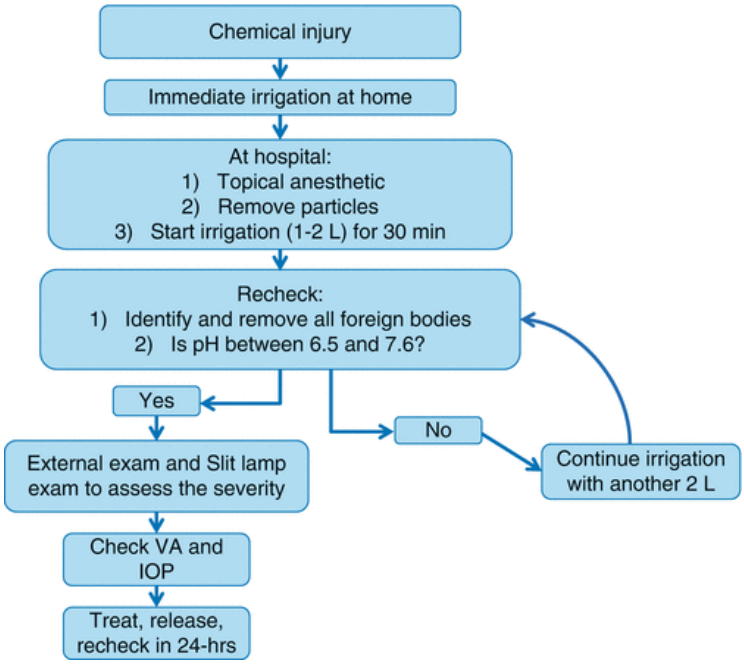
- normal saline/ringer lactate/ clean water
- cotton applicator stick
- kidney tray
- eye shield
- speculum

- topical anesthetic eye drops
- gloves
- pH paper

1.6.3 First Aid Treatment

- Take thorough history (nature of chemical, its concentration, method of injury, duration) and counsel the patient
- Wear gloves
- Cover the non-injured eye with shield
- Patient should lie down with head tilted towards the affected eye. Kidney tray placed on affected side
- Open the eye manually or with speculum
- Do copious irrigation with normal saline/ ringer lactate/ clean water to neutralize the pH by diluting the chemical for at least 30min using 1-3 liter of fluid.
- Irrigate the eye from inner to outer canthus

- During irrigation, the patient should be asked to look in all directions to ensure that the conjunctival sacs are irrigated.
- Clean the fornices with cotton tip and break any adhesions forming
- Remove contact lenses if present, presence of a contact lens can lead to persistence of the chemical burn despite irrigation.
- Remove any foreign bodies if present
- Measure pH using pH paper at least 5 min after stopping irrigation
- Inform the doctor for further management



1.6.4 Result:

Early irrigation of eye (dilution of chemical) leads to lesser complications

1.6.5 Prevention:

- Wear protective eye shields are when handling potentially corrosive substances
- Handle corrosive substances with great caution
- At home place corrosives away from reach of children

1.7 Ocular Thermal Bur / Trauma

Direct thermal burns to the ocular surface typically cause superficial injury due to brief contact time. Common causes of thermal ocular burns include hot water, hot cooking oil, curling irons, and a flame, as seen in an explosion or a fire. Tissue damage from thermal burns quickly becomes less intense once the heat energy is no longer in contact with the patient or after the source loses its thermal energy. The blink reflex usually causes the eye to close in response to a thermal stimulus. Thus, thermal burns tend to affect the eyelid rather than the conjunctiva or cornea.

1.7.1 Diagnosis:

- Thorough history about the offending agent, length of exposure
- Determine the size and location of the burn on the eyelid and surrounding areas
- Thermal burns can be classified into first degree (superficial), second degree (partial thickness), and third degree (full thickness) burns. Assess the depth of the burn to guide treatment decisions.
- Assess whether the burn involves other structures, such as the cornea or conjunctiva, as this can impact visual function

- Document all the findings

1.7.2 First aid of thermal burns:

- Thoroughly clean the wound with normal saline, remove if any foreign body present
- Singed/scorched eyelashes should be removed to avoid char falling into eye and prolonging ocular surface discomfort
- Adequate lubricating eye drops/ointments must be used to prevent dryness (minimum thrice a day). Moisture chamber goggles for lubrication can be used.

- Adequate topical antibiotics must be used to prevent infection
- Systemic analgesics to relieve pain must be given
- Dressings may be applied to protect the burn and promote healing
- Frequent evaluation of both globe and eyelids must be done
- Tetanus shot must be given
- Ophthalmologist must be informed

1.7.3 Prevention:

- Use protective shield while handling hot liquid/oil ,fire etc

1.8 Drug Allergy / Reactions

A drug allergy involves an immune response in the body that produces an allergic reaction to a medicine. Drug allergies to antibiotics including penicillin and related medications are the most common.

Signs of drug reaction include:

- Skin reaction such as hives, itching ,pale skin
- Wheezing or trouble with breathing
- Lightheadedness, fainting ,dizziness
- Facial swelling
- Nausea
- Weak and fast pulse

1.8.1 First aid of allergic reaction:

- Immediately stop the medication that caused reaction
- Give adrenaline injection (epinephrine) into outer mid-thigh. Repeat injection after 5min if no response.

- Give oxygen to help breathe
- Give intravenous antihistamine and cortisone to reduce inflammation of the air passage and improves breathing
- Help the person to lie on their back
- Turn them on their side if vomiting or bleeding
- Raise their feet about 12 inches and cover them with blanket
- Make sure their clothing is loose so they can breathe
- Avoid giving oral medications
- Observe the patient

1.8.2 Prevention

- All ways use test dose of medication before giving full dose
- Always remember the names of medication that causes allergy

1.9 Acute Congestive glaucoma

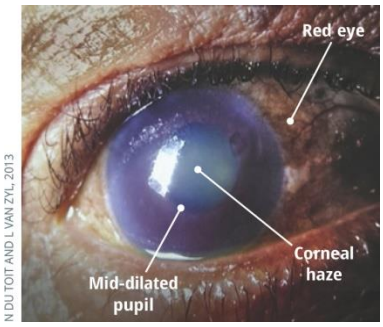
Acute angle-closure glaucoma is an ocular emergency that results from a rapid increase in intraocular pressure due to outflow obstruction of aqueous humor.

Acute angle-closure glaucoma presents as a sudden onset of severe unilateral eye pain or a headache associated with blurred vision, rainbow-colored halos around bright lights, nausea, and vomiting.

1.9.1 Diagnosis

- History

- Physical examination : fixed dilated pupil, hazy cornea, mark conjuctival injection, marked raise in IOP (60-80mmHg), reduced visual acuity
- Inform the ophthalmologist

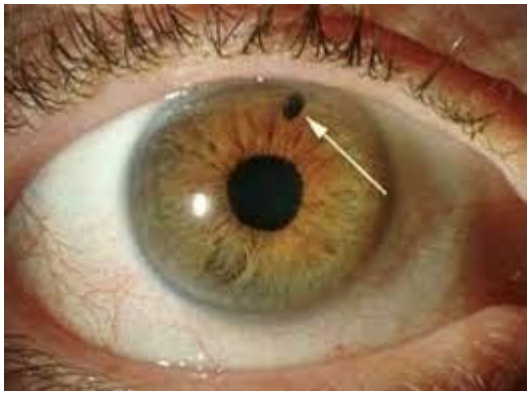


1.9.2 First Aid Treatment:

- **Relieve pupil block**: Ask the patient to lie down on her or his back. This improves the lens position (it will be more posterior) and thereby relieves pupil block.
- **Lower IOP**: Give acetazolamide 500 mg, preferably intravenously or orally, if intravenous is not available or if the patient is not nauseated. Instill topical glaucoma medications (beta blockers, alpha agonists and prostaglandin analogues).
- **Reduce pain** by giving analgesics and reduce inflammation by instilling topical steroids.
- **Reduce nausea and vomiting**. Give anti-emetics.
- After approximately 1 hour, the decrease in IOP should improve blood supply to the iris and make it more responsive to pilocarpine.
- Instill pilocarpine (2% or 4% eye drops) in two doses, spaced 15 minutes apart. If IOP remains dangerously elevated after the second dose of pilocarpine, consider giving hyperosmotic agents such as glycerol, isosorbide or mannitol.
- Laser peripheral iridotomy done by the ophthalmologist

1.9.3 Prevention:

- Regular ocular examination of high-risk patients
- Patients with history of acute angle closure glaucoma should avoid dim lightening conditions
- Avoid dilating eye drops
- Further attacks can be prevented by primary lens extraction or creating peripheral iridotomy.



1.10 Retinal Detachment

It is the separation of neurosensory retina from retinal pigment epithelium.

1.10.1 Diagnosis

Patient typically will present with symptoms such as:

- Sudden appearance of curtain like visual field defect

- Flashes of light
- Floaters
- Sometimes RAPD present
- Patient may give history of recent trauma ,diabetes, using high myopic glasses

Ophthalmic assistant can suspect retinal detachment on history and refer to ophthalmologist for further tests and management.
(relevant description is added here;)

Retinal detachment is a serious eye condition in which the retina, the light-sensitive tissue lining the back of the eye, pulls away from its normal position. The retina plays a crucial role in vision by capturing and processing light, sending signals to the brain via the optic nerve, which allows you to see.

Retinal detachment typically occurs when there is a tear or hole in the retina, and this allows the vitreous gel inside the eye to leak through the opening. As a result, the retina becomes detached from the underlying layers of the eye, which can lead to a loss of vision if not promptly treated.

1.10.2 Types:

1. Rhegmatogenous Retinal Detachment:

This is the most common type and occurs when a tear or hole develops in the retina. This can allow fluid from the vitreous gel in the eye to seep through the tear and accumulate between the retina and the underlying tissue, leading to detachment.

2. Tractional Retinal Detachment:

This type is often associated with conditions like diabetic retinopathy, where abnormal scar tissue on the retina's surface contracts and causes the retina to pull away.

3. Exudative (Serous) Retinal Detachment:

This type occurs when fluid accumulates beneath the retina, but not due to a tear or hole. Conditions such as age-related macular degeneration or inflammatory disorders can lead to this type of detachment.

Symptoms:

- The sudden appearance of floaters (small, moving specks or lines in the field of vision)
- Flashes of light
- A shadow or curtain-like effect in the peripheral vision
- Blurry vision or a sudden decrease in vision

Retinal detachment is considered a **medical emergency** because if left untreated, it can lead to **permanent vision loss**. Treatment depends on the type and severity of the detachment.

1.10.3 First aid management:

1. **Keep Calm:** Help the person stay calm and avoid any activities that could increase pressure in the eye, such as bending over, lifting heavy objects, or straining.
2. **Minimize Eye Movement:** Encourage the person to avoid moving their eyes rapidly or extensively, as this could worsen the detachment.
3. **Cover the Eye:** Cover the affected eye with a clean, sterile, and preferably non-pressurizing shield or patch. This can help protect the eye from further damage and prevent unnecessary movement.
4. **Avoid Pressure on the Eye:** Do not press on the eve or apply any direct pressure, as this can exacerbate the detachment.
5. **Positioning:** Encourage the person to lie down on their back, with their head slightly elevated. This can help reduce the strain on the retina.

6. **Pupil Constriction:** Dim light and pupil constriction can help reduce eye movement and pressure on the retina. You can achieve this by using a dim light source, Such as a penlight or flashlight, but consult with a medical professional before attempting this.
7. **Do Not Delay Medical Attention:**
8. Retinal detachment is a medical emergency that requires surgical intervention. **Do not attempt to treat it at home**; immediate medical treatment is necessary to prevent permanent vision loss.
9. **Call for Medical Help:** Dial emergency services or go to the nearest hospital as soon as possible.

b) Acute uveitis

Anterior uveitis is inflammation of the uveal tract, and includes iritis and iridocyclitis.

Acute anterior uveitis is characterized by an extremely painful red eye, often associated with photophobia, and occasionally with decreased visual acuity. The goal of treatment in uveitis is to control inflammation in order to prevent vision loss while also limiting the side effects of therapy.

1.11.1 Aim of intervention:

To reduce inflammation, to relieve pain and to prevent complications and loss of visual acuity, with minimal adverse effects.

1.11.2 Management:

- **Drugs that reduce inflammation:** Steroid eye drops 1 hourly (prednisolone acetate 1%)
- **Drugs that control spasm :**Mydriatic eye drops
- **Drugs that fight infection:** antibiotic eye drops

1.11.3 Prevention

- The prevention of uveitis depends on the cause of uveitis. The spread of many infections that cause uveitis can be prevented by putting public health measures
- Anti inflammatory immunosuppressive therapy of auto immune disease

1.11.4 First aid management:

1. **Seek Medical Attention:** Uveitis is a serious eye condition that requires prompt evaluation and treatment by an eye care specialist, such as an ophthalmologist. Contact an eye doctor or visit the nearest emergency room as soon as possible.

2. **Avoid Rubbing Your Eyes:** Refrain from touching or rubbing your eyes, as this can exacerbate the inflammation and potentially cause further damage to the eye.

3. **Use Artificial Tears:** Artificial tears or lubricating eye drops may provide temporary relief from discomfort and help keep the eye moist. These can be obtained over-the-counter at most drugstores. Ensure they are preservative-free, as preservatives can irritate the eyes.

4. **Wear Sunglasses:** If you have to go outside, wear sunglasses with UV protection to shield your eyes from sunlight, which can aggravate uveitis symptoms.
5. **Minimize Light Exposure:** Stay in a dimly lit room or wear sunglasses indoors if bright light worsens your symptoms.
6. **Avoid Eye Strain:** Limit activities that require prolonged reading, computer use, or other tasks that may strain your eyes.
7. **Follow Medical Advice:** Once you've received medical attention, follow your doctor's instructions closely. They may prescribe medication, such as anti-inflammatory eye drops, oral medications, or other treatments, depending on the severity of your uveitis.
8. **Rest:** Adequate rest can help your body heal and recover more quickly.
9. **Manage Pain:** Over-the-counter pain relievers like acetaminophen may help alleviate any associated discomfort, but it's essential to consult your doctor before taking any medication.
10. **Monitor Symptoms:** Keep a close eye on your symptoms and report any changes or worsening of the condition to your healthcare provider promptly.

KEYPOINTS:

KEYPOINTS
• ***First aid*** *is the initial and immediate assistance or care provided to a person who has been injured or suddenly taken ill before the arrival of professional medical help or until further medical treatment can be administered.*
• ***Eye emergencies*** *include cuts, scratches, object in the eye, burns, chemical exposure, and blunt injuries to the eye or eyelid.*
• ***First aid management of ocular emergencies*** *refers to the immediate and initial steps taken to provide medical assistance and alleviate the symptoms or minimize the potential harm associated with sudden eye injuries or conditions that pose a threat of vision.*
• ***Ocular foreign body removal*** *refers to the medical procedure of safely extracting a foreign object that has become stuck in the cornea of the eye.*
• ***Penetrating injury of the eyeball,*** *also known as an open-globe injury, occurs when an object enters the inner contents of the eye, this is a serious medical emergency that requires immediate attention and treatment by an ophthalmologist.*
• ***Corneal laceration*** *can be caused by various factors, such as: trauma, eye injuries, surgical complications, contact lens misuse etc.*
• ***Injuries to the eyelid*** *can cause lacerations or avulsions. In this case, do not apply any pressure or attempt to push the eyelid back into place if it appears to be out of position. Leave this to the medical professionals.*
• ***Eye thermal trauma*** *refers to damage caused to the eye due to exposure to extreme*

temperatures.

- ***Eye drug reactions*** *can occur with various types of medications, including eye drops, ointments, and other topical treatments.*
- ***Acute congestive glaucoma*** *is a severe form of glaucoma, a group of eye conditions that can lead to optic nerve damage and vision loss. It develops rapidly and is considered a medical emergency.*
- ***Retinal detachment*** *is a medical emergency that requires surgical intervention. Don't attempt to treat it at home.*
- ***Acute uveitis*** *is characterized by sudden-onset inflammation of the front part of the uvea, primarily involving the iris and the ciliary body.*

Assessment

1. Define ocular emergency.
2. Enlist first aid measures for management of embedded corneal foreign body.
3. Give first aid management of drug allergic reaction. Give first aid of patient with chemical ocular injury.

Unit 2: Microbiology

2.1 Introduction

Microbiology is the branch of science that deals with microscopic, unicellular, and cell-cluster organisms. The major microbial categories that may be associated with eye infections are bacteria, viruses, fungi, and parasites. A basic understanding of microbiology is helpful for the ophthalmic assistant, who may be required to take smears, stain the appropriate slide, and assist in taking a culture.

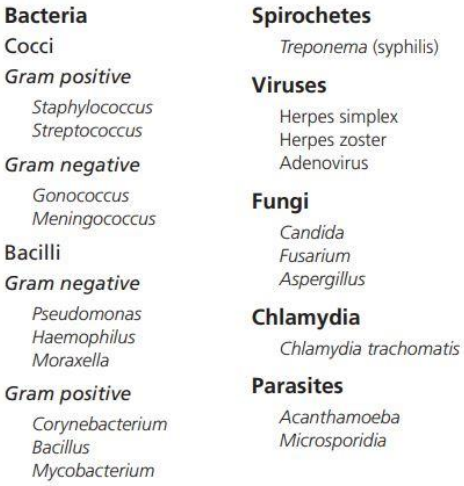
In everyday life, we are constantly in touch with microbes. We wash our hands to lower the number of microbes on our outer skin. We disinfect wounds for the same reason. We cover our sneezes and wash our fruit to prevent getting or spreading infectious diseases. We add chlorine to our water supply to inhibit the growth of pathogenic (disease causing) bacteria. We do many things to control the growth of bacteria, but most bacteria are helpful in our daily lives.

In fact, we could not live without the help of certain bacteria that exist in and on our bodies. For example, bacteria in our gut are necessary for absorption of certain vitamins.

2.2 Infectious Agents in Eye

Some bacteria actually educate our immune system and help to protect us against pathogenic microbial invaders. Certain species of bacteria are normal inhabitants of specific geographic areas of the body and their numbers are controlled by the local environment's moisture, temperature, and available nutrients. However, when such bacteria (say from the gut) get into the wrong place (like the eye) they have the potential to cause disease.

The eye is subject to the same types of infections that may occur in other parts of the body. Microorganisms are everywhere in our environment, and fortunately the eye is very resistant to infection. Our intact epithelial skin surface resists most microbial invaders. Any break in the skin of the outer eye can act as a portal of entry for microbes, at which point if a significant concentration of microbes, an inoculum, is present it may overcome our ocular defenses and cause an infection. Ocular trauma, surgery, radiation, severe surface dryness from exposure or inadequate blinking, lid abnormalities, and corneal degenerative changes may create surface disruptions that leave the eye more susceptible to infection. Persons with normal ocular surface structures may still be susceptible to diseases if their ability to defend against infectious agents is compromised. A compromised immune system can be present in patients with diabetes, acquired immunodeficiency syndrome (AIDS), and those taking immunosuppressive agents, such as oral steroids**.**



Micro-organisms that cause diseases in eye

2.3 Bacteria

Bacteria are single-celled microorganisms, larger than viruses and may easily be seen under magnification by a light microscope. Bacteria range in size from 0.2 to 5μm and viruses from 0.005 to 0.1μm.

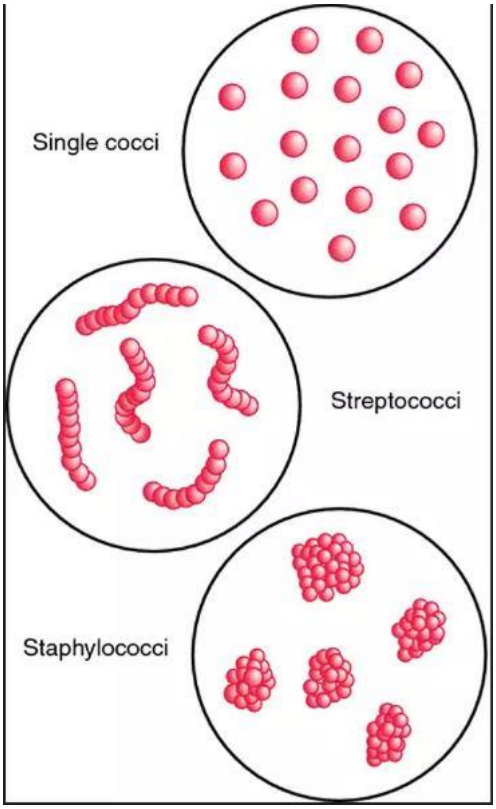
2.3.1 Classification of Bacteria

Bacteria can be categorized in different ways. They are commonly classified by morphology (shape), Gram character (dyed color), and ability to live in and use oxygen. Morphologically, there are three basic shapes: the round cocci, the rod-shaped bacilli, and the helix-shaped spirochetes. Although the shape can be used to classify the organism, another important differentiating feature is whether the organism stains blue (gram positive) or red (gram negative) with a special stain referred to as Gramstain. The organism's color after Gram staining is referred to as its Gram character. A bacterium's Gram character tells us about its cell wall makeup and therefore which antibiotics may be useful.

2.3.2 Cocci

The coccus is a round bacterium that arranges itself in a variety of patterns, each with its own characteristics. Certain strains of Staphylococcus spp., Streptococcus spp., and Neisseria spp. are sometimes referred to as pyogenic or pus-producing bacteria. Staphylococcus spp. are gram-positive organisms that may appear in grape-like clusters or, more commonly, singly or in pairs. Staphylococci frequently are present on the skin and may give rise to boils and styes.

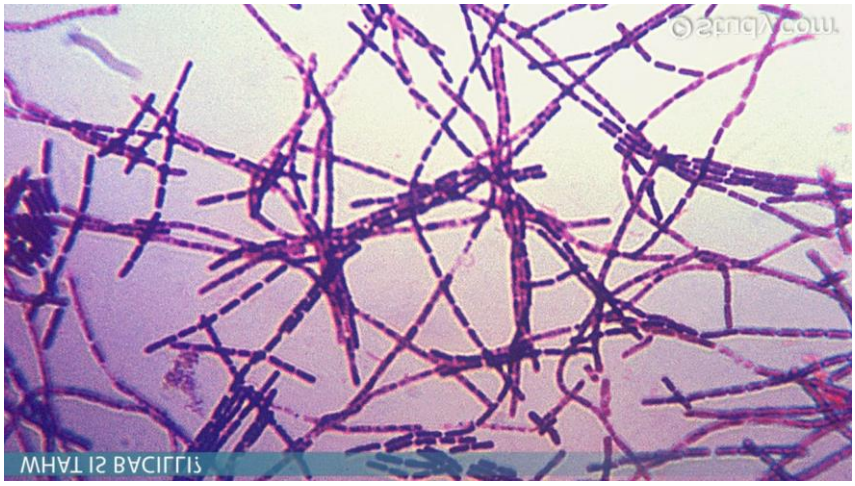
Not all staphylococci are pathogenic (disease causing); Staphylococcus epidermidis is a normal floral organism that lives on our skin and seldom causes disease. Staphylococcus aureus, however, is the species most commonly associated with skin infections. A particular type known as methicillin-resistant Staphylococcus aureus (MRSA) is a bacterium responsible for several difficult-to-treat infections in humans. It is increasingly reported as a pathogen in the skin and other tissue infections. Hospital-acquired MRSA infections are on the decline, but community-based MRSA infections are on the rise.



Streptococci are bullet-shaped gram-positive cocci that are usually arranged in pairs and short chains. Of the streptococcal organisms, the most common agent to affect the eye is Streptococcus pneumoniae (also known as Pneumococcus, Diplococcus). When causing disease, this organism possesses a polysaccharide (slime) capsule. The encapsulated form of this organism protects it from our body's defenses. Although Pneumococcus is a common cause of lobar pneumonia, it can also be the cause of conjunctivitis, a corneal ulcer, or an infection inside the eye referred to as endophthalmitis.

2.3.3 Bacilli

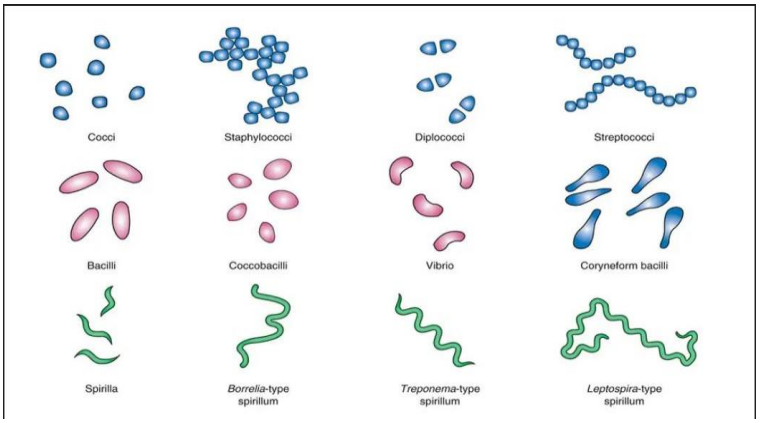
Another group of bacteria are the bacilli. All the members of this group are rod shaped, the rods being long or short, plump or slender, curved or straight, smooth or beaded. Commonly affecting the eye are the gram-negative rods, Haemophilus spp., Serratia spp., and Pseudomonas.



Historically, the organism Pseudomonas aeruginosa has been considered the most devastating gram-negative bacillus because of its very rapid and destructive potential. Pseudomonas is an opportunistic pathogen. It cannot usually penetrate our intact skin and it causes disease only when given an opportunity, such as a corneal abrasion. It is the most common cause of corneal ulcers in patients wearing contact lenses. Unless treatment is initiated early, the organism can cause significant visual loss.Gram-positive bacilli that affect the eye include Corynebacterium spp., Bacillus spp., and Mycobacterium spp. Corynebacteria are anaerobic rods that are part of our normal flora and live just beneath the outer skin layer. Bacillus spp. are soil organisms that seldom cause disease but are devastating in their destruction when involved in intraocular infections. Mycobacterial keratitis is rare but is often associated with previous ocular surgery. It is very difficult to treat and often results in poor visual outcomes.

2.3.4 Spiral:

Spiral-shaped bacteria, or spirochetes, are a unique group of bacteria characterized by their spiral or helical shape. Spirochetes are distinguished by their distinct mode of motility and the presence of axial filaments (endoflagella) that run along the length of their bodies. Treponema pallidum is a spirochete, responsible for causing syphilis, a sexually transmitted infection.



2.3.5 Characteristics of Rickettsiae:

Rickettsiae are a group of bacteria that are obligate intracellular parasites. Here are some key characteristics of Rickettsiae:

1. Small Size: Rickettsiae are small, gram-negative bacteria.

2. Transmission: Rickettsiae are primarily transmitted to humans through the bite of infected arthropod vectors. Different species of rickettsiae have specific vectors, such as ticks.

3. Pathogenicity: Rickettsiae can cause a range of diseases in humans, including typhus fever, spotted fever.

4. Outer Membrane Structure: The outer membrane of rickettsiae contains lipopolysaccharides (LPS). This outer membrane is involved in interactions with the host's immune system and plays a role in the bacteria's pathogenicity.

Transmission:

1. Arthropod Vectors: Rickettsia bacteria are primarily transmitted to humans through the bite of infected arthropod vectors, such as ticks, fleas and lice.

2. Vertical Transmission:

In some cases, Rickettsia bacteria can be transmitted from mother to fetus during pregnancy or through breastfeeding, although this mode of transmission is relatively rare.

Diseases caused by Rickettsiae:

1. Rocky Mountain Spotted Fever

Causative Agent: Rickettsia rickettsii.

Vector: Rocky Mountain wood tick

Clinical Features: High fever, headache, rash, muscle aches.

2. Typhus Group

Causative Agents: Rickettsia typhi

Vectors: Human body louse

Clinical Features: High fever, headache, rash, muscle pain.

3. Q Fever

Causative Agent: Coxiella burnetii

Transmission: Inhalation of contaminated aerosols from infected animals (such as cattle, sheep, and goats), ingestion of unpasteurized dairy products, and tick bites.

Clinical Features: Often presents as a flu-like illness with high fever, headache, muscle aches, and sometimes pneumonia.

Prevention & Control:

Here are some key approaches for prevention and control of rickettsial diseases.

1. Vector Control:

Effective control of arthropod vectors is crucial for preventing disease transmission. This can be achieved through measures like insecticide- treated bed nets, use of insect repellents, environmental management to reduce breeding sites.

2. Personal Protection:

Individuals in endemic areas should take precautions to avoid exposure to rickettsial vectors. This includes wearing protective clothing (long sleeves, pants, and closed shoes) and using insect repellents.

3. Hygiene and Sanitation:

Improving personal hygiene and sanitation can help prevent some rickettsial infections.

4. Early Diagnosis and Treatment:

Rapid diagnosis and treatment are essential for preventing complications and reducing the severity of rickettsial infections.

5. Travel Precautions:

Travelers to regions where rickettsial diseases are endemic should be informed about the risks and preventive measures.

2.3.6 Chlamydiae

Chlamydial organisms are technically classified as bacteria but deserve a classification of their own. They are intracellular parasites that are larger than viruses but smaller than most bacteria. Chlamydia is the most widespread sexually transmitted bacterial disease in the United States. In North America the most common chlamydial eye disease is adult inclusion keratoconjunctivitis, which is

usually spread from an infected sexual partner. Chlamydia may be transferred to infants while passing through the birth canal and result in an eye infection called ophthalmia neonatorum (eye disease of the newborn). Outside of North America, (in North Africa, the Middle East, and South Asia), another chlamydial disease, trachoma, remains epidemic and a serious cause of ocular morbidity. Characteristics of Chlamydiae:

1. Obligate intracellular Parasites:

Chlamydiae are obligate intracellular bacteria, which means they can only replicate inside the host cells of their host organisms.

2. Unique Life Cycle:

Chlamydiae have a unique biphasic developmental cycle that involves two distinct forms;

- **Elementary body (EB):** The infectious, extracellular form that is resistant to adverse conditions and facilitates transmission between host.
- **Reticulate body (RB):** The intracellular, replicative form that resides and multiplies within host cells.

3. Cellular Tropism:

Different species of Chlamydiae exhibit specific cellular tropism, targeting particular tissues or cell types. For example, Chlamydia trachomatis predominantly infects epithelial cells of the genital and ocular mucosa.

4. Diverse Diseases:

Chlamydiae are associated with a range of diseases in humans and animals. In humans, Chlamydia trachomatis can cause sexually transmitted infections, as well as trachoma (a leading cause of preventable blindness). Chlamydia pneumoniae is linked to respiratory infections, including pneumonia and bronchitis.

5. Transmission:

Chlamydiae are primarily transmitted from person to person through direct contact, including sexual contact. Vertical transmission from infected mothers to their newborns during childbirth can also occur.

6. Global Health Impact:

Chlamydiae infections are among the most common bacterial infections worldwide. They can lead to serious health complications if left untreated.

Transmission & Diseases caused by Chlamydiae:

Chlamydiae are transmitted through various means, depending on the species and the specific disease they cause.

Chlamydia trachomatis

Chlamydia trachomatis is a bacterium that causes a variety of diseases in humans, primarily transmitted through sexual contact. Here's more detailed information on its transmission and associated diseases:

Transmission:

1. Sexual Contact:

Chlamydia trachomatis is one of the most common sexually transmitted infections (STIS) worldwide. It can be transmitted during vaginal, anal, or oral sex when one person comes into contact with the genital, anal, or oral secretions of an infected person.

2. Vertical Transmission:

Mothers infected with Chlamydia trachomatis can transmit the bacteria to their infants during childbirth. This can lead to neonatal conjunctivitis (eye infection) or pneumonia in the newborn.

Diseases Associated with Chlamydia trachomatis:

The primary diseases associated with Chlamydia trachomatis are:

1. Genital Chlamydia:

This is the most common form of chlamydial infection. It often presents without symptoms (asymptomatic) but can cause symptoms such as genital discharge, pain, discomfort, and itching.

2. Trachoma:

Trachoma is an eye infection caused by Chlamydia trachomatis and is a leading cause of preventable blindness in developing countries.

3. Lymphogranuloma Venereum (LGV):

LGV is a rare and more invasive form of chlamydial infection that primarily affects the lymphatic system. It can cause severe genital symptoms.

Chlamydia pneumonia

Chlamydia pneumoniae is a type of bacteria that can cause respiratory tract infections in humans. Here's some information on its transmission and the diseases it can cause:

Transmission:

Chlamydia pneumoniae is primarily transmitted from person to person through respiratory droplets. When an infected person coughs or sneezes, tiny respiratory droplets containing the bacteria can be released into the air. These droplets can be inhaled y individuals in close proximity, leading to infection.

Diseases:

1. Respiratory Infections:

Bronchitis: Chlamydia pneumoniae can cause acute bronchitis, which is characterized by inflammation of the bronchial tubes. Symptoms may include a persistent cough, chest discomfort, and difficulty breathing.

Pneumonia:

Chlamydial pneumonia is another common manifestation of infection. It can lead to symptoms such as high fever, chills, productive cough, and difficulty breathing.

Pharyngitis and Sinusitis:

Chlamydia pneumoniae can also infect the upper respiratory tract, leading to symptoms similar to those of pharyngitis (sorethroat) and sinusitis.

Chlamydia psittaci

Chlamydia psittaci is a species of Chlamydia bacteria that primarily infects birds but can also be transmitted to humans. When humans become infected with Chlamydia psittaci, it can lead to a zoonotic disease called psittacosis or parrot fever. Here's information on the transmission and diseases associated with Chlamydia psittaci:

Transmission:

Avian Reservoir: Chlamydia psittaci primarily infects birds, especially parrots. It can also infect other bird species, including pigeons, ducks, and poultry.

Transmission to Humans: Humans can become infected through direct or indirect contact with infected birds or their secretions. People who work closely with birds, such as pet shop workers, bird owners are at higher risk of contracting psittacosis.

Diseases:

Psittacosis (Parrot Fever): Psittacosis is the disease caused by Chlamydia psittaci in humans. The severity of the illness can range from mild to severe, and symptoms typically develop within 5-14 days after exposure. Common symptoms of psittacosis include:

- Fever
- Headache
- Chills Cough
- Shortness of breath
- Muscle aches
- Fatigue
- Chest pain
- Nausea and vomiting

In severe cases, psittacosis can lead to pneumonia, respiratory distress, and other complications. Without appropriate treatment with antibiotics, it can be a serious and potentially life-threatening illness.

Treatment:

Chlamydia is a bacterial infection that can be effectively treated with antibiotics. Here is an overview of Chlamydia treatment:

1. Prescription Medications:

The most commonly prescribed antibiotics for chlamydia are Azithromycin and Doxycycline.

2. Treatment Guidelines:

It's essential to follow your healthcare provider's instructions and complete the full course of antibiotics. Avoid sexual activity during the treatment period.

3. Re-testing:

It's typically recommended to get re-tested for Chlamydia about three months after completing treatment.

Prevention:

1. Abstinence: The most effective way to prevent chlamydia and other sexually transmitted infections (STI) is to abstain from sexual activity, including vaginal, anal, and oral sex.

2. Consistent and Correct Condom Use: Proper and consistent condom use can significantly reduce the risk of chlamydia transmission during sexual intercourse.

3. Regular STI Testing: Individuals who are sexually active should undergo regular STI testing, including chlamydia screening.

4. Preventing Mother-to-Child Transmission: Pregnant women should be screened for chlamydia and other STI early in pregnancy. If an infection is detected, treatment can help prevent transmission to the baby during childbirth.

5. Hygiene: Good hygiene practices, such as washing the genital area with soap and water daily, can help reduce the risk of infection.

6. Avoid Sharing Personal Items: Avoid sharing personal items that may come into contact with infected genital secretions, such as towels.

Control:

1. Education and Awareness:

• Promote public awareness about Chlamydia, its transmission, and consequences.

• •Educate healthcare providers and the public about the importance of regular screenings, especially for sexually active individuals.

2. Screening and Testing:

•Develop and implement routine screening programs, especially for sexually active individuals, young adults, and individuals at higher risk.

The positive identification of bacterial organisms by microscopic shape and staining reaction alone is not usually possible, and culture characteristics are often necessary. The ophthalmologist, however, may frequently make a presumptive diagnosis in association with the clinical picture, but the microscopic picture always remains an important aid.

Characteristics of Spirochetes:

Spirochetes are Gram negative bacteria, characterized by their distinctive spiral shape and they are rarely associated with ocular diseases.

1. Shape:

Spirochetes have a long, slender, and helical shape, often resembling a corkscrew.

3. Gram-Negative:

Spirochetes are typically Gram-negative bacteria. However, their cell walls are different from those other Gram-negative bacteria, as they lack peptidoglycan but have unique outer membrane composition.

4. Outer Membrane:

The outer membrane of spirochetes is rich in lipoproteins, which play essential roles in host interactions and pathogenesis.

5. Anaerobic:

Many spirochetes are anaerobic bacteria, which means they can survive and thrive in environments with little or no oxygen.

6. Flagella and motility:

Spirochetes possess flagella that are located in the periplasmic space, between the inner and outer membranes. These flagella are responsible for their distinctive motility and allow them to move in a corkscrew fashion.

7. Pathogenicity:

Some spirochetes are pathogenic to humans and animals. For example, Treponema pallidum causes syphilis and Borrelia species are responsible for Lyme disease.

8. Environmental Importance:

Spirochetes play essential roles in various ecosystems. They can be found in aquatic environments, soil, and in the guts of termites, where they aid in cellulose digestion.

Diseases caused by Spirochetes and their transmission:

1. Syphilis (Treponema pallidum): Syphilis is a sexually transmitted infection caused by the bacterium Treponema pallidum. This disease can be transmitted through direct contact with infected bodily fluids or tissues during sexual activity.

2. Lyme Disease (Borrelia burgdorferi): Lyme disease is transmitted to humans through the bite of infected black-legged ticks. It can cause a range of symptoms, including fever, fatigue, joint pain, and a characteristic rash.

3. Leptospirosis (Leptospira spp.):

Leptospirosis is transmitted through contact with water, soil, or food contaminated with urine from infected animals.

4. Pinta (Treponema carateum):

Pinta is a skin disease caused by a different species of Treponema bacteria. It leads to skin discoloration. Pinta is mainly transmitted through direct physical contact with an infected individual. These lesions are typically painless, flat, and hypopigmented or hyperpigmented patches on the skin.

Prevention and Control:

Here are some general strategies for the prevention and control of spirochete infections:

1. Vaccination:

In some cases, vaccines are available to prevent spirochetal infections. For example, there is a vaccine for Lyme disease.

2. Avoidance of High-Risk Areas:

If you're in an area known for spirochete infections, take precautions to avoid exposure. This might include wearing protective clothing and using insect repellent.

3. Safe Sex:

To prevent sexually transmitted spirochetal infections like syphilis, practice safe sex.

4. Prompt Diagnosis and Treatment:

If you suspect you have a spirochetal infection, seek medical attention promptly. Early diagnosis and treatment can prevent the infection from progressing to a more severe stage.

5. Preventive Measures for Congenital Transmission:

In some cases, spirochetal infections can be transmitted from mother to baby during pregnancy or childbirth. Prenatal care and appropriate treatment can reduce this risk.

2.4 Viruses

Viruses are very different from bacteria. They are made of the genetic material ribonucleic acid (RNA) or deoxyribonucleic acid (DNA), never both, plus a bit of protein. They are obligate intracellular parasites that cannot live on their own. Viruses are very small organisms (5–300nm) that are not visible through a light microscope. Viruses multiply by injecting their genetic material into suitable host cells.

Once inside, they commandeer the reproductive machinery of the host cell and reprogram it to make more viruses. Our bodies acquire immunity to most viruses during the course of a viral infection so we can fight off a repeat infection by the same strain of virus in the future. However, our bodies are not capable to acquire immunity against all viruses, notably herpes simplex and human immunodeficiency virus (HIV).

2.4.1 Composition and Structure of virus:

Viruses are microscopic infectious agents that consist of genetic material (either DNA or RNA) enclosed in a protein coat called capsid. The composition of a virus can be broken down into several components:

Genetic Material:

The core of a virus is its genetic material, which can be either DNA or RNA. This genetic material carries the instructions necessary for the virus to replicate and produce new virus particles within a host cell. The genetic material can be single-stranded or double-stranded.

Capsid:

The capsid is a protein shell that surrounds and protects the viral genetic material. It is made up of repeating protein subunits called capsomers. The capsid gives the virus its shape and provides structural integrity. The arrangement of capsomers determines the overall shape of the virus, which can be icosahedral (20- sided), helical, or complex.

Envelope:

Some viruses have an outer lipid envelope derived from the host cell membrane. It contains viral glycoproteins that are important for attaching to host cells and facilitating entry.

Glycoproteins:

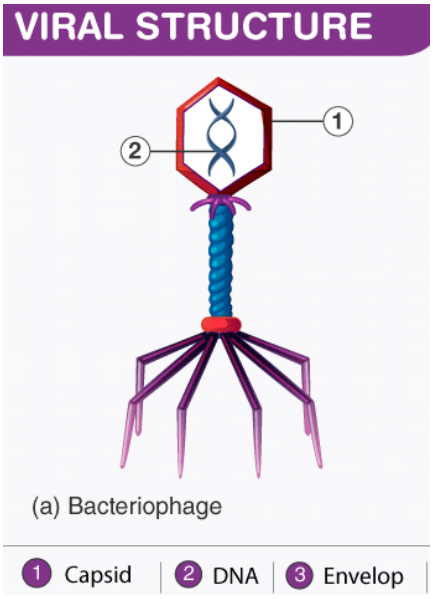
These are protein molecules with attached carbohydrate chains. Viral glycoproteins are often found on the surface of the virus and are involved in recognizing and binding to specific receptors on the host cell surface.

Enzymes and Proteins:

Some viruses carry enzymes within their capsid that are necessary for various stages of the viral life cycle, such as viral replication and integration into the host cell genome.

Matrix Proteins:

Enveloped viruses often have matrix proteins located between the envelope and the capsid. These proteins help to stabilize the viral structure.



2.4.2 Lifecycle of Virus:

Here's how a typical virus lifecycle works:

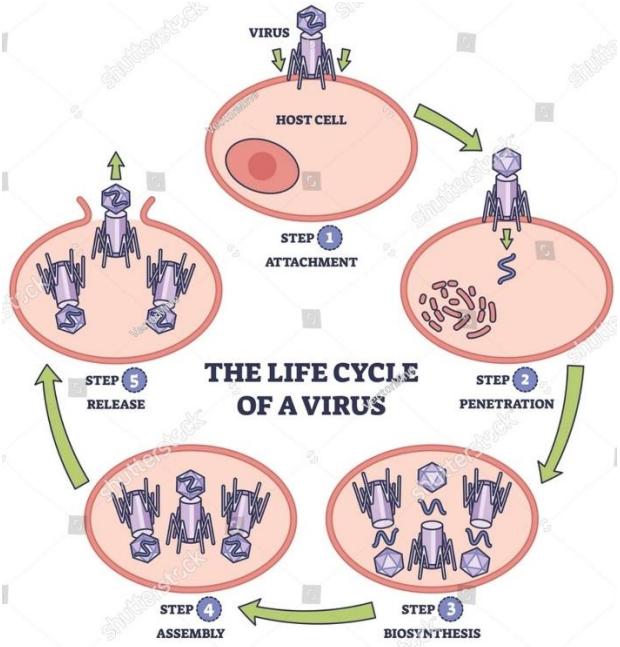
Attachment:
The virus attaches to specific receptors on the surface of a host cell. These receptors are usually proteins that the virus recognizes and binds to.

Entry:
The virus either injects its genetic material into the host cell or is taken up by the cell through endocytosis. Once inside, the virus's genetic material is released into the cell's cytoplasm.

Replication and Transcription:
The host cell's machinery is then hijacked to replicate the virus's genetic material and produce viral components. This often involves using the host's enzymes and ribosomes to transcribe viral genes into RNA and translate them into proteins.

Assembly:
New viral components are assembled into complete virus particles (virions) in the host cell's cytoplasm.

Release:
The host cell is often destroyed as the new virions are released. This can happen through cell lysis (breaking open) or through a more gradual process called budding, where the virus acquires a part of the host cell's membrane as it exits, allowing it to infect other cells more efficiently.



2.4.3 Classification of Virus:

Viruses can be classified in various ways based on different **characteristics**, such as their genetic material, structure, replication strategies, host range, and the diseases they cause. One of the most common classification systems is the Baltimore classification system. Here is an overview of virus classification:

Baltimore Classification:

This system categorizes viruses into seven groups (Classes I to VII) based on their genetic material and replication strategy:

Class 1: Double-stranded DNA viruses (dsDNA): These viruses have a double- stranded DNA genome that serves as a template for both transcription and replication. Examples include Herpes virus, Adenovirus.
Class II: Single-stranded DNA viruses (ssDNA): These viruses have a single-stranded DNA genome that needs to be converted into a double-stranded form for replication e.g., Parvoviruses.
Class III: Double-stranded RNA viruses (dsRNA): These viruses have a double- stranded RNA genome. They often carry their own RNA-dependent RNA polymerase for replication. Examples include Rotaviruses.
Class IV: Positive-sense single-stranded RNA viruses (+ssRNA): These viruses have a single-stranded RNA genome that can directly act as mRNA for translation. Examples include Picornaviruses and Coronaviruses.
Class V: Negative-sense single-stranded RNA viruses (-ssRNA): These viruses have a single-stranded RNA genome that needs to be converted into a positive-sense RNA intermediate before translation. Examples include Influenza viruses and Rabies virus.
Class VI: Retroviruses: These viruses have a positive-sense RNA genome, but they use reverse transcriptase to convert their RNA genome into DNA, which is integrated into the host cell's genome. Human Immunodeficiency Virus (HIV) is a well-known retrovirus.
Class VII: Reverse-transcribing DNA viruses: These viruses replicate through reverse transcription. Hepatitis B virus (HBV) is an example of this class.

2.4.4 Modes of Virus Transmission:

Here are some common modes of virus transmission:

Respiratory Droplets: Many viruses, including the flu virus and the SARS-COV-2 virus responsible for COVID-19, are primarily spread through respiratory droplets produced when an infected person coughs, sneezes, talks, or breathes. These droplets can contain viral particles that can infect people nearby who inhale them.
Direct Contact: Direct physical contact with an infected person or their bodily fluids can also lead to virus transmission e.g., shaking hands.
Fecal-Oral Route: Some viruses, like hepatitis A, can be spread through contaminated food, water, or surfaces. This typically occurs when people ingest virus- contaminated particles, often due to poor hygiene practices.
Vector-Borne Transmission: Certain viruses are transmitted by vectors, which are living organisms that can carry and transmit the virus from one host to another. For example, mosquitoes can transmit viruses like dengue.
Airborne Transmission: Some viruses can remain suspended in the air for longer periods and be transmitted by inhalation of tiny airborne particles e., Measles.

Vertical Transmission: Viruses can sometimes be transmitted from a pregnant woman to her fetus during pregnancy or childbirth. Examples include HIV.

Common Diseases caused by virus:
Here are some common diseases caused by viruses:

Flu:

Influenza, commonly known as the flu, is a contagious respiratory illness caused by influenza viruses. There are four main types of influenza viruses: A, B, C, and D. Influenza A and B viruses are responsible for seasonal flu epidemics in humans.
Transmission: The flu virus primarily spreads through respiratory droplets when an infected person cough sneezes, or talks. It can also spread by touching surfaces or objects contaminated with the virus and then touching the face (mouth, nose, or eyes).
Symptoms: Common symptoms include fever, cough, sore throat, runny or stuffy nose, muscle or body aches, headache, fatigue, and sometimes vomiting and diarrhea, especially in children.
Prevention: The most effective way to prevent the flu is by getting an annual flu vaccine.

Common Cold:

The common cold is a viral infection that primarily affects the upper respiratory tract, including the nose and throat. It is one of the most common illnesses experienced by humans and is caused by a variety of different viruses, most commonly rhinoviruses.

Symptoms

- Runny or stuffy nose
- Sneezing
- Sore throat
- Coughing
- Mild headache
- Fatigue
- Watery eyes
- Mild body aches

Incubation Period: The incubation period for the common cold is usually one to three days, meaning symptoms start appearing within this timeframe after exposure to the virus.
Duration: Cold symptoms typically last around 7 to 10 days, although some symptoms like a lingering cough can persist for a bit longer.
Prevention: Practicing good hygiene, such as frequent hand washing, can help prevent the spread of the virus.

COVID-19:

COVID-19 is a highly contagious respiratory illness caused by a novel coronavirus named SARS-CoV-2. The virus was first identified in the city of Wuhan (China) 2019, and it rapidly spread to become a pandemic.

Origin and Spread: The initial cases of COVID-19 were linked to a seafood market in Wuhan, where live animals were also sold. However, the virus soon began spreading from person to person, leading to a global outbreak. It is thought that the virus originated in bats and might have been transmitted to humans through an intermediate animal host. The virus can also cause conjunctivitis in addition to affecting many organs.

Symptoms: Common symptoms include fever, cough, shortness of breath, fatigue, muscle or body aches, loss of taste or smell, sore throat, and more.

Transmission: The virus primarily spreads through respiratory droplets when an infected person coughs, sneezes, talks, or breathes. It can also spread by touching surfaces or objects contaminated with the virus.

Preventive Measures: To reduce the spread of the virus, health authorities recommended various preventive measures, including wearing face masks, practicing physical distancing, frequent handwashing, and avoiding large gatherings.

Vaccines: Multiple vaccines were developed to combat the pandemic such as Pfizer, Moderna, Johnson and others. These vaccines proved to be effective in reducing the severity of the disease and preventing deaths.

HIV/ AIDS:

Human immunodeficiency virus (HIV) is a virus that attacks the immune system specifically CD4 Cells. If left untreated, HIV can lead to the disease known as AIDS.

Transmission: HIV is primarily spread through contact with certain body fluids, such as blood, semen, vaginal fluids, from a person who has HIV.

Symptoms: HIV symptoms can vary widely and may include fever, fatigue, swollen lymph nodes, sore throat, rash, muscle and joint pain, and ulcers in the mouth or on the genitals. However, many people with HIV may not experience any symptoms for years.

Treatment: Antiretroviral therapy (ART) is the standard treatment for HIV/AIDS.

Prevention:

- **Safe sex:** Using condoms and other barrier methods during sexual intercourse can reduce the risk of HIV transmission.
- **Pre-exposure Prophylaxis (PrEP**): This involves taking a daily medication by people at high risk of HIV to prevent infection.
- **Post-exposure Prophylaxis (PEP):** PEP involves taking antiretroviral medication within 72 hours of potential exposure to HIV to reduce the risk of infection.

Hepatitis B & C:

Hepatitis B and Hepatitis C are two distinct viral infections that primarily affect the liver. They are both part of a group of viruses known as the hepatitis viruses, which cause inflammation of the liver and can lead to serious health complications if not properly managed.

Herpes simplex virus:

The herpes simplex virus lives dormant in the nerve ganglia and when activated travels along the nerve root to invade the corneal epithelium and may give rise to a corneal ulcer. Epidemic keratoconjunctivitis (EKC):

A common disease known as epidemic keratoconjunctivitis (EKC) is caused by an adenovirus. Adenoviruses are highly contagious and may affect the upper respiratory tract, the conjunctiva, and the cornea, causing fever, lymph gland enlargement, conjunctivitis, and keratitis.

2.5 Fungi

Fungal ocular infections are much less common than bacterial and viral infections. Molds and mildew are fungi. Athlete's foot and ringworm are two common skin diseases caused by fungi. Fungi are larger than bacteria and grow either as a mass of branching interlacing filaments or as rounded yeast forms. They are typically found in soil and moist environments.

Ocular fungal infections are more likely to occur in the outer eye, cornea, and occasionally in the lacrimal sac. Ocular mycoses (fungal infections) are typically associated with trauma involving plant matter. A typical history is one in which a patient's cornea is scratched by a twig or leaf, and several days later the eye becomes red and inflamed.

The most common fungal infection of the eye is caused by Candida albicans, which is common yeast that also grows on moist skin and on mucous membranes as normal flora, but may overgrow and cause disease. Other fungi that may cause eye infections are the branching fungi Aspergillus spp. and Fusarium spp., both being more common in warm and moist climates. The largest outbreak of fungal keratitis ever recorded occurred in 2006; it was caused by a Fusarium sp. and was associated with a newly introduced contact lens (multipurpose lens care product).

2.5.1 Characteristics of Fungi:

Fungi are a diverse group of organisms that play crucial roles in various ecosystems. Here are some key characteristics of fungi:

1. Eukaryotic Cells:

Fungi are composed of eukaryotic cells, meaning they have a true nucleus with a nuclear membrane and membrane-bound organelles.

2. Cell Wall Composition:

Fungi have cell walls primarily composed of chitin, a tough and rigid polysaccharide.

3. Heterotrophic Nutrition:

Fungi are heterotrophic, meaning they cannot produce their own food through photosynthesis. Instead, they obtain nutrients by absorbing organic material from their surroundings.

4. Absorptive Feeding:

Fungi use a unique method of feeding called absorptive nutrition. They release digestive enzymes into their environment to break down complex organic molecules outside their cells. Once the molecules are broken down, the fungi absorb the resulting nutrients directly into their cells.

5. Reproduction:

Fungi can reproduce both sexually and asexually.

6. Economic and Medical Importance:

Fungi have significant economic and medical importance. They are used in various industries, including food production (e.g., brewing, baking, and cheese- making), pharmaceuticals (e.g., antibiotics), and bioremediation. Fungal diseases can affect crops, spoil stored food, and cause infections humans and animals.

7. Diversity:

Fungi are incredibly diverse, with over 100,000 known species and potentially millions more yet to be discovered. They include a wide range of forms, from microscopic yeasts to large mushrooms and molds.

2.5.2 Reproduction of Fungi:

Fungi reproduce through both sexual and asexual means. Here's an overview of fungal reproduction:

1. Asexual Reproduction:

Spore Formation:

Asexual reproduction in fungi often involves the formation and release of spores. Spores are typically single-celled structures that can grow into new fungal individuals under favorable conditions.

Conidia:

Some fungi produce specialized asexual spores called conidia. These are produced on the tips of specialized hyphae (conidiophores).

Budding:

Yeasts, a type of fungi, reproduce asexually through a process called budding. A small bud or daughter cell forms on the parent yeast cell and eventually separates to become a new individual.

Fragmentation:

In some fungi, the mycelium can break into smaller fragments, each of which can grow into a new individual. This is common in certain molds.

2. Sexual Reproduction:

Fusion of Gametes:

Sexual reproduction in fungi involves the fusion of specialized reproductive cells, such as gametes or spores, from different fungal individuals.

Mating Types:

Many fungi have mating types or compatibility factors that determine whether two fungal individuals can successfully mate. Compatible mating types can fuse and form a sexual structure.

Dikaryotic Stage:

After the fusion of compatible cells, a dikaryotic (two-nuclei) stage often occurs. In this stage, two distinct nuclei coexist within the same cell.

Formation of Sexual Structures:

Fungi can produce various sexual structures, such as mushrooms in some Basidiomycota, or cup-shaped structures in some Ascomycota. These structures bear specialized cells that undergo sexual reproduction.

Meiosis:

Eventually, the nuclei in the sexual structures undergo meiosis, a process that reduces the chromosome number. This results in the formation of spores that are genetically different from the parent fungi.

Spore Dispersal:

These sexual spores are released into the environment and can germinate to form new fungal individuals when conditions are suitable.

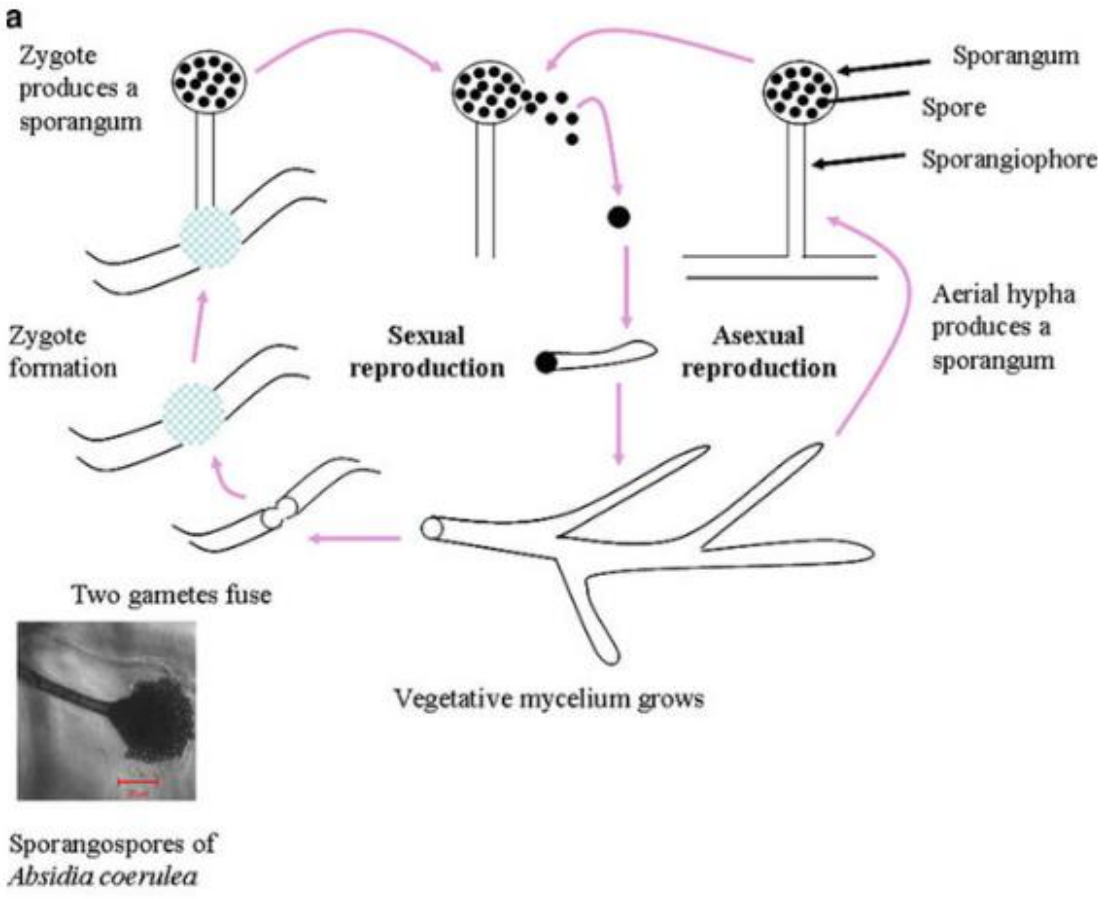


Figure: Life cycle of fungi, asexual and sexual reproduction of fungi.

2.5.3 Fungal Diseases in Operation Theatres:

Fungal diseases in operation theatres, also known as surgical site fungal infections, can pose a significant risk to patients undergoing surgical procedures. Here are a few examples of fungal diseases in operation theatre;

1. Respiratory Diseases

Fungi like Aspergillus and Histoplasma can lead to respiratory diseases such as aspergillosis and histoplasmosis.

2. Skin Infections

Fungal infections like dermatophytosis (ringworm) and candidiasis can affect the skin.

3. Allergies and Sensitization

Exposure to certain fungi can trigger allergic reactions like allergic bronchopulmonary aspergillosis (ABPA).

4. Immunocompromised Individuals

People with compromised immune systems are more susceptible to severe fungal infections.

5. Nail and Hair Infections

Fungal infections can also affect nails and hair, causing conditions like onychomycosis (nail fungus) and tinea capitis (scalp ringworm).

Prevention and Control:

Fungi can cause a wide range of diseases in humans, animals, and plants. Here are some strategies for controlling and preventing fungal diseases:

1. **Personal Hygiene**
   •Maintain good personal hygiene by washing hands regularly, especially after handling soil or animals, and before eating.
2. **Environmental Hygiene**
   - Fungi thrive in damp environments. Regularly clean and disinfect surfaces that may harbor fungal spores.
3. **Proper Footwear and Clothing**
   - Use appropriate footwear in public areas like swimming pools to prevent fungal infections.
   - Wear breathable clothing to reduce the risk of fungal infections caused by trapped moisture.
4. **Antifungal Medications**
   - Seek medical attention if fungal infections are suspected. Antifungal medications, both topical and oral, can effectively treat many fungal infections.
5. **Agricultural Practices**
   - Fungicides and biocontrol agents can be used to protect crops from fungal infections.
6. **Infection Control in Healthcare Settings**
   - Healthcare facilities should follow strict infection control measures to prevent healthcare-associated fungal infections.
   - This includes proper cleaning and disinfection, isolation of infected patients, and appropriate use of antifungal medications.

2.6 Protozoa

Protozoa are small single-celled parasites that eat organic matter including bacteria and infrequently may cause ocular infections. Acanthamoeba and Microsporidia are two protozoa capable of affecting the eye. Acanthamoeba can cause significant ocular morbidity. The organism is ubiquitous; it can be found in freshwater, soil, swimming pools, and hot tubs. It is capable of causing keratitis, which can progress despite the best available medication. Unhygienic contact lens use is the major risk factor for acquiring this infection; it feeds on bacteria in the contact lens case. This risk is increased when wearers use homemade saline, rinse lenses with tap water, or swim while wearing contact lenses.

Corneal transplantation may be required to restore vision but unfortunately there is approximately a 30% recurrence rate of the parasite in the graft. Microsporidia are small simple single-celled parasites that may infect compromised hosts. They are most commonly found in HIV-positive individuals and occasionally in other compromised hosts, such as those on prolonged steroid use. They are too small to be seen by simple light microscopy but may be detected by immunoassay or electron microscopy.

2.6.1 Characteristics of Protozoa:

Protozoa are a diverse group of single-celled, eukaryotic microorganisms that exhibit a wide range of characteristics. Here are some key characteristics of protozoa:

- **Cellular Organization:**
  Protozoa are unicellular organisms, meaning they consist of a single cell that performs all essential functions of life.
- **Eukaryotic Cells:**
  Protozoa are composed of eukaryotic cells, meaning they have a true nucleus and membrane-bound organelles.
- **Motility:**
  Many protozoa are motile, possessing various mechanisms for movement. They can use structures like cilia, flagella, or pseudopodia to move in their environment.
- **Nutrition:**
  Protozoa display diverse nutritional strategies. They can be autotrophic, heterotrophic, or mixotrophic.
- **Reproduction**:
  Protozoa reproduce both sexually and asexually. Asexual reproduction often involves binary fission. Sexual reproduction can involve conjugation or syngamy.
- **Habitats:**
  Protozoa inhabit a wide range of environments, including freshwater, marine ecosystems, soil. Some are free- living, while others are parasitic.

Protozoa's Biological Impact:

Protozoa play various roles in biology, ecology, and human health. These microorganisms can have both positive and negative impacts on their environment and on human health. Here are a few examples of how protozoa can cause biological effects:

1. **Disease Transmission:** Some protozoa are known to cause diseases in humans and animals. For instance, the protozoan Plasmodium is responsible for causing malaria, a deadly disease transmitted through the bite of infected mosquitoes. Another example

is the protozoan Trypanosoma, which causes diseases like sleeping sickness in humans.

2. **Waterborne Illness:** Certain protozoa are responsible for causing waterborne illnesses. For example, Giardia lamblia, a protozoan parasite that can contaminate water sources and cause gastrointestinal illnesses when ingested.
3. **Nutrient Cycling**: Some protozoa play a crucial role in nutrient cycling in ecosystems. They help decompose organic matter, releasing essential nutrients like nitrogen and phosphorus back into the environment.
4. **Biological Control:** In agriculture, some protozoa can be used as biological control agents. For example, protozoa that prey on harmful bacteria or other microorganisms can be introduced to crops to help manage pest populations in a more environmentally friendly manner.

2.6.2 Diseases caused by protozoa:

Malaria (Plasmodium species):

Malaria is a mosquito-borne disease caused by the Plasmodium protozoa. These parasites are transmitted to humans through the bite of infected female Anopheles mosquitoes. Symptoms of malaria include fever, chills, headache, and fatigue.

African Sleeping Sickness (Trypanosoma brucei):

This disease is caused by the protozoan parasite Trypanosoma brucei and is transmitted to humans through the bite of infected tsetse flies. Symptoms include sleep disturbances and confusion.

Chagas Disease (Trypanosoma cruzi):

Chagas disease is caused by the protozoan parasite Trypanosoma cruzi. It is primarily transmitted to humans through the feces of infected triatomine bugs. The disease can lead to heart and digestive system complications.

Leishmaniasis (Leishmania species):

Leishmaniasis is a disease caused by different species of the Leishmania protozoa. It is transmitted to humans through the bites of infected sandflies.

Toxoplasmosis (Toxoplasma gondii):

Toxoplasmosis is caused by the protozoan parasite Toxoplasma gondii. It can be contracted through consumption of undercooked or contaminated meat, as well as contact with infected cat feces.

2.6.3 Prevention and Control:

Here are some key measures for the prevention and control of diseases caused by protozoa:

Vector Control:

In diseases like malaria, where mosquitoes are the vectors, use of insecticide-treated bed nets and indoor residual spraying can significantly reduce disease transmission.

Personal Protection:

Using insect repellents, wearing protective clothing, and using bed nets treated with insecticides are effective ways to prevent mosquito bites and reduce the risk of protozoan infections.

Improved Sanitation:

Proper disposal of human waste and sewage can help prevent the spread of diseases like giardiasis.

Hygiene Practices:

Educating communities about proper hand hygiene, food preparation, and water purification methods can reduce the risk of protozoan infections.

Travel Precautions:

For travelers visiting regions with a high prevalence of protozoan diseases, taking preventive measures such as taking prescribed medications (e.g. antimalarials) and following local health guidelines is important.

2.7 Sterilization and Disinfection

2.7.1 Sterilization:

Sterilization is a process used to eliminate or destroy all forms of microbial life, including bacteria, viruses, fungi, and spores, from a surface, instrument, or substance. It is a crucial process in various fields, such as healthcare, pharmaceuticals, food industry, and research laboratories, to ensure the safety and sterility of equipment, instruments, and substances.

Methods of Sterilization:

There are several methods of sterilization, each with its own advantages and limitations: Some common methods include:

1. **Heat Sterilization:**
    - The application of heat is the most widely used method and includes techniques such as autoclaving, dry heat, and boiling.
    - Autoclaving is the most common method of sterilization and uses steam under pressure to achieve sterilization. The typical conditions for autoclaving are 121°C (250°F) at 15 psi for 15-20 minutes.
2. **Chemical Sterilization:**
    - Chemical agents like ethylene oxide and hydrogen peroxide gas plasma can be used to sterilize heat-sensitive items.
3. **Radiation Sterilization**:
    - Ionizing radiation (e.g., gamma rays) can penetrate materials to kill microorganisms.
4. **Filtration**:
    - Microbiological filters with pore sizes small enough to retain microorganisms are used for liquids and gases.

Sterilization in Healthcare:

- Sterilization is vital in healthcare settings to prevent infections during surgeries and procedures.
- Medical instruments like scalpels, forceps, and syringes are autoclaved before use.
- Patient care items like bandages and dressings may also be sterilized.

2.7.2 Disinfection:

Disinfection is a process used to reduce or eliminate harmful microorganisms on surfaces, instruments, or in the environment. While not as rigorous as sterilization, which aims to

destroy all forms of microbial life, disinfection aims to significantly lower the microbial load to a level where the risk of infection or transmission is minimized.

Levels of Disinfection:

1. **High Level Disinfection:** Kills all microorganisms except for high numbers of bacterial spores. Commonly used for medical equipment and devices that come into contact with mucous membranes or non-intact skin.

2. **Intermediate Level Disinfection:** Kills most bacteria, viruses, fungi, and some bacterial spores. Used for surfaces that may come into contact with intact skin but not mucous membranes.

3. **Low Level Disinfection:** Kills most bacteria and some viruses but may not be effective against bacterial spores. This method is commonly used for general surface disinfection.

Ophthalmic surgery demands maximum asepsis, particularly in operations involving the globe itself. Microorganisms that gain access to the interior of the eye can multiply and cause irreparable damage, often resulting in blindness. Aseptic technique demands:

• Proper sterilization of all instruments
• Antisepsis of the skin adjacent to the operative site
• Degerming of the hands of both the operator and the assistant
• Use of sterile solutions and ointments during and after the operation

Disinfection of Eyelid skin

Disinfection of eyelid skin may be done by cotton applicators soaked in such solutions as tincture of iodine 2%, povidone-iodine.

2.7.3 Sterility of ophthalmic solutions

The sterility of eye solutions is desirable not only because of the obvious danger of ocular infection, but also because contaminated solutions may prove toxic and irritating to the eye. The sterilization of ophthalmic solutions may be performed effectively by pouring through bacterial filters.

One solution notorious for harboring microorganisms, particularly Pseudomonas aeruginosa, is fluorescein. However, fluorescein is available in dried sterile strips that are safe to use. All solutions that enter the eye should be of the nonpreserved type (e.g., lidocaine 1% [Xylocaine], vancomycin). All solutions that are applied to an open wound should be made up fresh through micropore filters (e.g., mitomycin).

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2.8 Immunity and Immunology:

Immunology is a branch of biology involved with the study of the immune system, components of the immune system, its biological processes, types, its disorders and a lot more.

The immune system acts as a body's defense system by protecting our body cells, tissues and organs from invading infections through various lines of defense. Overall, the immune system functions by recognizing and destroying foreign antigens including harmful microorganisms and other disease-causing microbes. Under certain conditions, when our immune system is weak or stops functioning, this results in various infectious diseases, such as fever and fluand may also lead to dreadful diseases like cancer AIDS, etc.

Immune System

Immune system consists of different types of cells and organs which protect our body against pathogens. Antigens are molecules that elicit antibody generation. They can be everything that does not belong to our body, from parasites to fungi, bacteria, viruses, and haptens. All the cells and molecules of the immune system are distributed in all the tissues of the body as well as lymphoid organs which eliminate microbial infectious diseases, .

2.8.1 Types of Immune System

We, humans, have two types of Immune system and are classified based on whether they are present at the time of birth or not.

- Innate Immune System.
- Adaptive Immune System.

Innate Immune System

Innate immunity, also known as natural or nonspecific immunity, is the first line of defense that the human body employs against invading pathogens. It is a rapid and generalized immune response that provides immediate protection. Innate Immune System is present from the time of our birth.

Main elements of the innate immune system are –

- Dendritic cells.
- Phagocytic leukocytes.
- Natural killer (NK) cell.
- Physical barriers.
- Circulating plasma proteins.

Adaptive Immune System / Acquired immune system

The adaptive immune system is required to fight against pathogens that cannot be controlled by innate immune defenses. It is also referred to as the acquired immune system because it is acquired during the course of life. They are specific to the type of pathogen invading the body.

Two Types of adaptive responses are –

1. humoral immunity:moderated by antibodies which are developed by B lymphocytes
2. cell-mediated immunity:moderated by T Lymphocytes.

Active immunity and passive immunity are two types of acquired immunity. A prominent difference between active and passive immunity is that active immunity is developed due to the production of antibodies in one's own body, while passive immunity is developed by antibodies that are produced outside and then introduced into the body.

Active Immunity	Passive Immunity
Active immunity is usually long-lasting, sometimes life-long. It is produced by the antibodies of the host in response to direct contact with an antigen	Passive immunity lasts only for a few weeks or months. It is produced by the introduction of antibodies from outside into the host
It produces an immunological memory	It does not produce immunological memory
When the antigens enter the body, antibodies and other specialised lymphocytes are produced	Antibodies are introduced from an external source. For instance, a mother introduces antibodies to a fetus through the placenta and to an infant via mother's milk.
There are no side-effects	It may cause reactions
Immunity does not occur immediately	Immunity develops immediately

Resistance Factors:

Resistance factors are specific elements that contribute to an individual's ability to resist or combat infections and diseases. These factors can be related to both innate and acquired immunity. Examples of resistance factors include antibody production, immunological memory and vaccination.

2.9 Methods of Environmental Cleanliness:

Environmental cleaning refers to the process of removing contaminants and pollutants from the environment to improve its quality. Maintaining environmental cleanliness is crucial for the well-being of both human beings and the ecosystem as a whole. Some common methods are described here;

1. Waste Management

- **Reduce, Reuse, Recycle (3Rs):** Encouraging the reduction of waste generation by consuming less, reusing items whenever possible, and recycling materials like paper, plastic, glass, and metals.

2. Pollution Control

- **Air Pollution:** Air pollution can be minimized by implementing regulations on industrial emissions, promoting public transportation, and planting trees to improve air quality.

- **Water Pollution:** Water pollution can be minimized by treating wastewater before releasing it into water bodies and avoiding the dumping of hazardous substances into drains and water sources.

3. Chemical Disinfection

- Using chemicals to kill or neutralize harmful microorganisms. Examples include chlorine and ozone for water treatment.

4. Litter Prevention

- **Public Awareness:** Educating the public about the importance of not littering, through campaigns and educational programs.
- **Use of Trash bins in public areas:** Installing sufficient trash bins in public areas to encourage proper disposal of waste.

5. Eco-Friendly Transportation

• **Walking and Cycling:** Encouraging walking and cycling by creating pedestrian and bike-friendly infrastructure.

• **Public Transport:** Developing efficient public transportation systems to reduce individual car usage and associated emissions.

6. Waste Reduction Initiatives

- **Plastic Bans:** Implementing bans on single-use plastics and promoting the use of reusable alternatives.

7. Green Infrastructure

- Incorporating parks and green roofs to mitigate urban heat islands and improve air quality.

Achieving environmental cleanliness requires a multi-faceted approach involving collaboration among individuals, communities, businesses, and governments. By combining these methods, we can make significant pace toward a cleaner and healthier environment.

2.9.1 Bacteria-Free Instruments Maintenance:

Maintaining bacteria-free instruments and equipments is crucial to prevent infections and ensure the safety of patients and healthcare workers. Here are some guidelines for maintaining bacteria-free instruments and equipments in a medical setting.

1. Regular Cleaning

- Establish a cleaning schedule for your instruments and equipment. Regular cleaning helps prevent the buildup of bacteria. Use brushes and other tools to clean intricate parts.

2. Disinfection

- Disinfect your instruments and equipment after each use, especially if they come into contact with bodily fluids or are used in medical or clinical settings.
- Use an appropriate disinfectant that is effective against a wide range of bacteria and viruses.

3. Sterilization

- Sterilization is crucial for instruments and equipment used in medical, dental, and laboratory settings. Autoclaving is a common method to kill bacteria, viruses, and spores.

4. Personal Hygiene

- Ensure that anyone handling the instruments or equipment follows proper personal hygiene practices, such as washing hands before and after use. Encourage the use of gloves and other protective gear to prevent contamination.

5. Storage

- Proper storage is important to prevent recontamination after cleaning or sterilization.
- Store cleaned or sterilized items in a clean and dry environment, away from potential sources of contamination.

6. Disposable Items

- For certain situations, using disposable items can be an effective way to prevent bacterial contamination. Dispose of these items properly after use.

7. Regular Maintenance

- Regularly inspect and maintain your equipment to ensure it is functioning correctly. Malfunctioning equipment can lead to increased bacterial growth.

8. Educate and Train

- Educate individuals who use the instruments and equipment about proper cleaning, disinfection, and sterilization techniques.
- Provide training on how to handle items safely to minimize the risk of contamination.

2.10 Introduction to Cell Death

The cells of multicellular organisms undergo various processes of growth and death. Cellular death is very much essential for every organism in order to survive and grow. Our body consists of various types of cells located in different body parts. There are two ways through which the cell undergoes the process of death. It is either through getting exposed to an unfavorable or harmful environment, by an injury, or a regulated process of disintegration. The death of a cell occurs in two different ways, namely Apoptosis and Necrosis.

A number of various toxic chemicals or even physical events, such as radiation, trauma, heat, and lack of oxygen supply due to reduced flow of blood may lead to cell death. All these chemical or physical events can lead to a lethal disruption of the cell structure as well as the activity.

CELL DEATH:

Cell death is a natural biological process in which individual cells in a multicellular organism die. It can occur through various mechanisms and serves important functions in development,

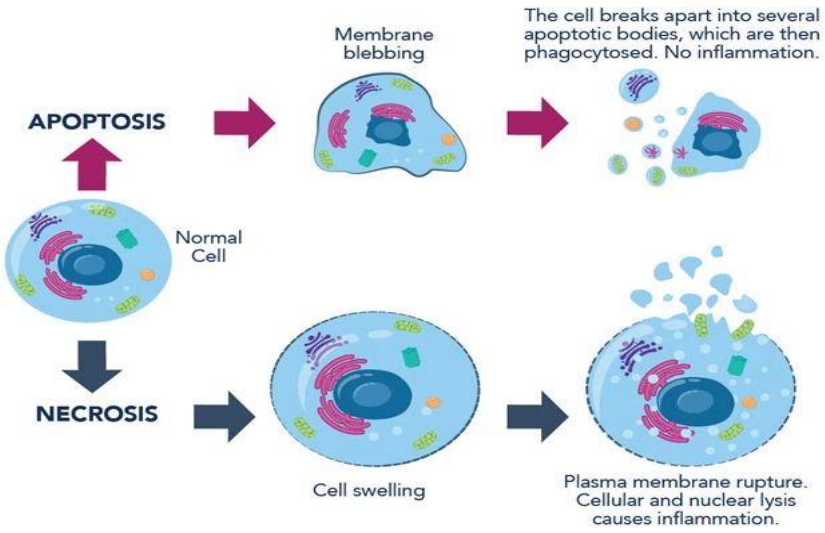
tissue maintenance, and the removal of damaged or unwanted cells. Two main types of cell death are apoptosis (programmed cell death) and necrosis (accidental cell death), each with distinct characteristics and roles in the body. Cell death is essential for the overall health and proper functioning of organisms.

1. Apoptosis

Apoptosis is a highly regulated and controlled form of cell death. It occurs as a normal part of an organism's life cycle and plays a critical role in various biological processes, including embryogenesis and immune system regulation.

2. **Necrosis**

Necrosis is an uncontrolled and often pathological form of cell death. It typically occurs as a result of external factors such as infection, toxins, or physical trauma and is associated with inflammation.



2.11 Inflammation or inflammatory reaction:

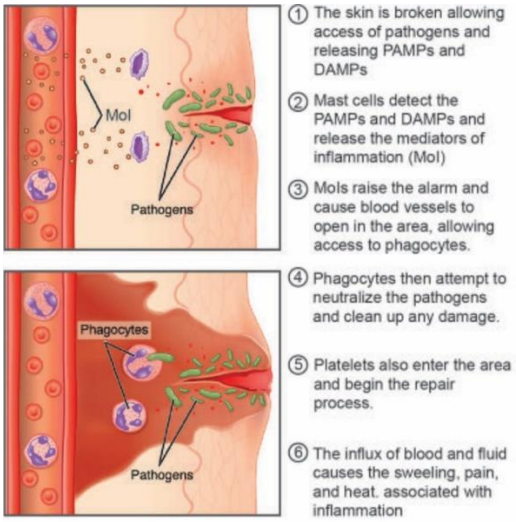
Inflammation is the immune system's response to harmful stimuli e.g. pathogens, damaged cells, toxic compounds, or irradiation.Inflammation is a defense mechanism that is vital to health.

Types of Inflammation

Inflammation can be either acute or chronic.

Acute Inflammation - Tissue damage due to trauma, microbial invasion, or noxious compounds can induce acute inflammation. It starts rapidly, becomes severe in a short time and symptoms may last for a few days e.g. cellulitis; acute pneumonia. Subacute inflammation is the period between acute and chronic inflammation and may last 2 to 6 weeks.

Chronic Inflammation - Chronic inflammation is also referred to as slow, long-term inflammation lasting for prolonged periods of several months to years. Generally, the extent and effects of chronic inflammation vary with the cause of the injury and the ability of the body to repair and overcome the damage.



2.12 Hypersensitivity:

Hypersensitivity, also known as allergic or hypersensitivity reaction is a heightened and abnormal immune response to substances that are typically harmless to most people. These substances, called allergens, can be found in various forms, such as pollen, dust mites, certain foods, medications, insect stings, or even chemicals. When someone with hypersensitivity encounters an allergen, their immune system reacts excessively, leading to a range of symptoms that can vary in severity.

There are four main types of hypersensitivity reactions, classified into different categories based on the underlying immune mechanisms:

1. Type l Hypersensitivity (Immediate Hypersensitivity): This is the most common form and is associated with allergies. It involves the rapid release of histamines and other chemicals from mast cells and basophils in response to allergens. Symptoms can range from mild to severe and include sneezing, itching, swelling, asthma.

2. Type II Hypersensitivity (Cytotoxic Hypersensitivity): In this type, the immune system targets and attacks the body's own cells, often due to mistaken identification or cross-reactivity with foreign antigens. Examples include autoimmune diseases like autoimmune anemia and some drug reactions.

3. Type Ill Hypersensitivity (Immune Complex-Mediated Hypersensitivity): This reaction occurs when immune complexes (antigen-antibody complexes) deposit in tissues, leading to inflammation and tissue damage e.g. vasculitis.

4. Type V Hypersensitivity (Delayed Hypersensitivity): Unlike the rapid response of type I hypersensitivity, type IV reactions take time to develop (usually 24-72 hours).

They involve the activation of T cells and are associated with conditions like contact dermatitis (e.g., poison ivy) and some autoimmune diseases like multiple sclerosis.

Hypersensitivity may require medical intervention. Management typically. involves identifying and avoiding allergens, using medications like antihistamines or corticosteroids to alleviate symptoms.

2.13 Neoplasms:

Neoplasms, commonly known as tumors, are abnormal growths of cells that can occur in various tissues and organs throughout the body. They are a hallmark of cancer, although not all neoplasms are cancerous. Neoplaşms can be broadly categorized into two main types:

1. Benign Neoplasms:
Benign neoplasms, also known as benign tumors, are abnormal growths of cells in the body that are not cancerous. Unlike malignant neoplasms (cancer), benign tumors do not invade nearby tissues or spread to other parts of the body through metastasis. Instead, they tend to grow slowly and typically have well-defined borders. The examples of benign neoplasms include fibroids, skin tumors and papillomas.

2. Malignant Neoplasms (Cancer):
Malignant neoplasms, commonly known as cancer, are a group of diseases characterized by the uncontrolled growth and spread of abnormal cells in the body. Malignant neoplasms have the potential to invade nearby tissues and organs and can metastasize, meaning they can spread to distant parts of the body. The examples include breast cancer, lung cancer and leukemia etc.

KEYPOINTS:

KEYPOINTS
• ***Microorganisms*** *are tiny organisms that cannot be seen with the naked eye.*
• ***Bacteria*** *are single-celled microorganisms that are classified as prokaryotes.*
• ***Rickettsiae*** *are obligate intercellular pathogens, responsible for causing a group of diseases collectively known as Rickettsioses.*
• ***Chlamydiae*** *can only replicate inside the host cells of their host organisms. Chlamydia is a sexually transmitted infection caused by the bacterium Chlamydia trachomatis.*
• ***Spirochetes*** *are Gram negative bacteria, and their most defining feature is their helical or spiral shape.*
• ***Virus*** *is a small infectious agent that requires a host cell to replicate and reproduce. Viruses can cause diseases that affect humans include the common cold, influenza, HIV, and SARS-CoV-2(the virus responsible for COVID-19).*
• ***Protozoa*** *are a diverse group of single-celled eukaryotic microorganism. Malaria is a deadly mosquito-borne disease caused by the Plasmodium falciparum (protozoa).*
• ***Fungi*** *are a diverse group of organisms that belong to their own kingdom, separate from plants, animals, and bacteria. They often serve as decomposers that break down organic matter and recycle nutrients.*
• ***Sterilization*** *is a crucial process in various fields, such as healthcare, pharmaceuticals, food industry, and research laboratories, to ensure the safety and sterility of equipment, instruments, and substances.*
• ***Disinfection*** *is a fundamental process in microbiology that involves the elimination of pathogenic microorganisms from surfaces, water, or other materials to prevent the spread of disease.*
• ***Immunity*** *is a defense mechanism that helps our body to fight against invading pathogens.*
• ***Acquired immunity*** *refers to the immune system's ability to respond specifically to a particular pathogen or antigen.*

- ***Resistance factors*** *are specific elements that contribute to an individual's ability to resist infections and diseases.*
- ***Cell death*** *is a natural process in which individual cells in a multicellular organism die. Two main types of cell death are apoptosis and necrosis.*
- *An* ***inflammatory reaction,*** *is a vital and complex biological response that occurs in the body in response to injury, infection or tissue damage.*
- ***Hypersensitivity*** *can significantly impact a person's quality of life and may require medical intervention.*
- ***Neoplasms****, commonly known as tumors, are abnormal growths of cells. They are a hallmark of cancer, although not all neoplasms are cancerous.*

Assessment

1. Define Microbiology? What are the different micro-organisms that cause diseases in eye? Give Classification.
2. Define and name different types of bacteria that are important pathogens of eye.
3. What important viruses cause diseases in eye? Give brief account of herpes and adenovirus?
4. What are fungi? What disease do they cause in eye?
5. Define Sterilization? What are important disinfectants used? What is cell death? What are the differences between necrosis and apoptosis?
6. What is a neoplasm? What are its types? Explain.
7. Define immunology? What is innate and acquired immunity?
8. What are the major differences between active and passive immunity?
9. What is hypersensitivity? Give its types?

UNIT 3: OPHTHALMIC EVALUATION

3.1.Symptomatology of Eye Diseases:

The symptomatology of eye diseases refers to the signs and symptoms that are associated with various eye conditions or disorders. Different eye diseases can present with a wide range of symptoms, and the specific manifestations can vary depending on the nature and severity of the condition.

Below is a list of common eye diseases along with their typical symptoms.

3.1.1. Refractive Errors (Myopia, Hyperopia, Astigmatism, Presbyopia):

- Blurred vision
- Headaches
- Eye strain
- Difficulty seeing up close (presbyopia) or at a distance

3.1.2. **Conjunctivitis (pink eye)**

- Red or pink appearance of the eyes
- ltching or burning sensation
- Watery eyes
- Discharge, which may be clear, yellow, or green

3.1.3.**Cataracts:**

- Cloudy or blurry vision
- Sensitivity to glare, especially at night
- Fading or yellowing of colors
- Double vision in one eye

i. . **Glaucoma:**

- Gradual loss of peripheral vision
- Blurred or hazy Vision
- Halos around lights
- Elevated intraocular pressure may lead to eye pain or headaches

ii. **Dry Eye Syndrome:**

- Dry, itchy, or gritty sensation
- Redness
- Excessive tearing (paradoxical response to dryness)
- Blurred vision

iii. **Macular Degeneration:**

- Central vision loss
- Distorted or wavy vision
- Difficulty recognizing faces or reading
- Changes in color perception

iv. . **Retinal Detachment:**

- Sudden onset of floaters (spots or lines in vision)
- Flashes of light

- Shadow or curtain across the visual field
- Blurred

3.1.8. **Corneal Disorders (e.g., Keratitis, Corneal Abrasion):**

- Pain and redness
- Photophobia (sensitivity to light)
- Blurred vision
- Excessive tearing

3.1.9. **Uveitis:**

- Eye pain
- Redness
- Photophobia
- Blurred vision

3.1.10. **Diabetic Retinopathy:**

- Blurred or fluctuating vision
- Floaters
- Dark or empty areas in vision
- Difficulty seeing at night

3.1.11. **Strabismus:**

- Misalignment of the eyes
- Double vision
- Squinting or closing one eye to see better
- Impaired depth perception

Eye Disease	Common Symptoms
Refractive Errors	Blurred vision, eyestrain, headaches
Conjunctivitis (Pink Eye)	Redness, itching, discharge, tearing
Cataracts	Cloudy vision, glare, difficulty seeing in low light
Glaucoma	Gradual peripheral vision loss, eye pain, halos around lights
Dry Eye Syndrome	Dryness, irritation, redness, sensitivity to light
Macular Degeneration	Central vision loss, changes in color perception
Retinal Detachment	Floaters, flashes of light, sudden vision changes
Corneal Disorders	Pain, redness, blurred vision, sensitivity to light
Uveitis	Eye pain, redness, photophobia, blurred vision
Diabetic Retinopathy	Blurred or distorted vision, floaters, eye hemorrhage
Strabismus	Double vision, misalignment of eyes

- TABLE: SYMPTOMS OF COMMON EYE DISEASES

b. Eye examination:

An ophthalmic evaluation, also known as an eye examination, refers to a comprehensive examination of the eyes and their related structures. It is typically conducted by an ophthalmologist to diagnose any potential vision problems or eye conditions. The regular eye examinations are essential for maintaining good eye health. Here are some key components of a typical ophthalmic evaluation.

- Medical history
- Visual acuity test
- Refraction test
- Slit lamp examination
- Eye muscle movement test
- Cover test
- Dilation
- Visual field test
- Intraocular pressure measurement
- Color vision test
- Evaluation of eye health
- Discussion of findings

3.2.1.History Taking

History taking is very important in ophthalmological management of patients because most of the procedures and interventions are mostly depending upon history.

Following are the major components of history taking which should be asked from patients

3.2.1.1. Personal profile;

This includes Name of the patient, Age, Gender, Marital status and profession of patient and address.

3.2.1.2. Presenting complain;

This includes the complaints with which patients presented to us. Presenting complaints are always written in chronological order i.e., the symptom which appears first should always be written first.

3.2.1.3. History of presenting illness;

This includes detail of presenting illness i.e., onset of symptoms, duration, progression and associated factor which were present along with symptoms. Pneumonic (ODPARA) is used to remember this whereas ‘ **o’** stands for onset, D for duration, P for progression, A for aggravating factors, r for relieving factors and a for associated features.

3.2.1.4. Past ocular history;

Past ocular history is very important in ophthalmological set-up. Any history of previous glasses usage, history of any ocular surgery, history of any trauma, history of any laser and intraocular injections should be asked from every patient. To remember this pneumonic ‘GSTMILO’ is used whereas G stands for glasses, S for surgery, T for trauma, M for medications, I for injections, L for lasers, O for other eye.

3.2.1.5. Past medical history;

History of diabetes mellitus, hypertension, thyroid disease, asthma, TB, stroke and any drug usage is important to ask from patients.

3.2.1.6. History of Allergies;

History of allergy related to drugs should be asked from patients.

3.2.2. . Visual Acuity

It is measure of the ability of eye to distinguish shapes and details of objects at a given distance.

3.2.2.1 Visual acuity at distance;

Visual acuity at distance is measured by using different standard charts. Most commonly used charts are 'SNELLEN^S chart & E charts''. Patient is made to sit at 6 meters distance and told to cover his one eye with palm of one hand and read out aloud and vice versa. A normal person can read all line and this vision is called 6/6. When patient can only read the 36m line, his distant vision is defective= 6/36.

When patient can't read out largest letter, he is asked to come forward towards chart. if he reads largest letter at 5,4,3,2,1 meter distance, his visual acuity is 5/60, 4/60, 3/60, 2/60, 1/60.

If he can't read top letter, he is asked to count the examiners finger.

If he can't count finger, light is concentrated on his eyes in dark room. He is asked to say when light is on the eye or when it is off. If he tells correctly the visual acuity is light perception=PL.

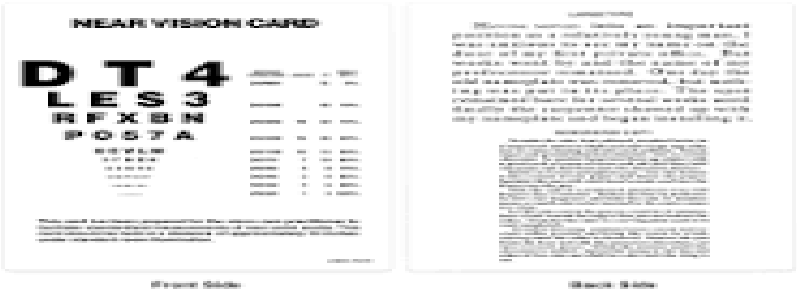
When the patient tells the correct indication of direction from where light is coming the visual acuity is said to be good projection of light.

If there is no perception of light, patient is said to be blind. (NPL).

E chart is used for illiterate people.

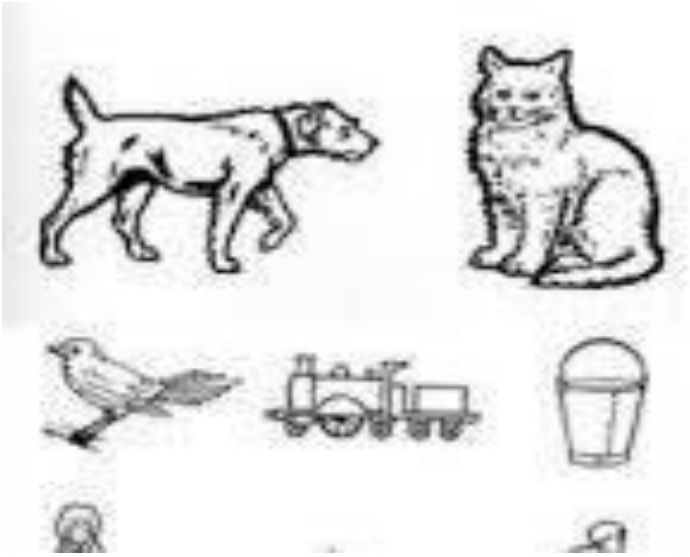
3.2.2.2. Visual acuity at Near;

Visual acuity at near is examined by asking patient to cover his/her one eye and read charts from near distance of 25 cm in good illumination.



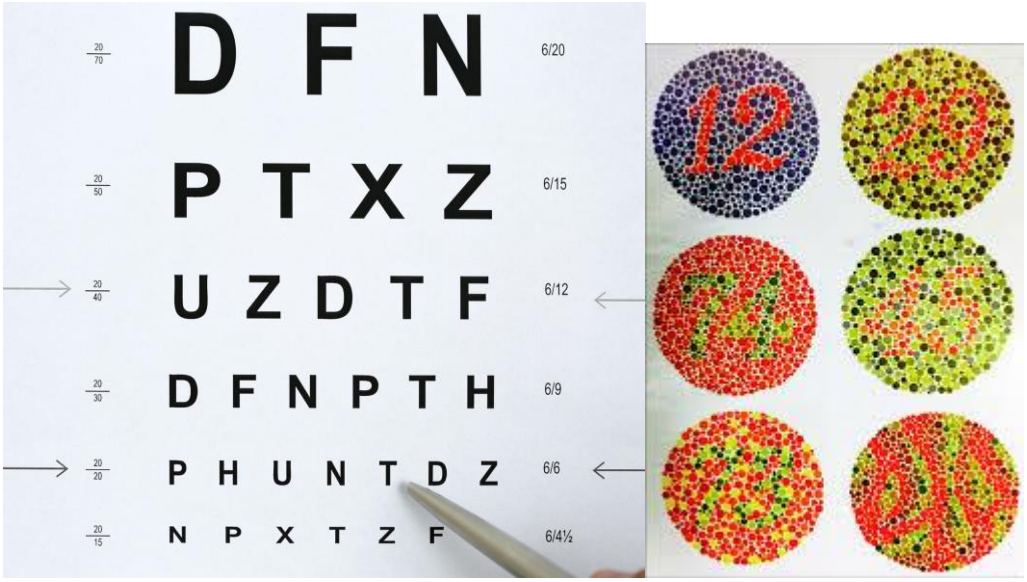
3.2.2.3 Visual acuity for children;

Visual acuity for children is done by using picture chart.



3.2.2.4. Color vision;

Color vision is examined by using different Ishihara charts and multiple color plates.



3.2.2.5, Pinhole vision;

In this pinhole disc is placed before patient's eye. This eliminates the peripheral light rays thus improving contrast resulting in improvement of vision. This is done to

differentiate visual loss due to refractive error and poor vision due to other disease of eye. If the vision improves by using pinhole,it means it is due to refractive error. It should be done in all patient who have visual acuity <6/18.

c. Eye External Examination:

3.3.1. Examination of anterior segment of eye

3.3.1.1. Inspection;

Examination of anterior segment is done by good inspection in good illumination.

1.Head---position is characteristic in extraocular muscles paralysis and ptosis.

2.Face---face deviation in 7th nerve palsy, skin changes & vesicle formation in herpes zoster

3.Eyebrow---overaction of frontalis muscle in ptosis, hypopigmentation and loss of hair e.g., leprosy.

4.Orbit---proptosis, orbital cellulitis, enophthalmos.

5.Eyeball---position changes in squint, movements may be oscillatory like in nystagmus, eyeball size may change e.g., microphthalmia, buphthalmos in glaucoma.

6.Eyelids—

Position; drooping occurs in ptosis, there may be deviation i.e. inward deviation called entropion, outward deviation is called ectropion.

Movement; restricted in symblepharon (adhesions b/w palpebral conjunctiva &bulbar conjunctiva).

Palpebral fissure; small in ptosis, increased in bell's palsy.

Margins; crusting in blepharitis.

Eyelashes; may be misdirected inward towards cornea(trichiasis), extra row of lashes(distichiasis), loss of lashes, color changes.

7.Lacrimal puncta; present at the medial end of lids, can be seen by everting lid margins.

8.Lacrimal sac; swelling and redness in mucocele, regurgitation test positive in dacryocystitis.

9.Conjunctiva;

Palpebral conjunctiva;upper palpebral conjunctiva is seen by everting the upper eyelid while patient is looking down. follicles, papillae, concretions, foreign body, scarring is noted. Lower palpebral conjunctiva is seen by pulling lower eyelid downwards and above-mentioned findings noted.

Bulbar conjunctiva---congestion, chemosis, foreign body, subconjunctival hemorrhage may be present. Edema, pterygium, growth should also be noted. Symblepharon, scarring and membranes should also be observed.

10. Cornea;

Corneal examination is very important in ocular examinations.

Size—corneal diameter is 12 mm vertical and 11mm horizontal in neonates. Enlarged diameters are termed as megalo-cornea, decreased diameter is termed as micro-cornea.

Curvature—normal radius of curvature is 7.8mm. It can be globular, flat or conical.

Transparency— ulcers, opacities may be present. Position of opacity related to iris is noted. Pannus or vascularization and striates are noted.

Sensation—it is tested by touching cornea with wisp of cotton. Brisk lid closure is called corneal reflex. Sensations are reduced in infections caused by herpes simplex, herpes zoster, absolute glaucoma, acute congestive glaucoma, leprosy.

Staining—staining of cornea is used to see abrasions and ulcer. Fluorescein and rose Bengal stains are commonly used in practice.

11.Sclera— sclera should be examined to see any pigmentation, staphyloma, thinning in myopia. Nodule formation in episcleritis and scleritis.

12.Anterior chamber;

Depth of anterior chamber is 2.5 mm and is shallow in glaucoma and deep in buphthalmos. Anterior chamber may have cloudy contents in acute anterior uveitis, pus (hypopyon) in corneal ulcer/abscess, blood in trauma(hyphema) or foreign body.

13.Iris;

Color may be different in both eyes or may have different color in the same eye called heterochromia irides as in some cases of uveitis. They have atrophic patches as in glaucoma. There may be loss of crypts or structure. Iridodonesis is excessive tremors in iris when eye moves.it occurs in aphakia, trauma.

Anterior synechia is adhesion between anterior surface of iris and posterior surface of cornea.

Posterior synechia is adhesion between posterior surface of iris and lens present in chronic uveitis cases.

14.Pupil;

Normal size of pupil is 2-4 mm.

Miosis—The pupil is small and constricted.

Mydriasis—The pupil is dilated

Anisocoria—unequal size of pupil in both eyes is called anisocoria.

Causes of miosis are **physiological** (babies, old age) **pharmacological** (pilocarpine) **pathological** (Horner syndrome, argyle Robertson pupil).

Causes of mydriasis are **physiological** (myopia, nervous excitement) **pharmacological** (atropine, cyclopentolate, tropicamide)**pathological**
(retina and optic nerve diseases, optic nerve atrophy, 3rd cranial nerve palsy).

Pupillary reactions;

Light reflex— direct reflex is when light falls in one eye, pupil constricts.

Indirect reflex is when light falls in one eye, pupil of other eye constricts.

15.Lens;

Color changes in cataract formation. Lenticular changes may be central or peripheral. Position of lens is very important as there may be subluxation or total dislocation in various diseases or after trauma.

Subluxation—It is due to partial rupture of zonules resulting in tilting of lens into anterior chamber causing astigmatism or diplopia or into vitreous.

Dislocation—It is complete rupture of zonules mainly after trauma.

Palpation;

Orbit—irregular margins, swelling, growth and tenderness are noted

Eyeball—tenderness and pulsation are noted.

Digital tension—It is assessed by fluctuation method.

Lymph nodes—Preauricular and submandibular lymph nodes are palpated.

3.3.1.2 Measurement of Intraocular pressure (IOP)

Measurement of Intraocular Pressure (IOP) is a critiçal part of a comprehensive eye examination, especially in the evaluation of conditions such as glaucoma. High intraocular pressure can be a risk factor for developing glaucoma.

Normal intraocular pressure is 10-20 mmHg.

Suspicion of glaucoma :20-25mmHg

Glaucoma: above 25 mmHg

Digital Tension; It is measured by palpating by fingers. Patient is asked to look down and sclera is palpated through upper lid beyond tarsal plate. The amount of fluctuation gives estimation of tension.

Schiotz tonometer;

The depth of indentation of cornea is measured.

Advantages—It is easy to use, cheap, convenient to carry and does not need slit lamp.

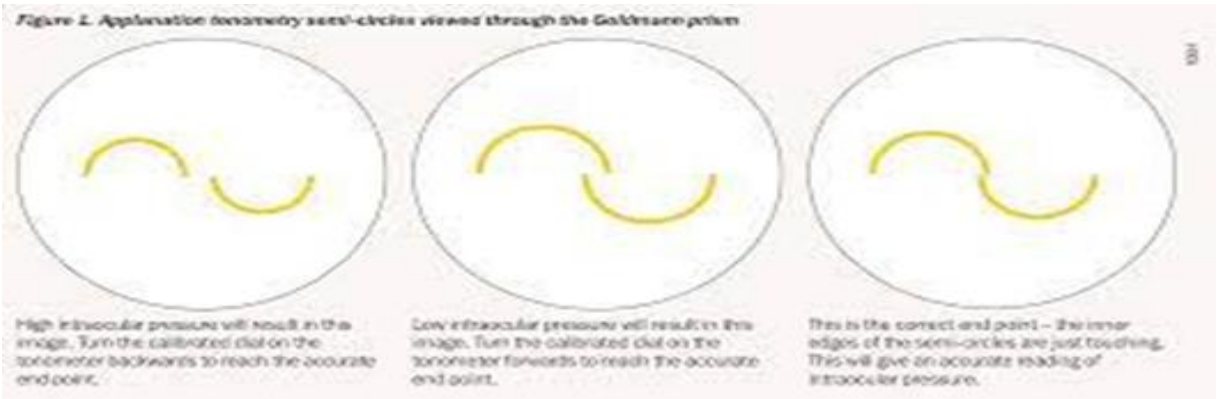
Disadvantage—ocular rigidity can produce error.

Applanation tonometer;

It is more accurate method. cornea is flattened by plane surface. The applanation tonometer measures the intraocular pressure by flattening the cornea (rather than indent) over a specific area 3. 06mm.this is more accurate because scleral rigidity is ruled out in this.

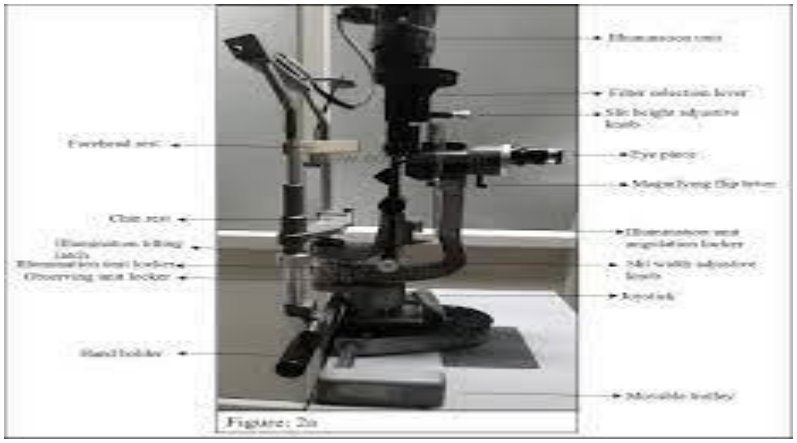
Method;

1. Patient's eye is anesthetized with local anesthesia and fluorescein drop is put into eye
2. Put the patient's chin onto chin rest and forehead onto support provided.
3. Slit lamp is moved towards patient's eye while patient is looking straight with open wide eyes.
4. Slit lamp is moved till tip of tonometer touches the cornea.
5. By flattening cornea, a just bit, tonometer detect pressure in the eye.
6. Same procedure is repeated for the 2nd eye,



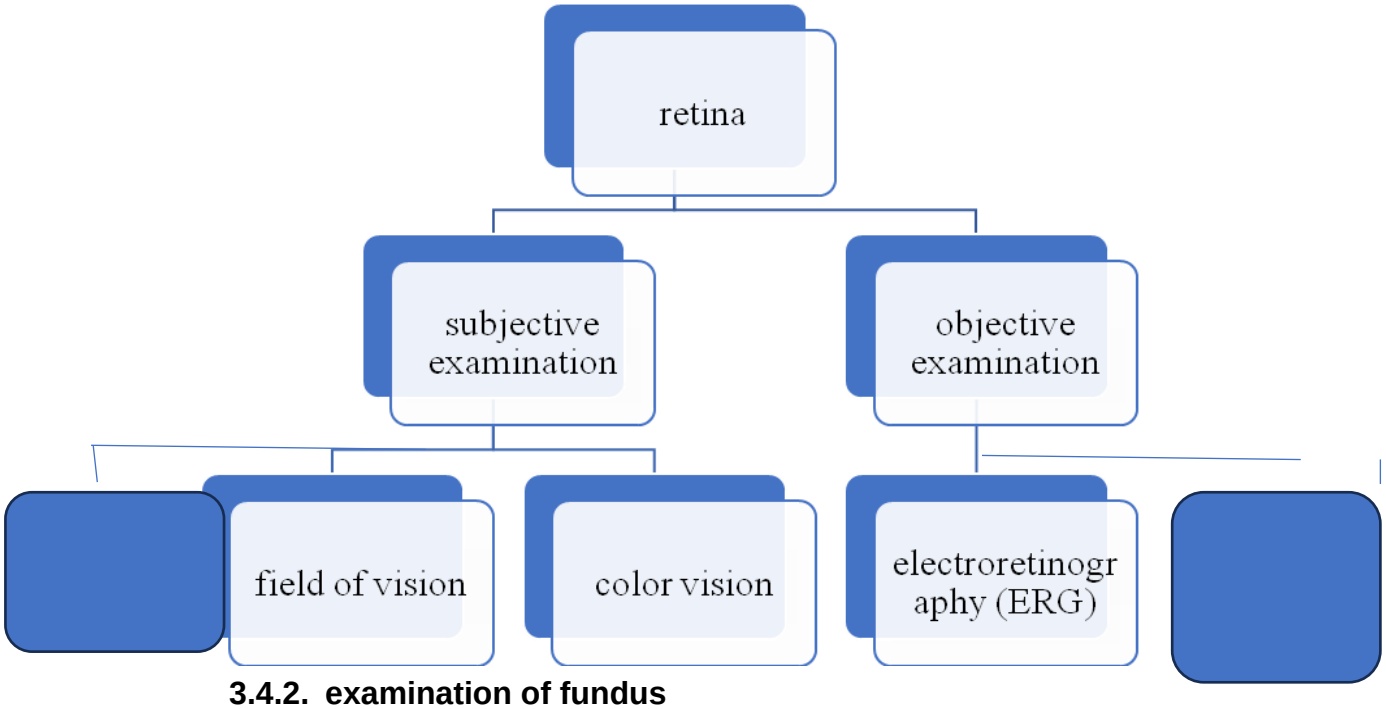
3.4 Slit-lamp examination;

It is used for minute detailed examination of eye is needed. A brilliant light is brought to focus as a slit or point by an optical system supported on an arm and observation are made by binocular examination.it has magnification power 16-25 times.



d. <u>Examination of posterior segment of eye</u>

3.4.1. Examination of retinal functions



3.4.2. examination of fundus

Visual acuity and color vision is explained above.

3.5. Field of vision;

The normal visual field is described as **island of vision surrounded by sea of blindness.**

3.5.1. Normal visual field; right eye field

Upward;60^ 60

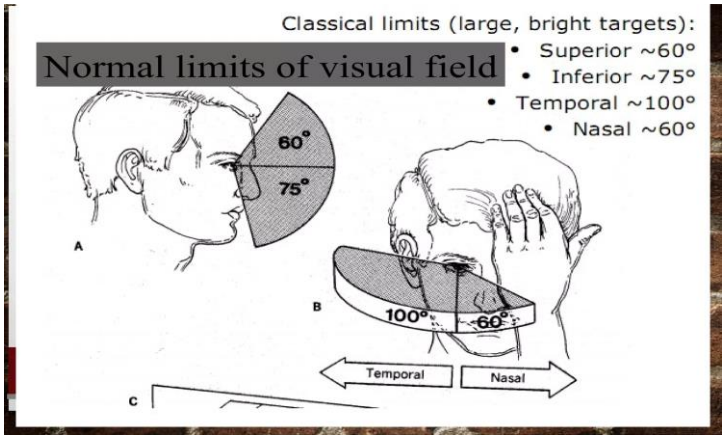
Inward;60^

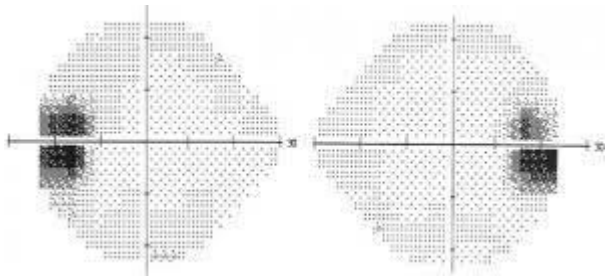
Downward;70^

Outward;90^ >90 60

70

60





Point of fixation;

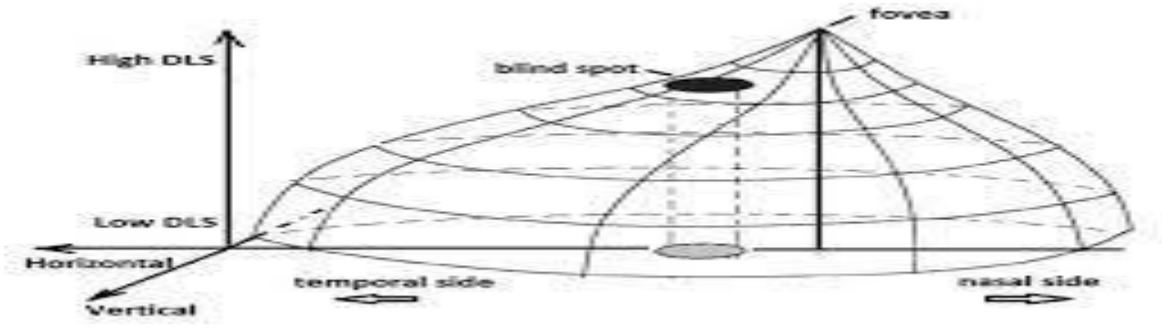
It is area of maximum visual acuity in normal visual field. It corresponds to foveola of retina.

Blind spot;

This is an area of absolute scotoma (non-seeing area) within the boundaries of normal visual field. It is located 15^ temporal to fixation point.

Scotoma;

It is area of depressed visual field (non-seeing) area surrounded by normal normal vision. It is commonly seen in glaucoma, optic neuritis.



Use of the Perimeter, Jerrum Screen:

3.5.2. Perimetry;

It is used to describe various techniques employed to evaluate both central and peripheral visual field using targets of various sizes and colors.

Two types of techniques are used;

Kinetic perimetry;

In this target is moved across the field to draw the two-dimensional extent of field.in this moving stimulus of known intensity is moved from periphery to center till is perceived by the patient. The point of perception is recorded in different meridian. These points are joint to plot a field. Following are methods by which kinetic perimetry is done.

1.confrontation method

2.goldmann perimeter

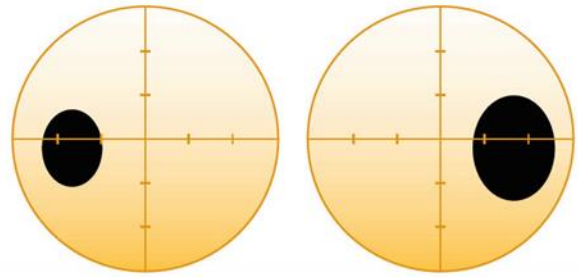
Static perimetry;

It is three-dimensional assessment of height of predetermined area of ‘’hill of vision’’. In this non-moving stimulus of varying intensity are presented in same position to get vertical boundary of visual field.

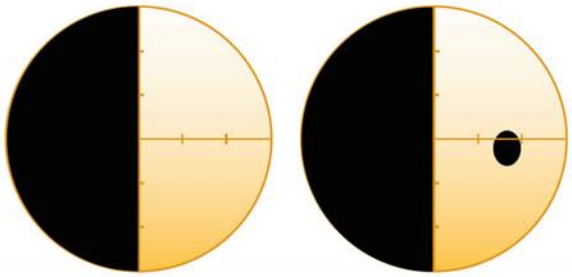
Uses;

Charting of visual field is used to monitor and progression of following diseases;

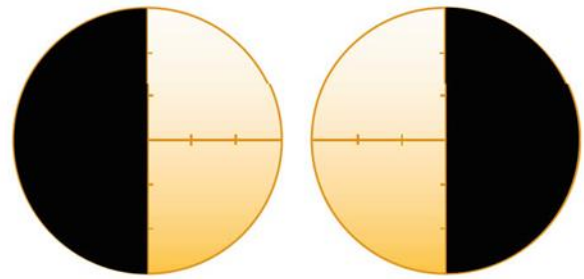
1. Glaucoma
2. Retinal diseases i.e., Retinitis pigmentosa
3. Follow up of laser therapy for diabetic retinopathy
4. Neurological disorders, e.g., brain tumors, head injury, multiple sclerosis.



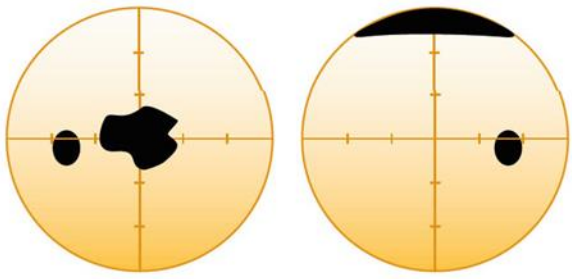
(a) Enlarged blind spots (e.g. papilloedema)



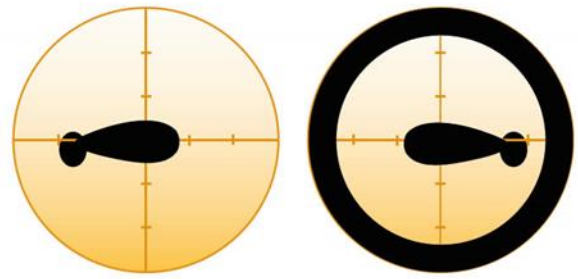
(b) Left homonymous hemianopia (e.g. stroke)



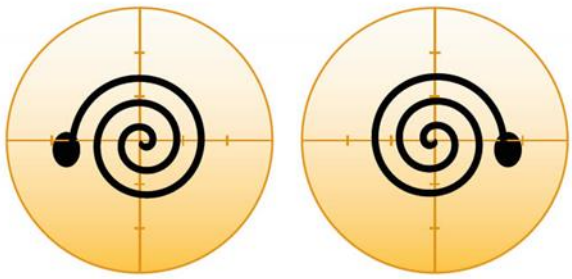
(c) Bitemporal hemianopia (e.g. pituitary tumour)



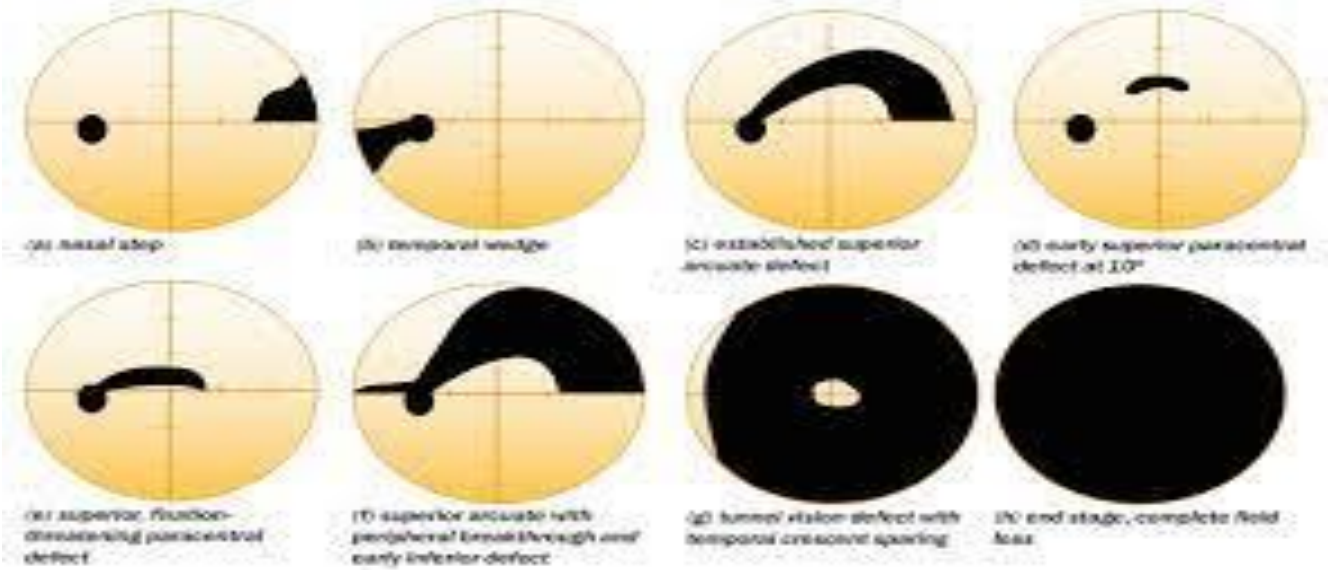
(d) Left central scotoma (e.g. central macular disease) and right upper eyelid artefact



(e) Centrocaecal scotomata (e.g. toxic optic neuropathy) and right lens rim artefact



(f) Spiral visual fields (the functional or hysterical visual loss associated with malingering)



Peripheral field;

Confrontation method;

It is rough but useful method. It can be done on bedside of patient or in clinic.in this patient field of vision is measured with comparison of examiner' s field of vision.

Method; Examiner stands facing patient at the distance of about 60cm.

Patient covers his one eye (right) and examiner his one eye(left). The examiner moves his hand from periphery towards center, keeping his hand in plane midway between patient and himself. Patient is instructed to tell examiner when he started to see target and tell no. of fingers. All four quadrants are being tested. Same procedure is being repeated with the other eye.

Goldmann perimeter;

It consists of half sphere within which a spot of light can be moved.

Method;

The patient is seated with his chin supported on chin rest.one eye is covered by pad. The eye is fixed on object placed on Centre of arc. The field is recorded fist with a white object 5mm in diameter from periphery to Centre.

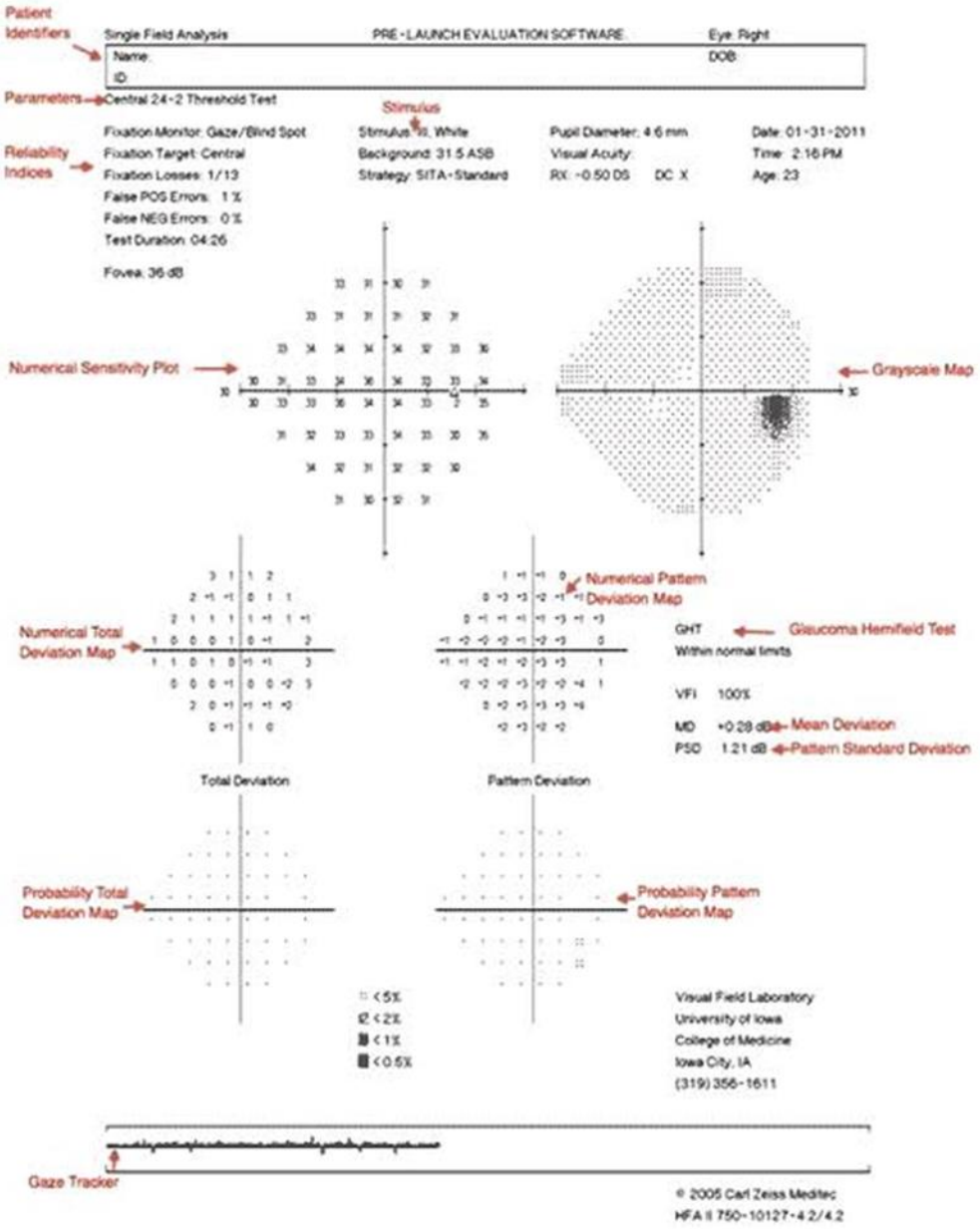
Central field;

It is limited to 30 degrees from fixation point.

Advantages;

1. These are more sensitive than manual perimetry.
2. Examiner bias is eliminated.
3. There is constant monitoring of fixation.

4. Visual field can be always stored and reproduced.



Bjerrum Screen:

The Bjerrum screen, also known as the "Bjerrum tangent perimeter," is a specialized type of tangent screen used in visual field testing. It was designed by Danish ophthalmologist Carl Bjerrum.

Procedure:

1. **Preparation:** The patient is usually seated in a darkened room, and one eye is typically tested at a time while the other is covered with an eye patch or occluder.

2. **Testing Apparatus:** The Bjerrum screen consists of a concave or curved screen with a fixation point (usually a small light or target) located at the center. The screen has a series of concentric circles or semi-circular arcs marked on it.
3. **Test Administration:** The patient is asked to focus on the central fixation point while the examiner presents a test stimulus (e.g., a small light) at various locations along the concentric circles or arcs on the screen.
4. **Response:** The patient is instructed to indicate when they first see the test stimulus by signaling or pressing a button. This helps to determine the boundaries of their visual field.
5. **Data Collection:** The examiner records the patient's responses, noting the location where the patient first detected the stimulus. This information is used to create a visual field chart, also known as an isopter, which outlines the boundaries of the central visual field.

Interpretation:
The results of the Bjerrum screen evaluation are used to assess the patient's central visual field and detect any abnormalities or defects. Normal visual fields should show a consistent circular or semi-circular shape around the central fixation point. Any deviations from this pattern may indicate a visual field defect.
Clinical Applications:

- **Glaucoma Diagnosis and Monitoring:** The Bjerrum screen is often used in the evaluation of glaucoma patients to detect and monitor changes in the central visual field, as glaucoma typically causes peripheral visual field loss that can progress toward the center.
- **Macular Degeneration:** It can also be used to assess central visual field changes in patients with macular degeneration, a condition affecting the macula, which is responsible for central vision.

While the Bjerrum screen has been historically used, modern automated perimetry devices, such as the Humphrey Visual Field Analyzer, have become more common for glaucoma assessment. These devices offer more standardized and quantitative measurements of the visual field.

3.6. Objective examination of retina

The retinal functions can be tested objectively by;

3.6.1. Electroretinogram (ERG);

It measures the changes in resting potential of eye which are stimulated by light. These changes are absent in complete failure of function of rods and cones like in pigmentary retinal dystrophy, complete occlusion of retinal artery, complete retinal detachment.

1. Negative **‘a’** wave represents the activity in rods and cones.
2. Positive **‘b’** wave arises in inner retinal layers.
3. Positive **‘c’** wave is associated with pigmentary epithelium.

i. Electro-oculogram (EOG);

It is measure of changes in resting potential when eyes are moved laterally. The electrodes are placed at the inner and outer canthus. It is absent in retinal dystrophies and retinal degenerations.**Basis of FFA , Ultrasound:**

b. Investigations;

Different investigations are used to detect disease in the anterior & posterior segment of the eye. The commonly used investigations are following.

3.7.1. Fundus fluorescein angiography (FFA);

It is a test to look at your retina. In this a contrast dye is injected which highlight blood vessels of retina.

Method;

1. Pupil is dilated with the help of mydriatics
2. Fluorescein dye is injected through the vein in arm.
3. This fluorescent dye travels through blood vessels in to eye.
4. The dye highlights the blood vessels of retina.
5. This allows the doctor to see blood vessels clearly and diagnose conditions which are affecting vision of the patient.

Uses; This is used to diagnose or monitor eye conditions that affect the blood vessels of retina. Some conditions are following;

1. Age related macular degeneration.
2. Cystoid macular edema.
3. Diabetes related retinopathy.
4. Macular hole.
5. Retinal detachment.

i. Eye ultrasonography;

Ocular ultrasound or eye ultrasound is a non-invasive diagnostic imaging technique used to look at the eye area. It also measures the size and structure of eye.

Method;

1. Patient's eye is numbed with the help of local anesthetic eyedrops.
2. The ultrasound wand (transducer) is placed against the front surface of eye.
3. Echoes of sound wave forms the picture of the structure of eye.
4. The test takes about 15 minutes.

Types;

There are two types of ultrasounds used in eye;

1. A scan
2. B-scan

A -scan;

It measures the axial length of eyeball. It is used to determine the right power of lens implant before cataract surgery.

B-scan;

1. It is used to see inside part of eye or space around and behind the eye (orbit) that cannot be seen directly e.g., in cataract, vitreous hemorrhage etc.
2. It is used to diagnose retinal detachment, tumors or other disorders as well.

c. STAINING OF CORNEA:

Corneal staining refers to the use of special dyes to identify and assess damage of abnormalities on the surface of the cornea. Corneal staining is a diagnostic technique used by eye care professionals to evaluate conditions such as corneal abrasions, infections, dry eye syndrome, or other corneal disorders. There are several types of corrneal staining, each with its specific purpose and associated dyes.

3.8.1. Types of Corneal Staining

1. Fluorescein Staining:

Fluorescein is the most commonly used dye for corneal staining. It is a yellow-orange dye that becomes green when illuminated with blue light. Eye care professionals typically use fluorescein staining to detect and assess various corneal conditions, including:

- Corneal abrasions or injuries
- Foreign bodies on the cornea
- Corneal infections, such as ulcers
- Contact lens-related issues, like poor fit or overuse

During the test, a small amount of fluorescein dye is applied to the surface of the eve using eye drops or a paper strip. The dye adheres to damaged or irregular areas of the cornea, making them visible under a blue light.

2. Rose Bengal Staining:

- Rose Bengal is a red dye used for corneal staining. It is typically employed to assess more severe forms of dry eye syndrome, as well as to detect more extensive corneal damage or ulcers.
- The dye is applied similarly to fluorescein, and areas of staining appear as red under white light.

3. Lissamine Green Staining:

- Lissamine green is another dye used to assess dry eye syndrome and corneal damage. It is less irritating than Rose Bengal and is often preferred for patients with sensitive eyes.
- Lissamine green staining helps to evaluate the health of the corneal epithelium.

Procedure:

a. Patient Preparation: Before the staining process begins, the patient's eye is typically numbed with a local anesthetic eye drop to minimize discomfort, during the procedure.

b. Application of Staining Dye: The eye care professional will then apply a small amount of a special ophthalmic dye (usually fluorescein or rose bengal) to the surface of the eye. The

dye is usually in the form of eye drops, and the patient may be asked to blink to ensure even distribution of the dye across the cornea.

c. Observation: After the dye is applied, the eye care provider will use a cobalt blue light or a special filter on a slit-lamp biomicroscope to examine the cornea. The dye causes any damaged or irregular areas on the cornea to become visible under the blue light.

d. Evaluation: The eye care provider carefully examines the stained cornea to assess the size, location, and severity of any abnormalities.

Interpretation:

Positive Staining: If areas of the cornea take up the dye and appear green or pink under the blue light, it indicates the presence of corneal irregularities, such as abrasions, ulcers, or dry spots. The pattern and extent of staining provide important diagnostic information.

Negative Staining: In a healthy cornea, the dye should not adhere or stain the Surface, and the cornea will appear uniform under the blue light.

Follow-up and Treatment:

Depending on the findings, the eye care provider will determine the appropriate treatment or management plan.

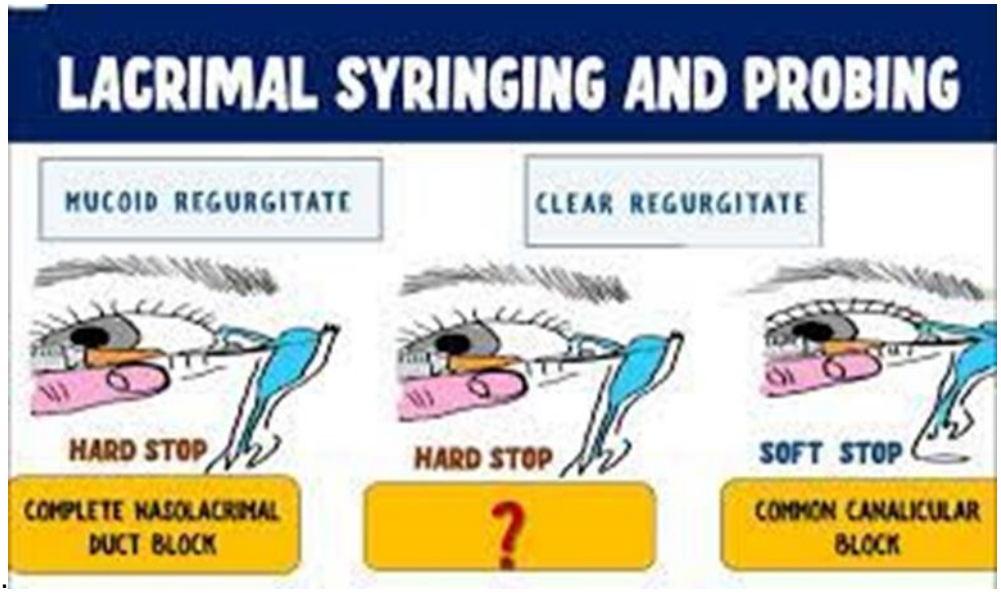
d. . PROBING AND SYRINGING OF LACRIMAL APPARATUS;

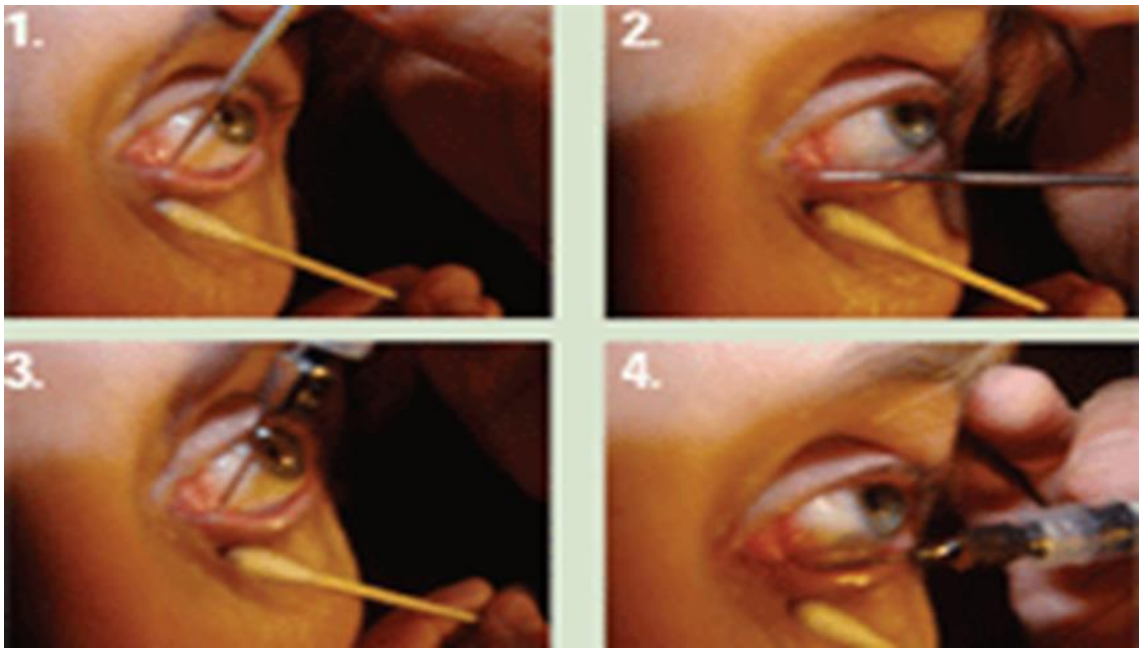
Probing of the nasolacrimal duct is performed through the punctum under general anesthesia. Great care is taken to avoid injury to the walls of the duct as it may cause fibrosis or infection.

METHOD;

Primary treatment of nasolacrimal duct obstruction consists of nasolacrimal duct probing. In this procedure a probe ranging in size from 0.70 to 1.10 mm in diameter is passed through either the upper or lower punctum following dilation of the punctum. The probe is advance along the canaliculus while exerting gentle lateral traction on the lid until it reaches the nasal bone. Then the probe is rotated 90 degrees and gently introduced into the nasolacrimal duct and advanced into the nose.

A small bolus of saline can be irrigated through the duct. If the infant is awake, the bolus will elicit a swallowing reflex. If the child is anesthetized the saline (colored with fluorescein typically) can be aspirated with suction.





KEPOINTS:

KEYPOINTS
• *An **Ophthalmic Evaluation** is a medical examination and assessment of the eyes and their related structures. It is typically conducted by an eye care professional, such as Ophthalmologist.*
• ***Refractive errors** are common vision problems that occur when the eye cannot properly focus light on the retina, leading to blurry vision. Its primary types are myopia, hyperopia, astigmatism, and presbyopia.*
• ***Myopia** is a refractive error of an eye where close objects are seen clearly, but distant objects appear blurry.*
• ***Hyperopia** is a condition in which distant objects can be seen more clearly than nearby objects.*

- ***Astigmatism*** *is a common vision condition that cause blurred or distorted vision due to an irregular shape of the cornea or lens of the eye.*
- ***Presbyopia*** *is a common age-related vision condition that causes difficulty in focusing on close objects.*
- ***Conjunctivitis****, commonly known as "pink eye" is an inflammation or infection of the conjunctiva.*
- ***Dry eye syndrome,*** *is a common eye condition that occurs when your eyes don't produce enough tears. Many people with dry eye experience a burning sensation in their eyes.*
- ***Macular degeneration*** *involves damage to the macula, a small but critical part of the retina located at the back of the eye.*
- ***Diabetic retinopathy*** *is a diabetes-related eye disease that affects the retina; it is a leading cause of blindness among people with diabetes.*
- ***Keratitis*** *is a medical term that refers to the inflammation of the cornea.*
- ***Ptosis*** *also known as "drooping eyelid" is a medical condition characterized by the abnormal drooping of the upper eyelid. Ptosis can be present at birth or develop later in life.*
- ***Visual acuity*** *is a measure of the sharpness and clarity of an individual's vision, specifically their ability to perceive fine details and distinguish objects at a given distance.*
- ***A Perimeter*** *is a diagnostic instrument used in eye examination to assess a patient's visual field. This examination helps identify and diagnose various eye conditions and neurological disorders that can affect a person's peripheral vision.*
- ***FFA*** *stands for "Fundus Fluorescein Angiography" which is a diagnostic medical procedure used in ophthalmology to evaluate the blood circulation in the retina and choroid at the back of the eye.*
- ***Ophthalmic Ultrasound,*** *also known as ocular ultrasound, is a non-invasive diagnostic imaging technique used to create detailed images of the eye's anterior and posterior segments, including the cornea, lens, vitreous humor, retina, and optic nerve.*
- ***Intraocular pressure (IOP)*** *measurement is a critical part of a comprehensive part of an eye examination, especially in the evaluation of conditions such as glaucoma. Most common methods for measuring IOP are the Goldman and Air-puff Tonometer.*
- ***Corneal staining*** *is a diagnostic technique used by an eye care professionals to evaluate conditions such as corneal abrasions, infections, dry eye syndrome, or other corneal disorders.*
- ***Syringing of the lacrimal apparatus,*** *also known as lacrimal duct irrigation is a medical procedure performed to treat blockages in the tear drainage system of the eye.*

Assessment

Question #1;

What is visual acuity? Describe its components. How it is measured, describe briefly.

Question #2;

How do you examine conjunctiva and cornea of a patient with the help of pen torch?

Question # 3;

What is meant by field of vision? **Question #4**

What is perimetry? Describe different methods to measure it.

Question#5

Describe difference between ERG and EOG?

Question #6

What is fundus fluorescein angiography? How it is performed? What are its uses?

Question #7

Write a brief note on eye ultrasonography. what are its types?

Question#8

What is probing syringing? For what purpose it is used?.

UNIT 4: PREVENTIVE OPHTHALMOLOGY

Use of appropriate strategies and methods to decrease the burden of eye diseases in a community is called preventive ophthalmology.

Basic principle;

Preventive ophthalmology comprises two basic principles;

1. An assessment to find out extent of eye diseases in a community and effect of blindness on socioeconomic status of community.
2. Finding and applying best appropriate solutions for eye problems in a community.

4.1. Blindness:

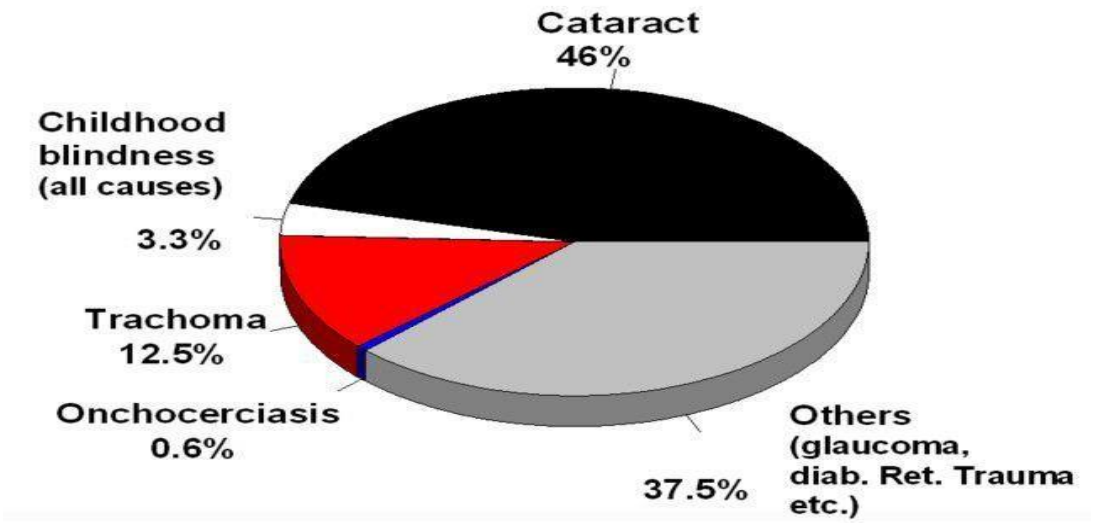
W.H.O definition of blindness is as following

“Visual acuity <3/60 or corresponding visual field loss in the better eye with best possible correction is called blindness.”

Common causes of blindness;

There are many conditions which can cause blindness if not treated on time. Therefore, prevention and timely management of these conditions is necessary. Following are some common conditions which can cause irreversible blindness.

1. Cataract
2. Trachoma
3. Ophthalmia neonatorum
4. Chronic simple glaucoma
5. Vitamin A deficiency
6. Retinal detachment



i. Cataract;

It is major cause of irreversible blindness in world. Early diagnosis and management of cataract is important to prevent blindness.

For prevention of congenital cataract, vaccination of mother during pregnancy for measles and rubella should be done. Early diagnosis of congenital cataract in children and their early surgery should be done to prevent amblyopia.

Senile cataract should be diagnosed early and their surgical treatment is done on time. Awareness should be given to people that its early treatment can prevent blindness as there are many myths and misconceptions in communities that blindness in inevitable with increasing age. Factors which can cause cataract should be controlled e.g., diabetes mellitus.

ii. **Trachoma;**

This is most common cause of infectious irreversible blindness in world. It is caused by microorganism **chlamydia trachomatous.** It is commonly present in third world countries as there is poor hygiene and sanitation.

Education of people living in villages and trachoma regarding sanitation and handwashing to prevent trachoma is important.

SAFE strategy is implemented in communities to treat trachoma and prevent blindness.

Prevention of trachoma involves

1. Assessment to identify communities with blinding trachoma.
2. Delivery of community bases trichiasis. Surgery by trained paramedical staff (S of SAFE)
3. Antibiotic treatment (either tetracycline eye ointment or oral azithromycin) for people with active disease. (A of SAFE)
4. Promotion of facial cleanliness (F of SAFE) and environmental improvement.
5. (E of SAFE) includes personal hygiene and community sanitation as a part of primary health care.

iii. Ophthalmia neonatorum;

Ophthalmia neonatorum is common in neonates and its prevention ans early management can prevent blindness in neonates.

It is caused during birth by contact with the mother's birth canal that is infected with sexually transmitted disease. The infection may be bacterial, chlamydial or viral. Historically, gonorrhea was usual cause but chlamydial infection is now more common.

More effective means of preventing ophthalmia neonatorum include screening all pregnant women for gonorrhea and chlamydia infection and treatment and follow ups of those found to be infected. Mothers who were not screened should be tested at delivery.

Erythromycin ophthalmic ointment is considered effective in preventing gonococcal ophthalmia neonatorum.

iv. Chronic glaucoma.

Blindness in chronic glaucoma can be prevented by giving awareness to patients that strict adherence to medication is how much important. Eye drops are main treatment for glaucoma. Regular exercise and a nutritious diet are important to prevent risk factors which can cause glaucoma in patients. Regular checkups and follow ups are important in treatment and monitoring of glaucoma.

v. Vitamin A deficiency;

Vitamin A is very important in vision. To visualize full spectrum of light, eye needs to produce certain pigments for retina to work properly. Vitamin A deficiency stops the productions of these pigments leading to night blindness. Vitamin A is also needed to nourish other parts of eye including cornea. Without vitamin A, eye cannot produce enough moisture to keep them properly lubricated.

Vitamin A is leading cause of preventable blindness in children worldwide. It can be prevented by taking diet rich in vitamin A. Its deficiency is treated with vitamin A supplements. The number of supplements depend upon the age of the child.

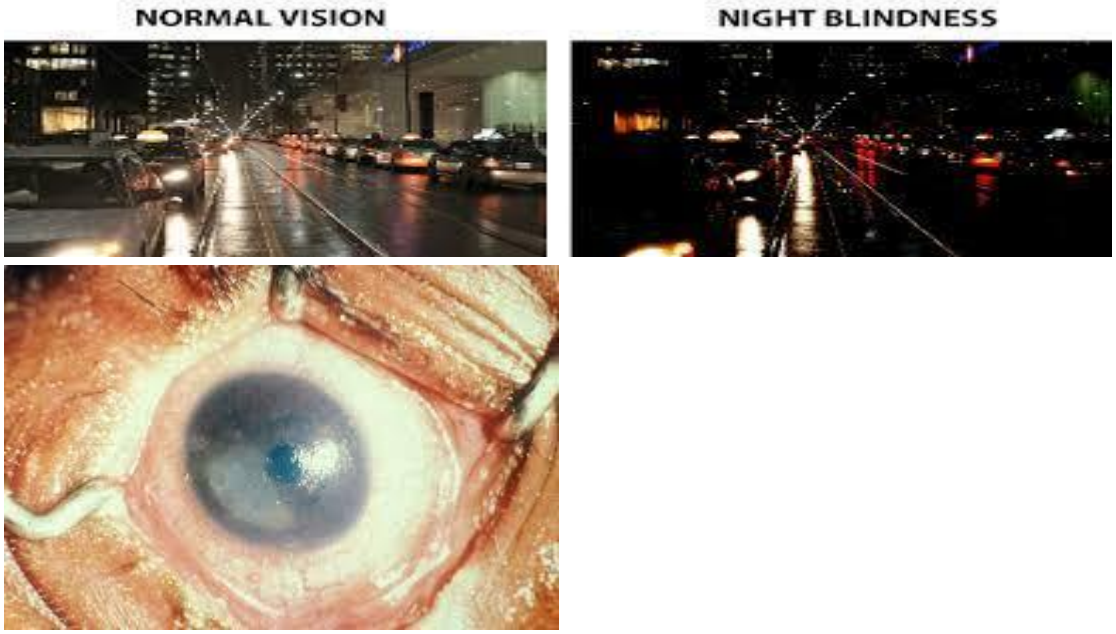
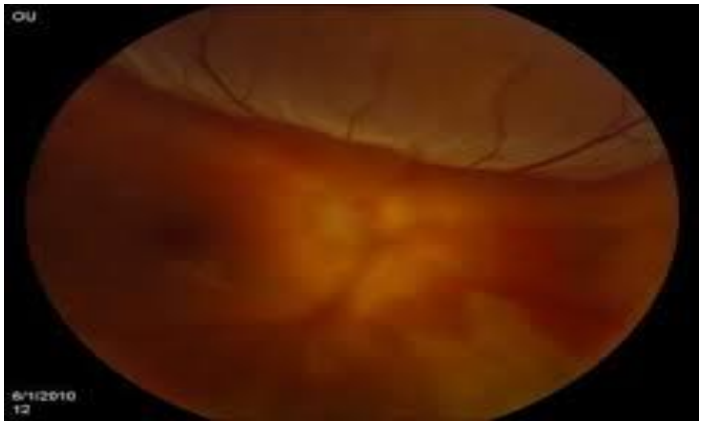


Figure 1 shows xerophthalmia due to vitamin A deficiency

Retinal detachment in high myopic patient is cause of total blindness in people. Diabetic retinopathy is also major risk factor for causing tractional retinal detachment. Awareness and education should be given to people to reduce these risk factors to prevent retinal detachment. Education should be given to patients for good control of diabetes and regular fundus examination for early detection and management of diabetic retinopathy. High myopic patients should be warned against trauma to head and face region. People should be educated about symptoms of retinal detachment e.g., floaters, flashes and visual loss, and advised to consult ophthalmologists as early as possible if they feel any above-mentioned symptoms.



b. Prevention of ocular injuries in industrial workers and radiant injuries;

Ocular injuries are very common in industrial workers and workers doing their job in radiology and radiation department. Prevention of these injuries is important for retaining visual acuity. Flying pieces of debris, metal and glass accounts for a large majority of workplace injuries. In fact, 70% of serious injuries are caused by flying or falling objects and 60% of these objects are smaller than head of pin.

Chemicals, splashing of fluid and burns from steams all other work-related eye injuries with which a person can interact. These can damage cornea and cause ulcers, keratitis, and limbal ischemia.

Radiation exposure in workers of radiation department can cause acute lesion in eyelid, conjunctiva and corneal epithelium. They can lead to blurry vision, dry eyes, cataracts, retinal detachment, glaucoma, loss of eye lashes, problems with tear duct or bleeding in the eye.

These injuries can be prevented by wearingOSHA-approved eyewear and goggles. It may be necessary to wear side shields or full-face shields and helmets to protect from exposure or blunt trauma.

c. Prevention of amblyopia in children;

Screening of children within first 4-6 weeks after birth and then monitoring yearly up to 4 years of age should be done to prevent amblyopia. This is done in children in whom parents note any kind of visual inattention, squint, or any other abnormalities. Red reflex test with direct ophthalmoscope, pupillary reactions, external examination by torch light is done up to 3 months of age. For 3 to 6 months old children, corneal reflex test and behavior after occlusion of one eye is tested in addition to other above-mentioned tests. In additions to these tests, visual acuity is examined and if refractive error is present glasses are prescribed. If amblyopia is found to be present, counselling of patients regarding patching of better eye according to instructions of optometrists should be done.

d. Ophthalmic care in school children;

1. Refractive errors are most common cause of poor vision in school going children. If these remain untreated, they can more greatly impact on their life as they can lead to amblyopia. They can impact on daily life of children, mobility, reading and fine work. Therefore, early detection and correction of these refractive errors and usage of glasses improves quality of life of children.
2. Unhygienic conditions and poor sanitation can lead to eye infections. Most common ocular condition associated with unhygienic condition is trachoma. Early detection and management are important as trachoma can lead to blindness.
3. As children are growing, they need more nutrition to fulfill their body requirements. School going children can suffer vitamin A deficiency which can lead to dry eyes and night blindness. Diet rich in vitamin A and supplements containing vitamin A can prevent this blindness.
4. Trauma with sharp objects e.g., tip of pencils and nib of pens, fall on sharp objects can cause tear of ocular layers and structures leading to poor vision. Education of children and their regular monitoring can prevent this kind of trauma related injuries and blindness in children.

a. LASER and its uses in ophthalmology;

i. LASER;

Laser is acronym for

L; light

A; amplification (by)

S; stimulated

E; emission (of)

R; radiation

ii. LASER physics;

Light as electromagnetic waves, emitting radiant energy in tiny packages called quanta/ photons. Each photon has characteristic frequency and its energy is proportional to its frequency. These photons when interact with atoms they can undergo absorption, spontaneous emission or stimulated emission.

iii. Definition of LASER;

It is a device that generates an intense beam of coherent monochromatic light (or other electromagnetic radiation) by stimulated emission of photons from excited atoms or molecules.

iv. Properties of LASER light

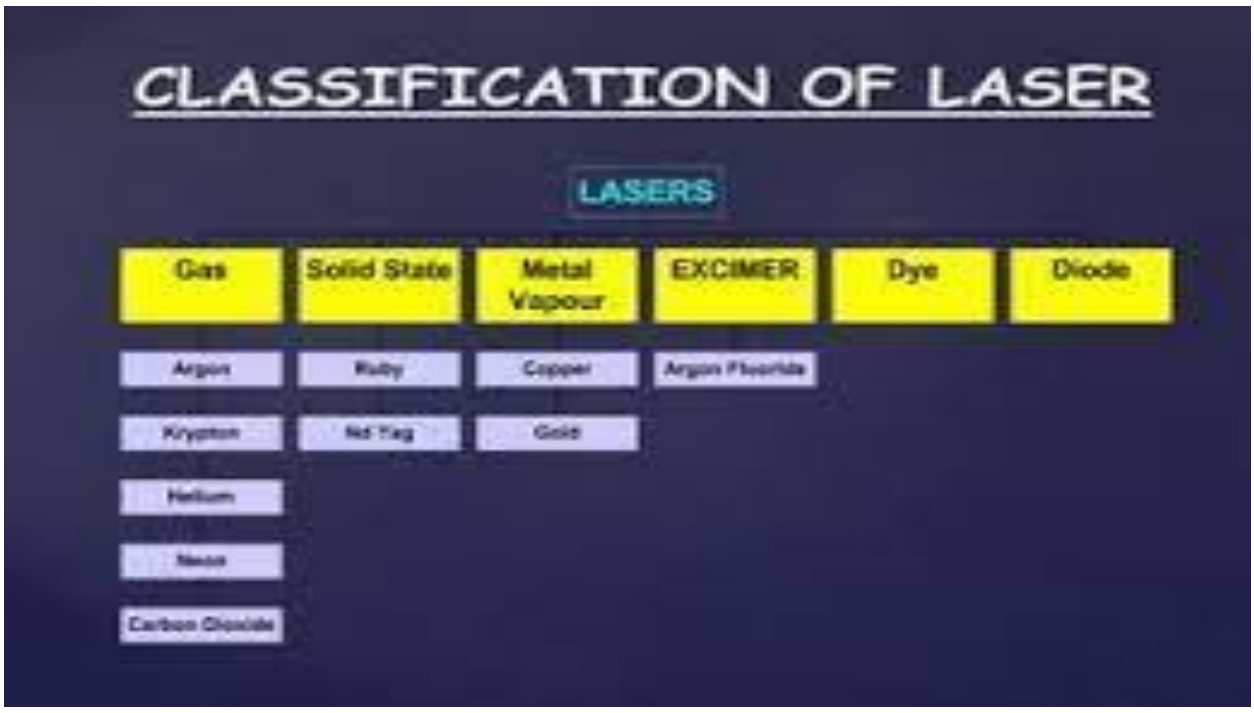
Monochromatic; (emit only one wavelength)

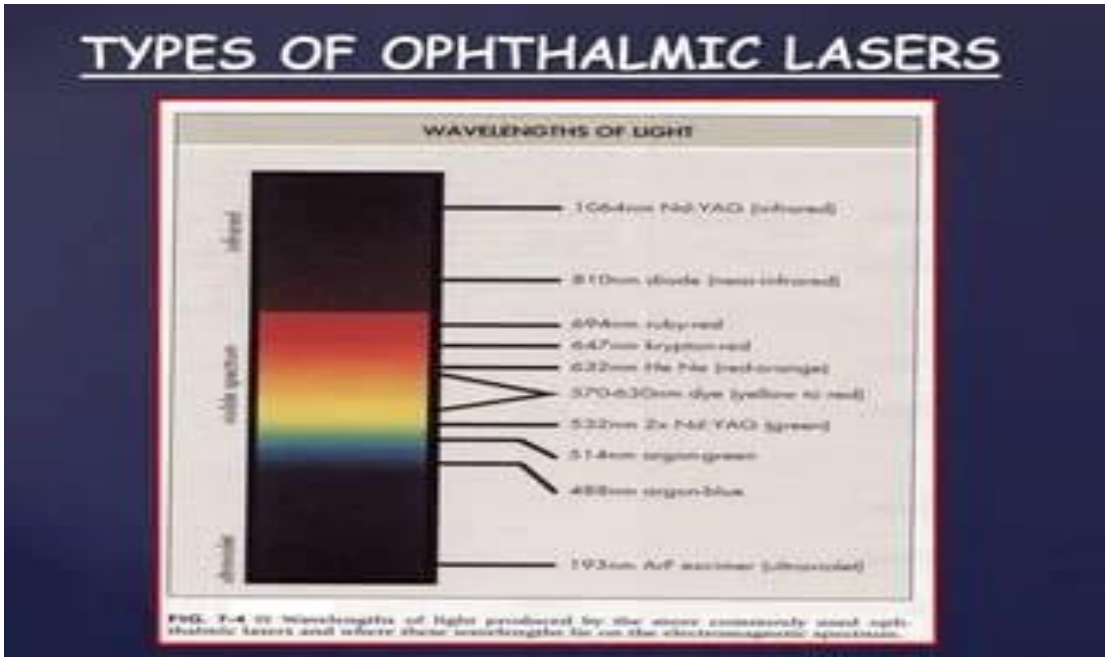
Coherence; (all in same phase -improve focusing)

Polarized; (all in one plane-easy to pass through media)

Collimated; (in one direction &non spreading)

High energy;(intensity measured by **watt** J/s)





v. Nd:YAG LASER;

(Neodymium-doped yttrium aluminum garnet) is a crystal that is used as a lasing medium for solid state lasers. Nd-YAG laser typically emit light with a wavelength of 1064 nm in the infrared spectrum.

Uses;

1. To correct posterior capsular opacification
2. Peripheral iridotomy in angle closure glaucoma patients.
3. Frequency doubled Nd-YAG lasers are used for pan retinal photocoagulation in diabetic retinopathy patients.

vi. Excimer laser;

It is a form of ultraviolet laser which is used in LASIK.

b. Uses of laser in ophthalmology;

Lasers are used in ophthalmology for following purposes

1. Diagnostic uses
2. Therapeutic uses

i. Diagnostic uses;

Lasers are used in diagnostic instruments which are helpful in making diagnosis od ocular diseases.

1.scanning laser ophthalmoscopy

2. laser interferometry

Figure 2 scanning laser ophthalmoscope

ii. Therapeutic uses of lasers;

Lasers are used therapeutically in

1. Extra-ocular adnexa
2. Anterior segment
3. Posterior segment

Therapeutic uses in extra-ocular adnexa;

It is used for

1. Removal of lid masses
2. Orbitotomies
3. Blepharoplasty, aesthetic (smoothen wrinkles)
4. Capillary hemangioma, port wine stain

a. Uses of Laser in anterior segment;

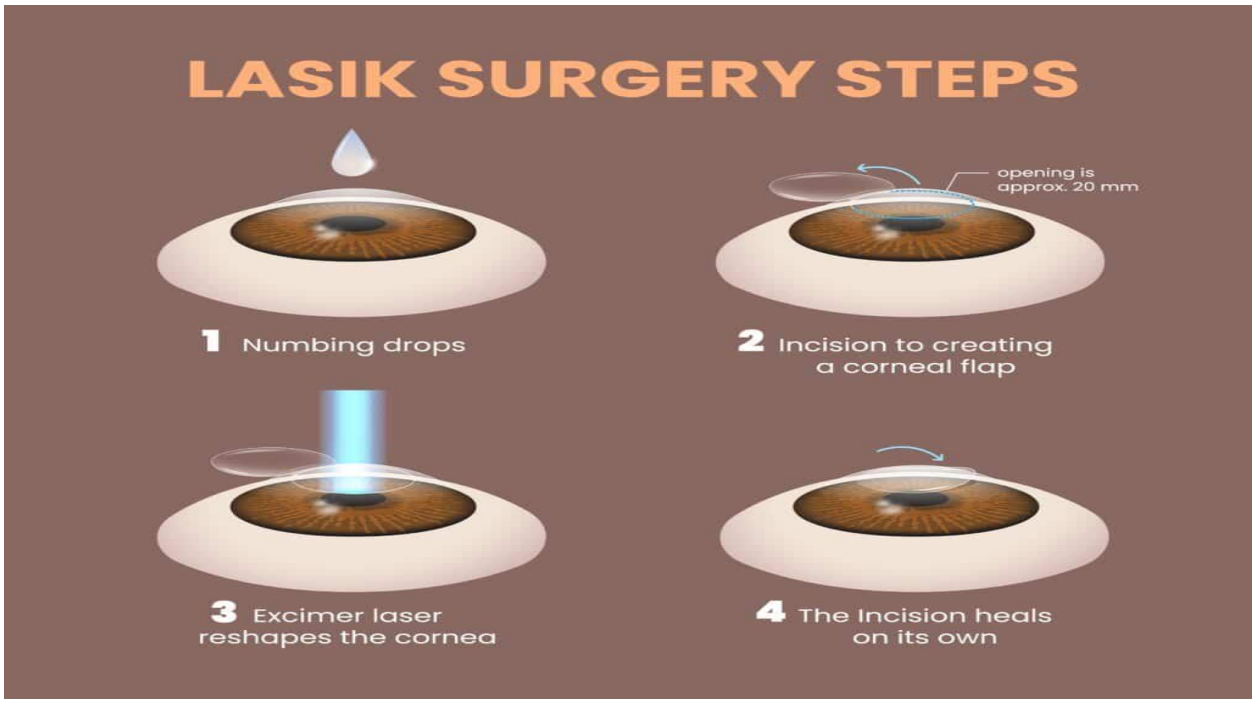
i. Cornea;

laser is used in keratorefractive surgeries;

- Photo refractive surgery (PRK)
- Laser in situ Keratomileusis (LASIK)
- Laser subepithelial keratectomy (LASEK)

It is also used in

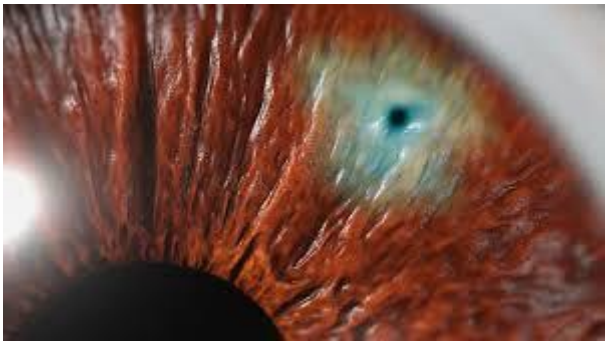
- Laser thermal keratoplasty
- Corneal neovascularization



ii. Laser in glaucoma;

Laser is used in glaucoma for

- Laser iridotomy
- Laser trabecuplasty (LT)

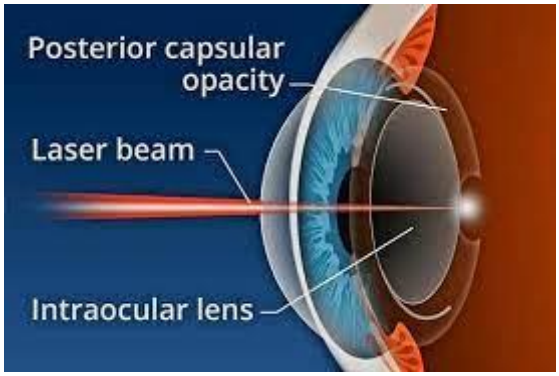


iii. Use of laser in lens;

Laser is used in lens for

- Posterior capsulotomy

- Laser phacoemulsification



iv. Laser in vitreous;

Laser in vitreous is used for

- Vitreous membranes
- Vitreous traction bands.

v. Laser treatment of fundus disorders;

Laser is used in following fundus condition as treatment;

- Diabetic retinopathy
- Retinal vascular diseases
- Choroidal neovascularization
- Clinically significant macular edema
- Central serous retinopathy
- Retinal break/detachment
- tumor

Figure 3 shows pan retinal photocoagulation

KEYPOINTS:

KEYPOINTS
• ***Preventive Ophthalmology*** *focuses on the early detection, management, and*

prevention of eye diseases and visual impairments.

- ***Total blindness**, and partial blindness, can result from a variety of causes such as cataracts, glaucoma, retinal detachment, diabetic retinopathy, macular degeneration, trauma etc.*
- ***Ocular injuries** can occur in various ways, including accidents, trauma, exposure to harmful substances, and more.*
- ***LASER,** stands for "Light Amplification by Stimulated Emission of Radiation," is a technology that harnesses the principles of quantum mechanics to produce highly focused and intense beams of coherent light.*
- ***Key uses of Laser in Ophthalmology** include use in cataract surgery, glaucoma surgery, macular disorders, LASIK surgery, PRK, laser-assisted vitrectomy.*
- ***Vision screening in school children** is a systematic process designed to identify potential vision problems or eye disorders. It helps to detect common vision issues early on.*

ASSESMENT

Question#1

What is preventive ophthalmology? What is its principle?

Question #2

What is W.H.O definition of blindness??what are common causes of blindness??write a note on any 2 major causes of blindness.

Question #3

What is trachoma? What is its causative agent??what is SAFE trial?

Question #4

How do you prevent ocular injuries in industrial workers?

Question #5

How do you prevent amblyopia in children?

Question #6

What are common causes of poor vision in children and how do you prevent this?

Question # 7

What is laser? How do you define it? What is its physics?

Question#8

Write classification of laser and brief note on Nd-YAG laser/

Question #9

Write uses of lasers in ophthalmology.

LIST OF PRACTICALS

5.1 Ocular Emergencies Practicals

5.1.1 Practical-1: Removal of conjunctival Foreign Body

- Indication
- Apparatus
- Procedure
- Results
- Precautions

Removal Of Conjunctival Foreign Body

5.1.1.1 Diagnosis:

Diagnosing a conjunctival foreign body involves a thorough examination by an eye care professional. The symptoms may include redness, tearing, a sensation of a foreign object in the eye, and sometimes pain. Visualization of the foreign body may be done using a slit lamp or pen torch.

5.1.1.2 Equipment:

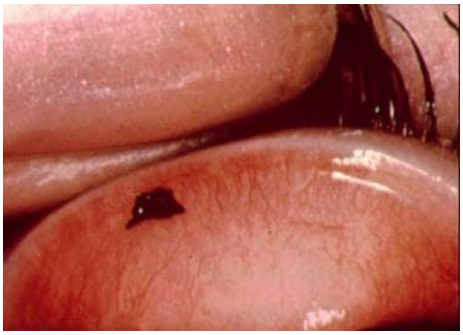
- Topical anesthetic drops (2% proparacaine/ 0.5% alcaine)
- Cotton swab moistened with saline
- Cotton applicator stick or paper clip for eversion of the upper eyelid
- Saline irrigation bottle
- Forceps
- Slit lamp for illumination/magnification or pen torch

5.1.1.3 Procedure:

- Instill 2 drops of topical anesthetic in affected eye
- First inspect the eye for any foreign bodies on bulbar conjunctiva by asking the patient to look up/down/right/left
- Next inspect the inferior conjunctival cul de sac by having the patient look up while the examiner pulls the lower lid down.
- For visualization of foregin bodies in upper conjunctival sac upper lid eversion is required by asking the patient to look down and then place the cotton stick applicator/ paper clip in the upper lid

recess.While the patient continues to look down, grasp the upper lid margin lashes with the fingertips of one hand, and pull the lid downward and toward you (see the image below). The conjunctival surface of the inside of the upper lid is now visible.

- Conjunctival foreign bodies located in any of these areas can be removed by gently wiping the foreign body with a saline-moistened cotton swab. If a visible foreign body does not adhere to the moistened swab, irrigation with saline may be attempted but if it is firmly adhere then remove it with forceps.



Conjunctival FB on upper lid

5.1.1.4 Result:

- Foreign body removal will provide comfort to the patient and prevent further damage to the eye (corneal abrasion/laceration ,infection, inflammation)

5.1.1.5 Prevention:

- Protective Eyewear: Using protective eyewear when engaging in activities that may pose a risk of foreign body entry.
- Eye Safety Measures: Being cautious when working with tools, chemicals, or participating in activities where foreign bodies may be present.
- Regular Eye Checks: Regular eye examinations can help identify and address any potential issues before they become problematic.
- Avoiding Rubbing: Advising the individual not to rub the eye, as this can exacerbate the situation or cause further injury.

If someone suspects they have a foreign body in their eye, it is crucial to seek prompt medical attention for proper diagnosis and safe removal.

5.1.2 Practical-II: First Aid Management of Ocular Emergencies

a. Removalofcornealforeign body
b. Penetrating InjuryoftheEyeball
c. Lacerationofthecornea
d. Injuriesof theeyelid
e. ChemicalInjuriesoftheeye
f. ThermalTrauma
g. Drug reactions
h. AcuteCongestive Glaucoma
i. Retinal Detachment
j. AcuteUveitis

Thestudentwillhavetocoverfollowingpointsforeachofaboveandothereye emergencies / diseases:-

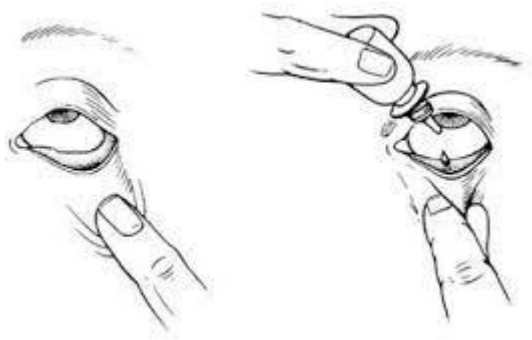
- Apparatus
- Procedure
- Results
- Precautions

5.1.3 Practical-III: Instillation of Eye Drops

.For Treatment
.For Anaesthesia
.ForDiagnostic Purpose
.InPostOperativeCases

5.1.4 Instillation of eye medication / eye drops

Eye medication can easily become contaminated by incorrect instillation. There is a right and a wrong way to instill eye medication both before and after minor office surgery. With the patient's head tilted back, the dropper, dropper bottle, or ointment tube should be held about half an inch (1.25 cm) from the eye before the release of medication. When corneal anesthesia is required, the patient should be asked to look down so that the cornea will be completely covered by the medication. It is important that the tip of the dropper or dropper bottle never touches the eye or eyelid. Contamination will result, in which case the dropper and medication should be discarded. Alcohol and alcohol-type solutions must never enter the eye. They are damaging to the corneal epithelium.



- Indication
- Apparatus
- Procedure
- Results
- Precautions
- OphthalmicEvaluation/CommunityOphthalmology

5.1.5 Other Practicals

● 5.1.5.1 Perimetry

- Perimetry is the systematic measurement of the visual field function to determine presence different Visual Field Defects.
- It is the measurement of Hill of Vision in terms of establishing the patient's differential light sensitivity across the visual field.

- **5.1.5.1.1 INDICATIONS**
- Detection of glaucoma, progression
- Chorioretinal lesions
- Optic disc and optic nerve lesions
- Neuro-ophthalmological diseases

- **5.1.5.1.2 TYPES**

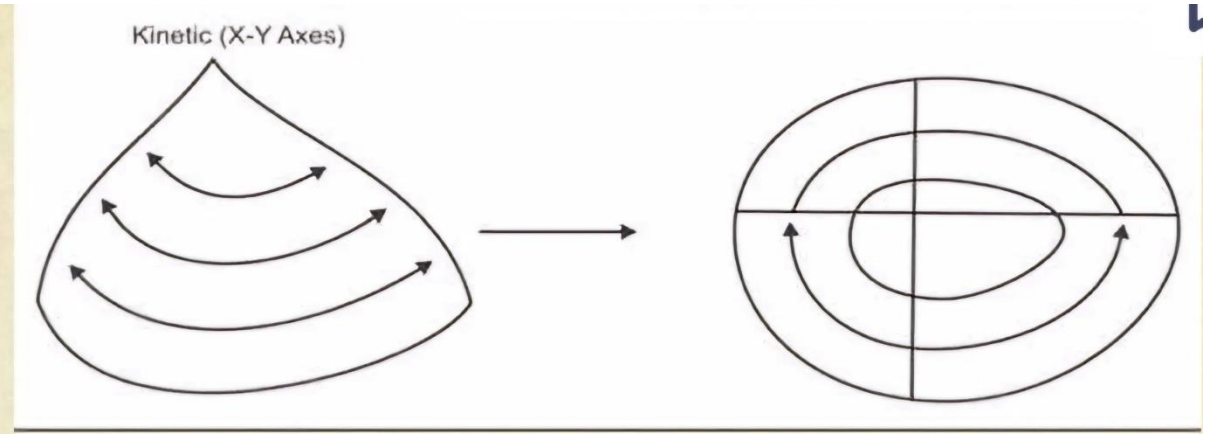
- **5.1.5.1.2.1 KINETIC PERIMETRY**
  - Confrontation
  - Tangent screen
  - Lister perimetry
  - Campimetry
  - Goldmann perimetry

- **5.1.5.1.2.2 STATIC PERIMETRY**
  - Humphrey Perimetry
  - Octopus Perimetry

- Oculus Perimetry

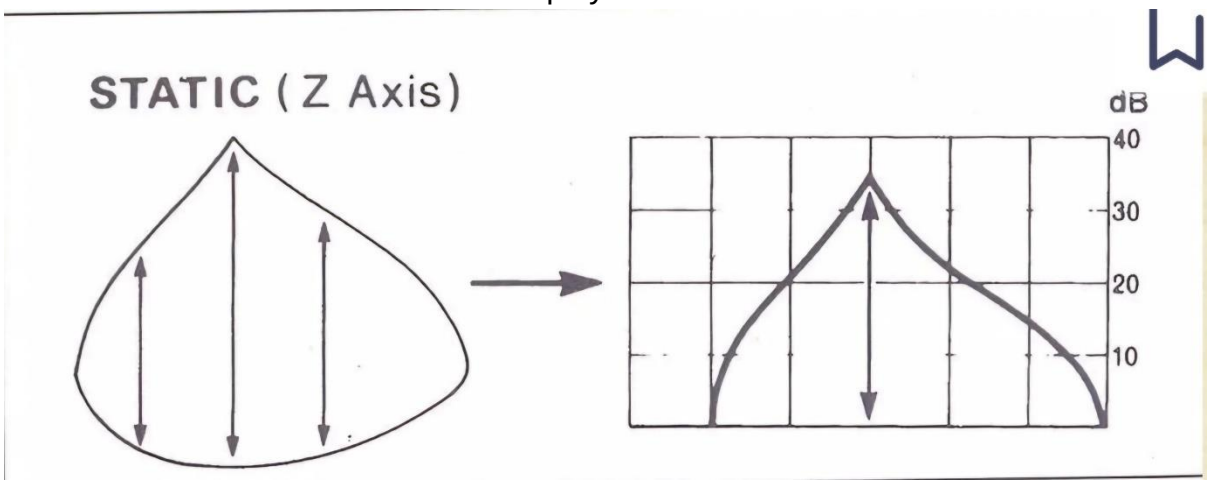
- **<u>5.1.5.1.3 PROCEDURE</u>**

- **5.1.5.1.3.1 KINETIC PERIMETRY**
- **5.1.5.1.3.1.1 Type :**
  - **Manual**
- **5.1.5.1.3.1.2 AIM**:
  - To find points in the visual field of equal retinal sensitivity.
- **5.1.5.1.3.1.3 METHOD**:
  - Stimulus is moved from a non seeing area to a seeing area of visual field.
  - Procedure is repeated with the use of same stimulus along a set of meridians , usually spaced every 15 degree.
  - The speed ,size , color and brightness of target are the different variables.
  - When the island hill-of-vision is kinetically explored along the **X-Y axes** i.e. a plane parallel to the surface of the sea, the locations of points with the same threshold are identified; these are isopters.



- **5.1.5.1.3.2 STATIC PERIMETRY**
- **5.1.5.1.3.2.1 Type:**
  - **Computerized**
- **5.1.5.1.3.2.2 Aim** :
  - To find out the threshold of retina at various fixed points.
- **5.1.5.1.3.2.3 METHOD**:
  - Patient looks into a white hemispherical bowl at a small fixation point at the center.
  - Visual field stimuli are briefly presented at fixed stationary locations.
  - Duration of presentation is about 200 milliseconds.
  - Patient presses a response button when the stimulus is detected.
  - Stimulus size and location is maintained constant.
  - Brightness varied at various predetermined constant locations in order to find out the threshold at these locations.

- In other words contrast sensitivity is tested through out the extent of area perceived.
- This type is concerned with altitude or vertical Z axis of island of vision.
- When island hill of vision is explored along Z axis: plane perpendicular to the surface of sea,varying points of sensitivity is identified,
- These are thresholds displayed as meridional cuts.



- **5.1.5.1.4 PRECAUTIONS**
  - Instructions should be given clearly to the patient.
  - Examination of eye should be done thoroughly.
  - Repeat the procedure at 15 degree interval.
  - Mapping should be in clockwise direction.
  - Blind spot should be marked in horizontal meridian in temporal quadrant.
  - VF should test both eyes separately.
  - Illumination should be adequate.
  - The patient should remove his/her glasses, if he normally uses them otherwise the field of vision will be restricted.

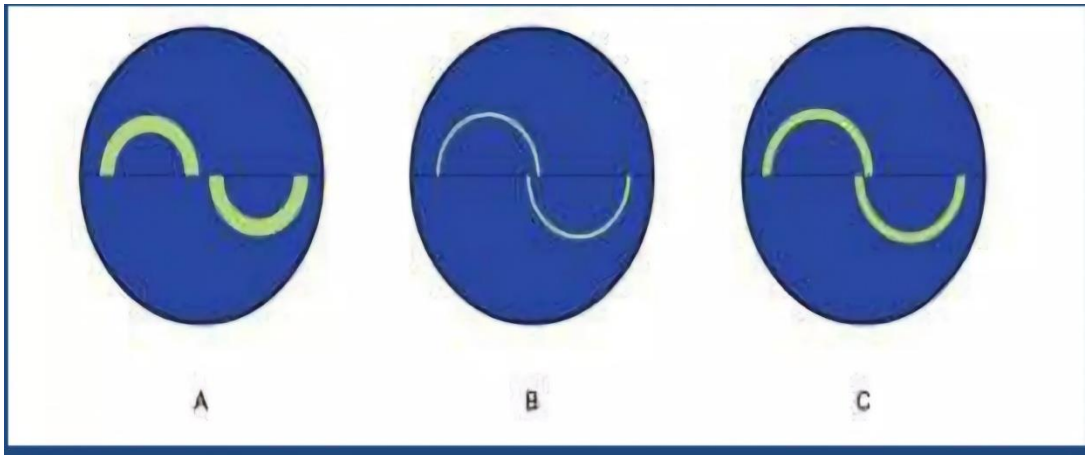
- ## 5.1.5.2 Ophthalmoscopy
    - Ophthalmoscopy is the clinical examination of the interior of the eye by means of an ophthalmoscope.
    - It is primarily done to assess the state of fundus and detect the opacities of ocular media.
- **5.1.5.2.1 INDICATIONS**
    - To diagnose opacities in the refractive media- any opacity in the refractive media is seen as a black shadow in the red glow.
    - To differentiate between a mole and a hole of the iris- a small hole and mole on the iris appears as a black spot on oblique illumination.
    - To recognize detached retina or a tumor arising from the fundus is seen as a greyish reflex.
- **5.1.5.2.2 APPARATUS**
    - Direct Ophthalmoscope
    - Indirect Ophthalmoscope
- **5.1.5.2.3 TYPES**

  There are 3 types of Ophthalmoscopy
    - Distant direct ophthalmoscopy
    - Direct ophthalmoscopy
    - Indirect ophthalmoscopy
- **5.1.5.2.4 PROCEDURE**
    - **5.1.5.2.4.1 DIRECT OPHTHALMOSCOPY**
        - For a good view of fundus the pupil should be dilated by instilling few drops of short acting mydriatic drug (e.g.combination of tropicamide and phenylephrine)
        - The subject should be examined in sitting or lying down position.
        - Examination room should be semi dark.
        - Keep the eye as still as possible**.**
        - For examining right eye of the patient, Examiner should stand on right side of the patient.
        - Hold the instrument in his right hand and Use examiner's right eye.
        - If examining the left eye, stand on the left side, hold the instrument in the left hand and use the left eye**.**
          Viewing should begin about half metre awayfrom the eye.
        - First see the "Red reflex"
        - Initially the lens power in the instrument should be set to zero, and if refractive error present in patient or examiner, e.g. if the patient is myopic then set the (-ve)lens, if the examiner or patient is hypermetropic then set the lens to (+ve) lens. If both patient & examiner have refractive error then sum together their powers.

        - Rotate the lens dial until the optic disc is focused clearly.
        - (Red numbers/negative numbers in myopia or short-sightedness.
        - Green numbers/positive numbers in hyperopia or far-sightedness.)
    - **5.1.5.2.4.2 DISTANT DIRECT OPHTHALMOSCOPY**
        - It should be performed routinely before the direct ophthalmoscope, as it gives a lot of useful information.
        - It can be performed with the help of a self-illuminated ophthalmoscope or a simple plain mirror with a hole at the centre.
        - **Procedure**- The light is thrown into patients eye sitting in a semi-darkroom, from a distance of 20-25 cm and the features of the red glow in the pupillary area are noted.
    - **5.1.5.2.4.3 INDIRECT OPHTHALMOSCOPY**
        - The patient is made to lie in the supine position, with one pillow on a bed or couch and instructed to keep both eyes open.
        - The examiner throws the light into patients eye from an arms distance.
        - In practise, Binocular ophthalmoscope with head band or that mounted on the spectacle frame is employed most frequently.
        - Keeping his or her eyes on the reflex, the examiner then interposes the condensing lens in the path of beam of light, close to the patient eye, and then slowly moves the lens away from eye until the image of retina is clearly seen.
        - The examiner moves around the head of the patient to examine different quadrants of the fundus.
        - He or she has to stand opposite to clock hour position to be examined.
        - By asking the patient to look in extreme gaze, and using of scleral indenter, the whole peripheral retina up to ora serrata can be examined.
        - **Scleral indentation**- helps in making prominent the barely perceptible lesions, done with the depressor placed on patients lid.
        - Examiner should move the scleral depressor in a direction opposite to that in which he or she wishes the depression to appear.
        - Scleral depressor should be rolled gently and tangentially over the eye surface.
        - The temporal part of upper lid is sufficiently lax so depressor can be placed inferiorly in the horizontal meridian.
- **5.1.5.2.5 PRECAUTIONS**
    - Room should be Semi-Dark.

- Convex lens should be Used.
- Pupils of the patient should be dilated.
- Examiner and Patient should be At same level in sitting position.
- Light Should not be too bright for the patient's eyes.
- Both Eyes should be examined separately.

- **5.1.5.3 TONOMETRY**
  - Tonometry is the procedure performed to determine the intraocular pressure
    (IOP).
- **5.1.5.3.1 INDICATIONS**
  - The test is used to screen for glaucoma.
  - To measure how well glaucoma treatment
- **5.1.5.3.2 TYPES**
  - **5.1.5.3.2.1** Direct Tonometery
    - Indentation Tonometry
    - Applanation Tonometry
  - **5.1.5.3.2.2**Indirect Tonometry
    - Manometry
- **5.1.5.3.3 APPARATUS**
  - **5.1.5.3.3.1** Direct Tonometry
    a. Indentation Tonometer
    b. Applanation Tonometer
       i. Contact Tonometer
          - Goldmann Tonometer
          - Perkins Tonometer
       ii. Non-Contact Tonometer
          - Air-Puff Tonometer
          - Pulse Tonometer
  - **5.1.5.3.3.2** Indirect Tonometry
    a. Manometer
- **5.1.5.3.4 PROCEDURE**
  - Goldman Tonometer is Most Common and Most Accurate. Its Method is as follows.
    - Topical anesthesia is given.
    - Staining tear film with fluorescein.
    - The cornea and biprisms are illuminated with cobalt blue light.
    - Biprism just touches the apex of cornea.
    - At this point two fluorescent semicircles are viewed through prism.
    - Applanation force against cornea is adjusted until inner edges of two semicircles just touch.



- **5.1.5.3.5 PRECAUTIONS**
    - Avoid tonometry in infected or injured eyes.
    - Clean prism before every use.
    - Disinfect prism before first use and when indicated.
    - Wait adequately for the cleaned surface to dry.
    - Replace prism every 2 to 3 years.
    - Unused prism can be kept indefinitely.
    - Verify prism for scratches/sharp edges and cracks.

- **5.1.5.4 BIOMETRY**
  - Biometry is the process of measuring the power of the cornea (keratometry) and the axial length of the eye, by using the data to determine the ideal intraocular lens (IOL)
  - **5.1.5.4.1 INDICATIONS**
    - Biometry Is Indicated in following conditions.
      - IOL calculation
      - Corneal Curvature Measurement
      - Anterior Chamber Depth measurement
      - Axial Length Measurement
      - White to White Dot
  - **5.1.5.4.2 TYPES**
    - Ultrasound (A-Scan) Biometry
      - Contact Biometry
      - Immersion Biometry
    - Laser Interferometry (IOL Master)
  - **5.1.5.4.3 APPARATUS**
    - A-Scan Ultrasound Device
    - IOL Master Device (Interferometer)
  - **5.1.5.4.4 PROCEDURE**
    - **5.1.5.4.4.1 A-Scan Ultrasound Method**
      There are two types,
    - **5.1.5.4.4.1.1 Hand Held Method**:-
      - Performed by using hand held ultra sound transducer probe.
      - The probe is placed on the patient's cornea.
      - The probe is attached to a device that delivers adjustable sound waves.
      - The measurements are displayed as spikes on the screen of an oscilloscope (Visual monitor).
      - The appearance of the spikes and the distance between them can be correlated to structures within the eye
    - **5.1.5.4.4.1.2 Stand held Method**:-
      - Probe is fitted in place of Tonometer prism in Tonometer slit lamp models.
    - **5.1.5.4.4.1.3Immersion Technique**:-
      - Also called water bath method, the patients is supine and ultrasound probe is suspended in fluid filled scleral cup placed over the eye**.**
    - **5.1.5.4.4.2 IOL Master Method**
      - It is a non contact optical device that measures the various parameters based on the following principle

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- AL measurement is based on patented interference optical method known as Partial Coherence Interferometry (PCI).This technique relies on a laser Doppler technique to measure the echo delay and intensity of infrared light reflected back from the tissue interface-cornea and retinal pigment epithelium.
- Corneal curvature(K) is determined by measuring the distance between reflected light images as in conventional keratometry.
- Anterior chamber depth (ACD) is determined as the distance between the optical section of the crystalline lens and cornea produced by lateral slit illumination
- White-to-White is determine from the image of the iris.
- Calculation of IOL power by softwere incorporating internationally accepted calculation formulae.

- **5.1.5.4.5 PRECAUTIONS**
  - Ensure the machine is calibrated and set for the correct velocity setting (e.g. cataract, aphakia, pseudophakia)
  - The echoes from cornea, anterior lens, posterior lens, and retina should be present and of good amplitude.
  - Misalignment along the optic nerve is recognised by an absent scleral spike
  - The gain should be set at the lowest level at which a good reading is obtained
  - Take care with axial alignment, especially with a hand-held probe and a moving patient (as described above).
  - Don't push too hard - corneal compression commonly causes errors.
  - Average the 5-10 most consistent results giving the lowest standard deviation(ideally < 0.06 mm).
  - IOL Master Should not be used in patients with Significant Media Opacity such as Dense Cataract as Patient cant fixate and there is Absorption of light.

- ## 5.1.5.5 FLUORESCEIN ANGIOGRAPHY
    - Fluorescein angiography, fluorescent angiography, or fundus fluorescein angiography is a technique for examining the circulation of the retina and choroid using a fluorescent dye and a specialized camera.
- **5.1.5.5.1 INDICATIONS**
    - Unexplained Vision Loss.
    - Diabetic Retinopathy.
    - Retinal Vein Occlusions.
    - Choroidal Neovascularization
    - Neuro Ophthalmic conditions like Giant cell arteritis
    - Central retinal artery occlusion
    - Polypoidal choroidal vasculopathy
- **5.1.5.5.2 APPARATUS**
    - The **Modern Mydriatic Fundus Camera** is the tool most commonly used for this purpose, Or
    - Scanning Laser Ophthalmoscope or
    - Specialized wide-field fundus cameras or
    - Fluorescein angiography can be performed using 35mm black-and-white panchromatic films or with digital cameras.
- **5.1.5.5.3 PROCEDURE**
    - Patient is informed of the normal procedures, the side effects and the adverse reactions.
    - Pupil is Dilated.
    - Patient is Made to sit comfortable.
    - 3-4 red free photographs are taken. (**Control Photographs)**
    - 5ml of 10% or 3ml of 25% Sodium Fluorescein (NAF) dye is injected through the anticubital vein.
    - Wait for 10- 12 seconds(normal arm-retina time).
    - Photos are taken at 1 second interval for 10 seconds.
    - Then every 2 seconds interval for 30 seconds
    - Late photographs are usually taken after 3 ,5 and 10 minutes.
- **5.1.5.5.4PHASES OF NORMAL FLUORESCEIN ANGIOGRAM**
    - Prearterial phase (choroidal phase)
    - Arterial phase
    - Arterio -venous phase
    - Venous phase
        - early venous
        - mid venous
        - late venous
    - Late phase
- **5.1.5.5.5 PRECAUTIONS**

- If the patient has chronic kidney disease, then the dye can cause renal toxicity. So FA Should be Avoided in such Cases.
- If the patient is allergic to the dye, Avoid FA in such patient.
- We avoid angiography during pregnancy.
- An Anaesthetic should be on Board to handle any reaction.
- Emergency tray should be Available.

- ## 5.1.5.6 CORNEAL STAINING
    - Vital stains most commonly used for ocular use
        - Sodium fluorescein
        - Lissamine green
        - Rose bengal
- **5.1.5.6.1 INDICATIONS**
    - Determine the fit of contact lenses.
    - Visualize tear film components.
    - Localization of corneal foreign bodies.
    - Enhancement of palpebral conjunctival pathology.
    - To detect ocular abnormalities, such as dry-eye,, corneal damage, and inflammatory conditions (ie, corneal infiltrates).
    - Depending on the eye care practitioner, this may be performed as part of an annual check-up or only when a patient presents with a problem or both.
    - Vital stains are often used to determine the live/dead cell ratio in a cell population.
- **5.1.5.6.2 APPARATUS**
    - **Fluorescein 2%** or **Rose Bengal 1%** or **1% Lissamine Green** diagnostic drops or impregnated paper strips.
    - Normal saline drops.
    - Local anaesthetic drops.
    - Clean cotton wool or gauze swabs.
    - Torch or slit lamp (depending on availability/skill level) for illumination.
- **5.1.5.6.3 PROCEDURE**
    - Ask the patient to look up.
    - Instil the diagnostic Fluorescein or Rose Bengal drops or use the paper strips.When using the strips, moisten with a small amount of normal saline or anaesthetic drop, taking care not to touch the end of the strip (impregnated with the dye) with the dropper.
    - Ask the patient to look up and gently touch the inside of the lower eyelid with the moistened strip, taking care not to touch the cornea.
    - Ask the patient to close the eye, gently wipe away any surplus fluid and wait about 30 seconds.
    - Using a torch or slit lamp with the appropriate colour light (blue light, if using Fluorescein, and white light, if using Rose Bengal), examine the corneal surface, note any staining and record in patient's documentation.
    - **Fluorescein** stains **Green** indicating corneal epithelial loss.
    - **Rose Bengal** stains **Red** indicating dead tissue and mucus filaments.
    - **Lissamine Green** stains **Green** indicating Degenerative cells where there is a disruption or damage of Mucin Coating.

- **5.1.5.6.4 PRECAUTIONS**
    - Allergy to fluorescein dye can cause a variety of symptoms, especially if used intravenously. It is always better to have a crash cart ready while doing a procedure such as FFA.
    - At concentrations of 2% and above of Lissamine Green, patient discomfort starts to set in so higher Concentrations should be avoided.
    - Lissamine green is not contact lens compatible therefore, after use in contact-lens wearers,so irrigate the eyes with saline.
    - Studies have shown higher degrees of ocular toxicity of Rose Bengal than other vital dyes, which is further worsened on light exposure so it should be taken care of.
    - High degree of patient discomfort, even a 1% solution of the Rose Bengal dye causes stinging and burning sensation soon after instillation, so care should be taken when using it.
    - The presence of even lubricating eye drops on the ocular surface interferes with uptake of the Rose Bengal. So, it should be carefully used.

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