Chronic Visual Loss

OBJECTIVES:

There is some difference between f1&f2 slides so make sure to cover all the different point (click here)

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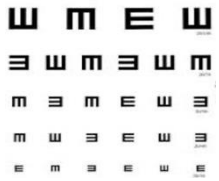
REFERENCES: lecture, 436 group (A) team, 435 team.
Editing file

Color index: Important | Notes | Book | Extra

Special thanks to 436 (A) teamwork.

Introduction to chronic visual loss

Tunnel vision in advanced glaucoma



Good quantity but bad quality.

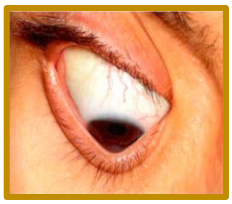
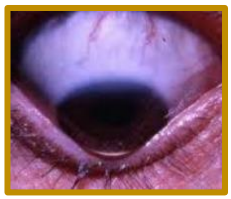
- **Definition:** a gradual progressive event (painless visual loss).
- Duration: > 2 weeks.
- **Vision:** (how can we assess vision?)
  - Quantity: VA (visual acuity).
  - Quality: VF (visual Field), clarity of vision, color vision.
- **Causes:**
  - Refractive (the most common).
  - Cornea.
  - Lens.
  - Vitreous.
  - Retina.
  - Optic nerve.
  - Neurologic.

- **Refractive:**
  - Mostly in young adults.
  - **Causes:**
    - Myopia, hyperopia or astigmatism.
    - Amblyopia (كسل العين).
  - **Signs:**
    - Normal exam.
      - You will have completely normal examination apart from affected visual acuity with refraction error.
      - However, sometimes patients with astigmatism have **corneal scar** on examination.
    - Refraction needed to show errors.
  - **Treatment:**
    - Glasses, contact Lenses, refractive surgery.
    - There are different types of refractive surgery:
      - Lasik and epilasik: we are maintaining the epithelium &r applying it again. Faster visual recovery.
      - PRK: there is scraping of the epithelium by focusing the laser emission on the corneal stroma. Higher safety margin in patients who have borderline corneal thickness.

- NB: lenticular causes need cataract surgery.
    - Lenticular causes of refractive error (not important to know, but good for your knowledge).
    - If you have:
    - A bulky lens, it will focus the light rays in front of the retina, and it will induce more myopia.
    - Or if you have weak zonules, the lens will either move forward or backward.
        - If it moves forward, the light rays will be more focused in front of the retina, so it will induce more myopia.
        - If it moves backward, light rays will be focused behind the retina, so it will induce hyperopia.

- **Cornea:**
    - **Causes:**
        - Scar from previous trauma or infection.
        - Hereditary: corneal dystrophies, keratoconus.
            - Why there is a scar whenever you have a trauma or an infection? because the collagen fibers intercalated with each other instead of being parallel causing scaring.
            - We suppress the scarring by steroids (we give steroids after eye surgeries).
    - **Signs:**
        - Corneal scar.
        - Bulging cornea.
        - Stromal opacities.
        - Patients might have some conjunctival injection with chronicity.

        - **Keratoconus** قرنية مخروطية (very important for exam):
            - In keratoconus, instead of having a smooth regular corneal surface, it is bulging anteriorly; It will induce more myopia and more astigmatism because the regularity of the cornea will be lost.
            - It is impossible for someone with keratoconus to have hyperopia.
            - In early phases, astigmatism is regular; Then with advanced keratoconus it becomes irregular astigmatism.

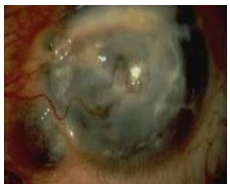
Keratoconus
Sign: Munson's sign.

            - When the lid margin bulges down when someone looks down, this is a sign called **Munson's sign** that occurs with advanced Keratoconus.

            - Descemet's membrane will rupture, then aqueous will enter to the corneal stroma. With chronicity, it will induce corneal haze, corneal edema. It also causes apical scarring.
            - **Advanced keratoconus:**
            - **Irregular myopic astigmatism.**
            - **Munson's sign.**

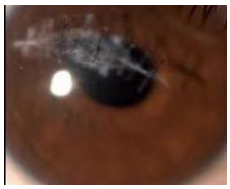
- **Apical scarring.**

- Stromal opacities



  - Conjunctival injection with chronicity. Conjunctival injection is almost always seen in acute event, but sometimes you might see it as chronic event because of chronic infection like fungal keratitis or herpetic keratitis.

- Corneal scar

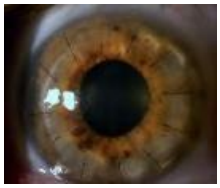


Important picture

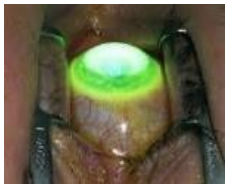
  - This pt. had a penetrating globe injury by a metallic object (full thickness corneal laceration). It needed suturing, we sutured it by (10 nylon) which is non absorbable, we need to remove it after a while.
  - The cornea will heal by scaring which will induce chronic visual loss. Also, corneal scaring induces astigmatism that is a cause of chronic visual loss (**this is the main reason**).
  - Sometimes the scar is central, within the pupillary area, so corneal haze will obscure the entry of light rays within the pupil, resulting in astigmatism and a barrier toward full light entry through the pupil.
  - Also, infection. If you are a contact lens wearer, you might have a corneal ulcer (microbial keratitis). The most common organism in contact lens wearer is pseudomonas. It causes a very rapid corneal perforation.

♦ **Treatment:**

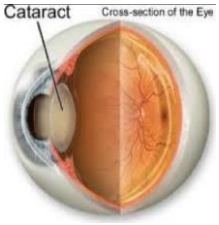
- Refraction to correct astigmatism or myopia.
- Contact lens (soft or hard) for keratoconus.
  - It is used to depress the coning cornea back.
- Corneal cross linking.
  - UV light is applied to strengthen the corneal stroma and as a result the bulging will stop. but we should protect the retina (by vitamin B drops).
- Keratoplasty (زراعة قرنية):



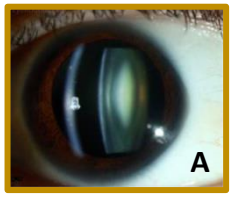
  - If the conservative measures fail.
  - A cornea is taken from a donor & is implanted in a recipient eye, there are 3 types:
  - Penetrating keratoplasty: implanting all layers of cornea.
  - Lamellar Keratoplasty: transplanting only the stromal and bowman layers.
  - Indications:
    - Keratoconus without scaring or with anterior stromal scaring
    - **Not** for deep posterior stromal scaring.

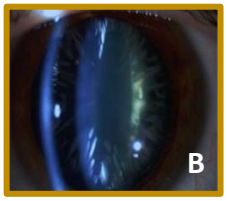


- **Lens** "cataract":
  - Lens is transparent, and it contains proteins which are well-organized. When there is disorganization of lens protein, there will be clouding of the lens (cataract).
  - **Pathophysiology:** Video
    - Disorganization of lens proteins → **opacification.**



  - **Causes:**
    - Age related (the most common cause).
      - The origin of the lenses is the surface ectoderm, same as hair and skin. After age 40, changes happen to hair, skin and vision. People develop (presbyopia) because accommodation is slightly affected (the lens loses its elasticity) secondary to disorganization of lens proteins.
    - Metabolic: DM is the most common cause of cataract development & progression.
    - Traumatic.
    - Congenital.
    - **Drugs: Steroid,** it will cause **posterior sub-capsular cataract** (it will cause glaucoma as well).
    - Inflammation: Uveitis
    - Ocular: Patient with retinitis pigmentosa





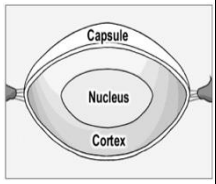
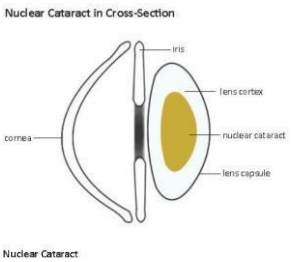
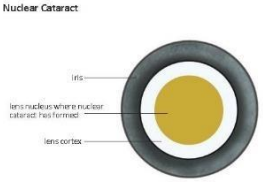
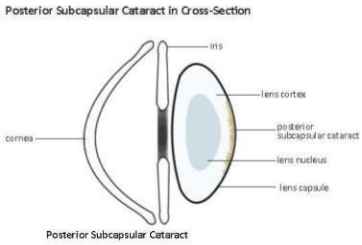
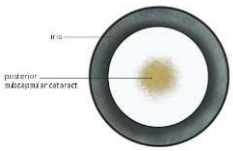
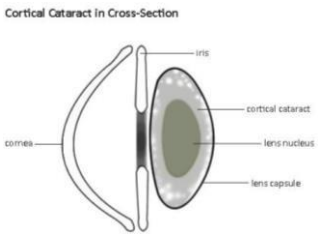
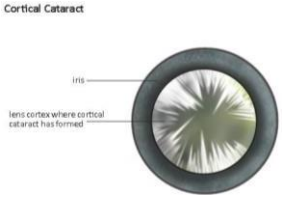
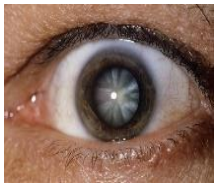
Diagnosis:

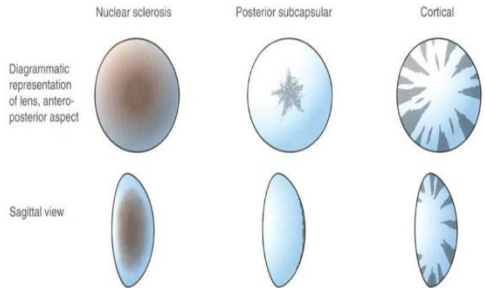
A. **Cortical cataract.**
B. **Nuclear cataract.**

Treatment options:

- **Phacoemulsification.**
- **Extra-capsular cataract extraction.**

♦ **Clinical Classification** (important):

1- According to The Maturity (progression from immature, mature, hyper-mature).		
Immature	**Mature**	**Hyper-Mature**
▪ you can see the posterior pole (retina).	▪ The whole lens is completely white. ▪ you **cannot** see the posterior pole "retina". ▪ The anterior chamber is shallow(narrow) →risk of glaucoma, so do a prophylaxis which is iridotomy.	▪ The lens proteins leak through the intact capsule, Lens is composed of nucleus, cortex & capsule. When the cortical proteins start to leak through an intact capsule, the nucleus will sink down within the capsule & the capsule will wrinkle. 
2- According to the Anatomic location important for surgical intervention, it can be a mixture of all types.		
Nuclear	**Sub capsular**	**Cortical**
▪ The lens nucleus itself becomes opacified.   	▪ Nucleus is not significantly affected. ▪ It precipitates in the posterior sub-capsular area.   	▪ Cortex is opacified.   
3- According to the Age		
Congenital.	Infantile.	Pre-senile & Senile.



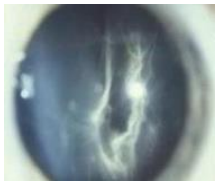
- **Clinically:**
  - **Gradual onset of painless visual loss.**
  - Visual acuity:
    - Worsening of existing myopia
      - In cataract the lens will enlarge & the anterior-posterior diameter increases, so light rays will be focused more anterior to retina).
    - Correction of hyperopia
      - In hyperopia, the light rays fall behind the retina; thus, some cataract patients, especially old once who need near vision, will be happier with nuclear sclerosis, WHY? The diameter increases, light rays fall more anterior into the retina. So old patients who do not drive at night, will be happier & should be informed that they will need glasses for near vision after surgery.
  - Loss of contrast sensitivity in low light المريض ما يقدر يفرق بين درجات الألوان, فيحتاج ضوء اقوى عشان يفرق.
  - Glare in bright light (scatter of light):
    - Classically happens with posterior subcapsular cataract during night drive. Even if the patient has a visual acuity of 20\20; this affects visual quality.
    - The posterior sub-capsular cataract will not allow equal penetration of light through the pupil. The light that passes through areas of condensation of posterior subcapsular cataract will have different intensity than the light that passes freely.

- **Treatment:**
  - Medical Treatment isn't effective!
  - Simply you have an opacified lens proteins you need to exchange the lens with an artificial clear lens).
  - Congenital: lens aspiration ± IOL (intraocular lens)
  - Acquired:
    - ECCE (Extracapsular cataract extraction) + PCIOL (posterior chamber intraocular lens) "very severe cataract".
    - Open anterior capsule & empty the lens from the opacified proteins; After that, you do ECCE or phacoemulsification then you put an artificial lens.
    - The problem with artificial lens: it does not allow accommodation. But new lenses allow patients to look far, intermediate and near without correction, it is called multi- or tri- focal IOL.
  - or Phaco (Phacoemulsification) + PCIOL (Phaco is modified ECCE: small opening and putting a foldable lens).

- **Vitreous:**
  - Vitreous hemorrhages:
    - Causes:
      - Trauma (bleeding blood vessels will cause gradual loss of vision).
      - PDR (Proliferative diabetic Retinopathy).
      - Uveitis.
      - PR (proliferative retinopathies in general).

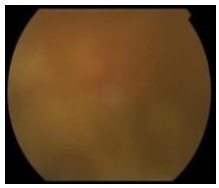
Vitreous hemorrhage, you cannot see the posterior pole

  - Vitreous condensation, opacification:
    - Causes:
      - In chronic inflammation or posterior vitreous detachment (PVD), there will be accumulation of inflammatory cells within the vitreous.
      - With inflammation, there will be fibrosis, scaring and haziness.
      - Patient will complain of flying fly, especially with old patient.
      - The vitreous is a jelly like transparent structure once it detached from its insertion it will shrink and cause condensation. sometimes it will affect the vision.



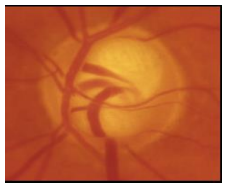
Vitreous condensation (flying fly)

  - Vitritis:
    - Causes: uveitis.
      - with chronic uveitis, the vitreous will be full of inflammatory cells.



  - Treatment:
    - Treat the underlying causes
      - Uveitis: steroids and immunosuppressive medication.
      - Vitreous hemorrhage: observation, if it not resolved by itself you need to do vitrectomy.

- **Glaucoma Video**
  - **The significance:** الماء الأزرق
    - Second leading cause of blindness.
    - Early diagnosis is crucial to prevent loss of vision.
    - Why it is important? because it's common, causes irreversible blindness and is a silent disease.
  - **Risk factors:**
    - IOP (most imp).
    - Age.
    - Family history.
    - DM/HTN.
    - Medication "Steroids".
    - Myopia.
  - **Symptoms:**
    - Initially asymptomatic.
    - Usually detected on routine examination.
    - Glaucoma starts with **peripheral(navigational) vision involvement** (**NO** central vision involvement).
      - Patients present late to the clinic when they have progressive loss of vision & their visual field is markedly affected.
  - **Signs:**

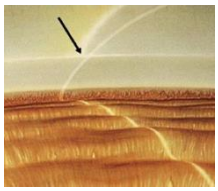


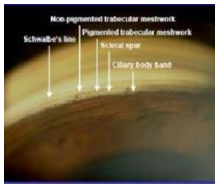
    - Glaucoma triad: high IOP (most commonly, but **not always MCQ**), characteristic optic nerve head damage and visual field loss.
    - **High IOP.**
    - Characteristic optic nerve head changes.
    - **Visual field loss** secondary to nerve fiber layer loss.
    - IOP is the single factor to be controlled (normal is 10-21 mmHg).
      - In end stage glaucoma, patients lose their peripheral visual field resulting in what's called tunnel vision. Patients will tilt their heads toward you when you speak to them.
    - In clinic, you need to
      - Examine the vision to assess the patient stage.
      - Measure IOP:
        - There are several methods to check IOP, most important is Goldman Applanation (the gold standard method).
      - Use gonioscopy lens, to check the angle of the eye, where iris meet the cornea.
  - **Aqueous humor**: video
    - Active secretion:
      - Na/K ATPase.
      - Cl secretion.
      - Carbonic anhydrase (available within the ciliary body and corneal endothelium).

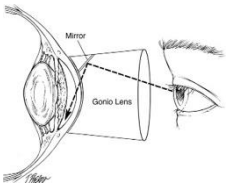
- The endothelium pumps fluid away from the cornea to keep the stroma dry.
  - The principal physiological function of the corneal endothelium is to allow leakage of solutes and **nutrients** from the **aqueous humor** to the more superficial layers of the cornea while at the same time pumping **water** in the opposite direction, from the stroma to the aqueous.
- Accumulation of fluid within the stroma will result in a cloudy cornea instead of the normally transparent cornea.
- For example, a patient underwent a penetrating keratoplasty and developed glaucoma. I want to give the patient a medication to stop the action of carbonic anhydrase pump in order to reduce the aqueous production. At the same time, the medication will stop the function of the carbonic anhydrase pump within the, and fluid will accumulate in the stroma (resulting in a cloudy cornea). In such a case, carbonic anhydrase pump inhibitors are <u>not</u> my 1st option.

- Passive secretion:
  - Ultrafiltration.
  - Diffusion.

♦ **Gonioscopy or zeiss gonioscopy lens:**





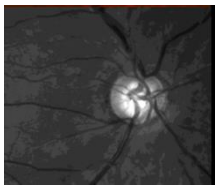


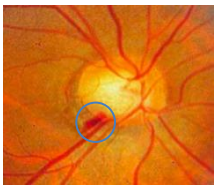
- **Normal angle structures (important):**
  - Schwalbe's line (SL).
  - Trabecular meshwork (TM).
    - Non pigmented.
    - Pigmented.
  - Sclera spur (SS).
  - Ciliary body.
- It is important to know these structures because if we do not see them, it means the angle is closed.
- In the aqueous humor pathway, the area of maximum resistance is between the lens and iris.

Instrument: gonioscope/goniolens. It is used to view the iridocorneal angle in case of glaucoma.

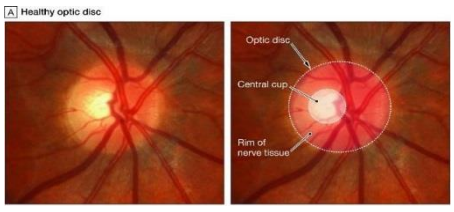
♦ **Optic Nerve Head (ONH) complex evaluation:**

- You will definitely have cupping in your exam.
- In clinic do detailed optic nerve exam because you might have:
  - glaucomatous optic nerve head damage.
  - Anomalous disc.
  - Disc pallor because of CNS or DM.
- What to evaluate:
  - Disc margin and disc diameter.
  - **Cup/disc ratio:** (important)
    - How to estimate it? Take the vertical ratio; if more than 0.3 we should worry.
    - Normal value is 0.3, bigger cup = more nerve tissue loss!
    - Cause for large cups: glaucoma.



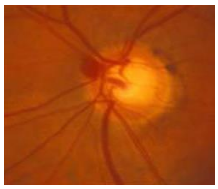


Disc hemorrhage in normal tension glaucoma



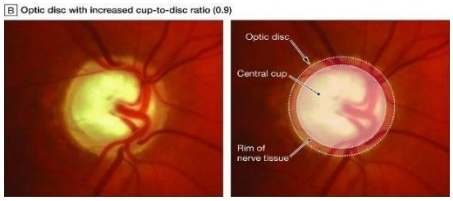
- Neuro-retinal rim:
  - Neuro-retinal rim is the neural tissue in the disc.
  - The cup is almost circular. There are almost 1 million axons passing within the optic canal to go to the brain. These axons will form the **optic disc**. There is an empty space in the middle because 1 million axons cannot completely fill the canal. The space is called cup. When there is an enlargement of the cup, it means you are losing some axons because of glaucoma.
  - How to assess the cup? 1- disc margin 2- neuro-retinal rim. نسبة وتناسب

    How much is the ratio of the cup to the disc margin vertically.



Optic disc hemorrhage

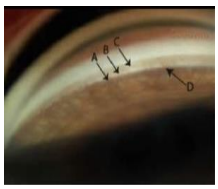
- Disc size.
- PPA (peripapillary atrophy).
- NFL defect (nerve fiber layer).
- Optic disc hemorrhage (important).
  - It comes commonly with normal tension glaucoma. you will see spot of disc hemorrhage at the disc margin. Most of the times, you need to pay attention to the cupping itself.



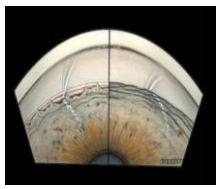
Notice: increase cupping, thinning of neuroretinal rim

- **Classification of glaucoma:**
  - According to the etiology:
    - Primary: no detectable reason and often bilateral.
    - Secondary: predisposing factor and often unilateral.
      - **Most common causes of secondary glaucoma: DM (neovascular glaucoma),** uveitis (unilateral or bilateral).

        - Generally, if you have a glaucoma patient in your clinic, you need to decide the type of glaucoma, open or closed angle. Why? For management.
        - Patient in which the structures are visible with gonioscopy, but is having high IOP, optic nerve head & visual field changes → open angle glaucoma.
        - Patient in which the iris is rolling on the angle structures with gonioscopy lens → angle closure glaucoma.
        - Sometimes, you will have the iris covering the angle structures. In this case, press the gonioscopy lens gently on the cornea. Why? We want to force the aqueous in the anterior chamber to go to the angle and push the iris posteriorly. If the angle will open with pressure, and you can see the structures, then this is appositional angle closure. If it opened and you see adhesions, then this is a chronic process and the patient is having a primary angle closure glaucoma.

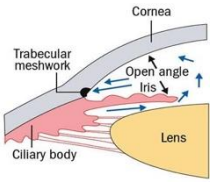


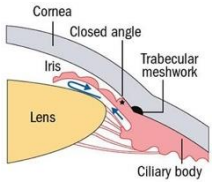
Open

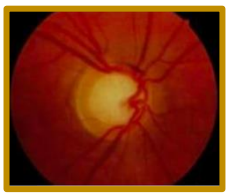


Closed

- According to the angle:
  - It can be open, closed or combined mechanism.
  - Open → iris not covering TM
    - In open angel you can see the angel structures (without pressing on the cornea by gonioscopy lens).
      - The problem with the pores in the TM.
  - Closed → iris covering TM
    - In peripheral anterior synechiae there will be adhesion between iris and angle (MCQs or SAQ).

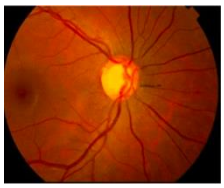






Diagnosis: disc cupping
An investigation to confirm the diagnosis: visual filed examination.
2 types of visual field defect:
Nasal step.
Arcuate scotoma.
Peripheral visual field defect.

- Why does the angel close? remember we said the maximum area of resistance in between the iris & lens. Sometimes, patients who have increased anterior posterior diameter of the **lens** (as in cataract for example), resistance will be higher. So aqueous is accumulating behind the iris. Then it will push the iris anteriorly. Iris will roll against the angle. So, instead of 2 microliters\min coming out, 1 microliter\min is coming out which means the is an accumulation of 1 microliter\min. This will push the iris & close the angel. With chronicity, adhesions will be developed.



Diagnosis: disc cupping
Next step: Goldman applanation tonometry.

♦ **Treatment:**

- Treatment is aimed at reducing intraocular pressure by 3 modalities available:
  - Antiglaucoma medications.
  - Laser treatment: SLT (selective laser trabeculoplasty for open angle), **PI (peripheral iridotomy for closed angle).**
    - SLT is applied on the trabecular meshwork to stretch the pores of the sclerosed meshwork.
    - 2 different laser entities for 2 different glaucoma entities (be careful).
  - Glaucoma surgery
    - Surgically, we do peripheral iridectomy.

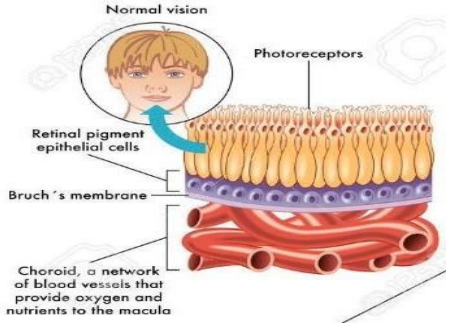
Macular degeneration (AMD): Video

- **Impaired central vision**, while peripheral vision preserved (opposite to glaucoma) IMPORTANT.
  - That is why patients with macular degeneration will complain faster than patients with glaucoma.
- Leading cause of legal blindness in developed world.

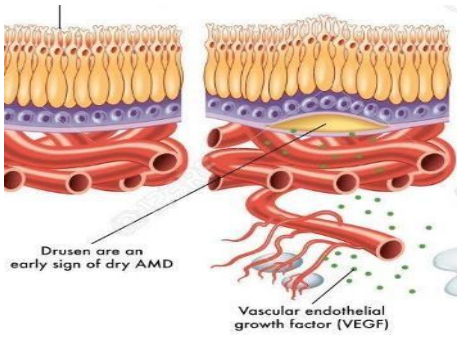
♦ Symptoms: "احفظوها زين"
- Metamorphopsia: distorted vision(الرؤية مطعوجة كأني أشوف الي قدامي مكسر).
- Micropsia: reduction of size of objects.
- Macropsia: enlargement of size of objects.
- Scotoma: visual field loss.

♦ **Etiology:**
- Multifactorial: **age**, smoking, vascular disease, UV light, diet, and FHx (family history).

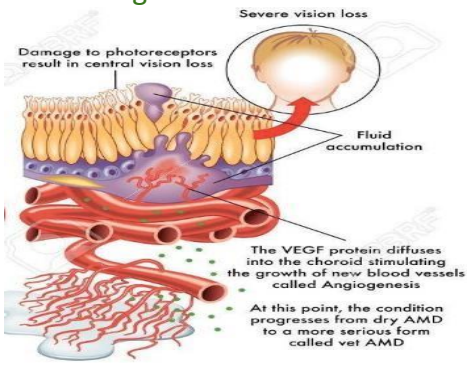
♦ **Pathogenesis:**
- Macular involvement:
  - Outer retinal layer "photoreceptors".
  - Retinal pigment epithelium (RPE).
  - Bruch's membrane.
  - Choriocapillaris.



- **Drusens:** (yellowish discoloration)
  - Drusens are lipid products from photoreceptor outer segment, found under retina.
  - Normally, the lipid deposits will be drained and absorbed by the choroid. If there is accumulation of lipid deposits, what will happen to the oxygenation from the choroid reaching the retina? decreased> ischemia> atrophy.
  - Bruch's membrane will be stretched because of drusen accumulation. This is precipitated by hypoxia resulting in break of bruch's membrane.
  - In response to retinal hypoxia, vascular endothelial growth factor (VEGF) will be elaborated resulting in neovascularization, which is a bad thing in the retina, because blood vessels are abnormal and fragile, and almost always come with fibrosis and scaring.



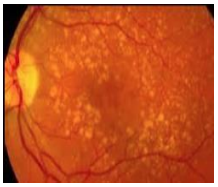
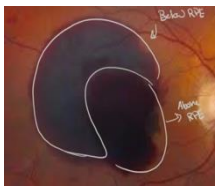
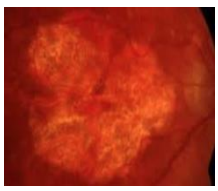
- **Neovascularization:**
  - With ischemia new vessels from choroid grow into the subretinal space forming subretinal neovascular membrane.



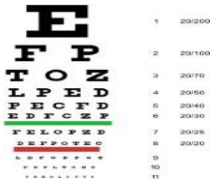
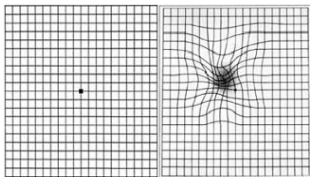
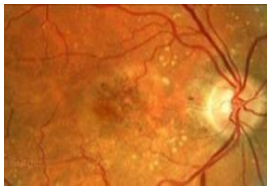
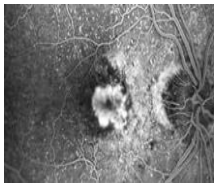
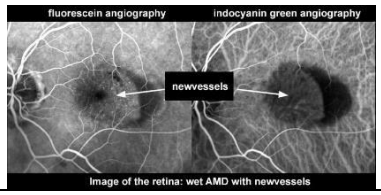
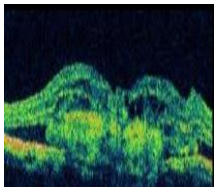
- **Hemorrhage:**
  - It can be multilayer: sub-retinal, sub-choroidal and sub/intra-vitreal depending on the extent that neovascularization reaches.
  - New vessels are bad either it continues to vitreous causing **vitreous hemorrhages** or it will bleed under the RPE causing **sub-RPE hemorrhages** or it will bleed under the internal limiting membrane and causes sub-hyaloid hemorrhage.
  - Hemorrhage into subretinal space or even through the retina into the vitreous results in significant loss of vision.

Diagnosis: age-related macular degeneration.
2 risk factors: age & smoking.
Name of investigation in pic B: Fundus fluorescein angiography.

♦ **Types:**

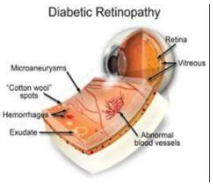
<table>
<tr><th>Atrophic = dry</th><th>Exudative = wet</th></tr>
<tr><td>• Often asymptomatic.
• Gradual over years.</td><td>• Rapidly progressive (weeks). It can be an acute or chronic cause of visual loss.</td></tr>
<tr><td>• Signs:
▪ Drusen.
▪ Geographic atrophy.
▪ Photoreceptor degeneration.
▪ Scotoma when light adapting.</td><td>• Signs:
▪ Choroidal (subretinal) neovascularization.
▪ Preretinal hemorrhage (shiny blood).
▪ Elevation of retina because of accumulation of blood.
▪ Subretinal fibrosis.
▪ Metamorphopsia (a classical complain of patients with macular degeneration).
المريض يشوف صورة متعرجة
• Central scotoma (because of blood and scaring within the macular area).
  </td></tr>
<tr><td>• Drusens are soft, mostly circular & deep.
▪ Its color is dark similar to that of the normal retina.
  </td><td>• Subretinal hemorrhage
▪ If choroidal (subretinal) neovascularization bleeds, it will appear dark grey hemorrhage. That means it is under RPE (RPE is always dark in color).
 
▪ If it is bight, that means it is above RPE.</td></tr>
<tr><td>• The accumulation of drusens for so many years will create a barrier that prevents oxygenation to reach the retina (photoreceptors) causing atrophy of the photoreceptors & RPE resulting in geographic atrophy.
  </td><td>• Subretinal fibrosis
▪ Remember we said the neovascularization almost always comes with fibrosis.
▪ Once the patient has sub-retinal fibrosis, nothing can be done; thus, it needs urgent management.
  </td></tr>
<tr><td colspan="2">What’s the difference between dry and wet age-related macular degeneration?
(extra)
• Dry ARMD is when you have drusen and macular RPE atrophy.
• Wet ARMD implies choroidal neovascularization that has grown up through Bruch’s membrane and bleed into the retina. “Wet” essentially means “bloody” in this instance.</td></tr>
</table>

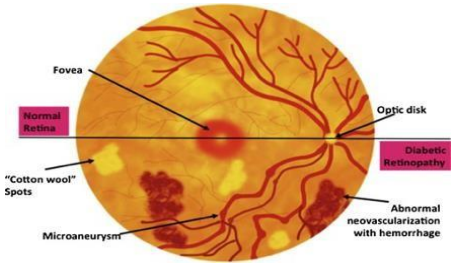
- **Diagnosis:**

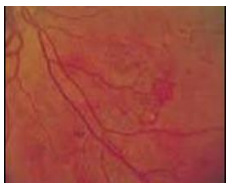
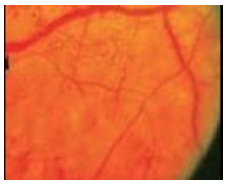
Visual acuity	Amsler grid	Ophthalmoscopy
 ▪ Because central vision will be affected first.	 If the patient sees wavy lines, it means there is disorganization of photoreceptors secondary to accumulation of drusens. The black spot (blind spot) is caused by accumulated drusens, localized ischemia, localized loss of photoreceptors, hemorrhage & fibrosis.	 ▪ Here you can see drusens, geographic atrophy, hemorrhage or fibrosis. Depends on the pt's stage.
Fluorescein angiography	**ICG (Indocyan Green)**	**OCT (Optical Coher Tomography)**
 ▪ It will show you the choroidal neovascular membrane. 		 ▪ To show subretinal hemorrhages and fibrosis, which is dense homogenous membrane under the retina.

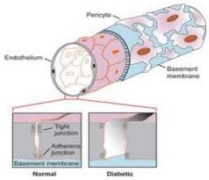
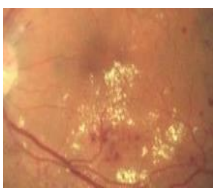
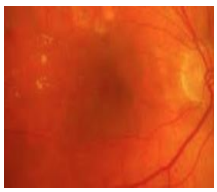
- **Treatment:**
  - If dry:
    - **Lifestyle**: stop smoking, reduce UV exposure, Zinc & antioxidants.
    - Low-vision aid.
    - Monitoring with Amsler chart to follow up the progression **(important).**
    - Observation.
    - Laser photocoagulation, for neovascular membrane especially for the wet type.
    - Anti - VEGF agents e.g.: avastin, Lucentis & eylea Wet type (stop the retina from signaling VEGF & as a result will stop formation of abnormal blood vessels).
    - You don't need to know this: Verteporfin photodynamic therapy (PDT): injection of photosensitizer into systemic circulation followed immediately by laser targeting new vesselsin macular area.

- **Diabetic retinopathy (important):** Video
  - Pathophysiology:
    - **Microangiopathy** which involves precapillary arterioles, capillaries and postcapillary venules.
    - 2 mechanisms:
      - Microvascular occlusion.
      - Microvascular leakage.





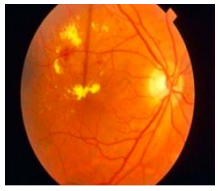
Microvascular occlusion	
• **Thick capillary basement membrane**; it means lumen is smaller.	 abnormal blood vessels (fan-shape)
• **Capillary endothelial cell damage → Retinal ischemia →AV shunt and NV.**	
• **Change in red blood cell** and increased viscosity in diabetic patients.	 abnormal blood vessels
• All of these will lead to decreased blood supply > retinal ischemia > neovascularization and AV shunt formation. • The retinal surface is dry (there should be no fluid within the retina).	

Microvascular leakage	
• Loss of pericytes between endothelial cells (then there will be gap) → plasma leakage into retina (retina should be dry) (with plasma there will be lipid leakage) → exudates and edema.	
• Exudate of lipid in Retina ▪ ill-defined exudate, no pattern. ▪ More superficial. 	• Retinal Edema. 

- **Risk factors:**
  - Duration, pregnancy, nephropathy, poor metabolic control, smoking, HTN, obesity and hyperlipidemia.

- **Clinical classifications** (important**): you will have a slide in the exam**.

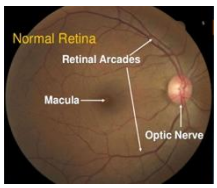
  - **Remember! The hallmark feature of non-proliferative diabetic retinopathy is micro-aneurysms; while in proliferative diabetic retinopathy, it is neovascularization.**



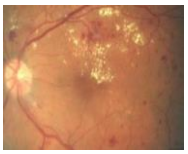
Diagnosis: non-proliferative diabetic retinopathy. Treatment: Laser photocoagulation.

  - **Non proliferative diabetic retinopathy (NPDR):**
    - Mild (micro-aneurisms, **the only patients developed**).
    - Moderate (exudates, hemorrhages as well as micro-aneurisms).
      - Hemorrhage in 1-3 quadrants is considered moderate.
      - Venous bleeding in 1 quadrant is considered moderate.
      - Hemorrhage in 3 quadrants along with venous bleeding in 1 quadrant is still considered **moderate.**
    - Severe (hemorrhages in 4 quadrantes, venous bleeding or slugging (means diameter of the vein is increasing) in 2 quadrates, intra-retinal malformation of blood vessels in 1 quadrate).
      - Memorize it like this: **HIV**
        H: hemorrhages, **I:** intra-retinal vascular malformation, **V:** venous bleeding.
      - The intra-retinal vascular malformation is deep within the retina (deep to the arcade).
      - Intra-retinal vascular malformation is also known as intra-vascular micro-vascular abnormalities (IRMA).

Extra

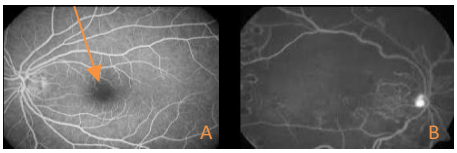


    - Symptoms:
      - Asymptomatic
      - Decreased visual acuity: clinically significant macular edema & macular ischemia.
      - Causes of visual loss of pts w/ non-proliferative is macular edema or macular ischemia.



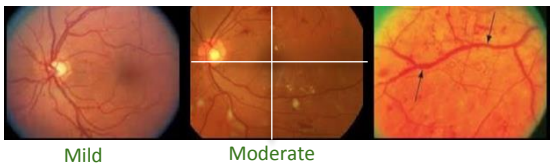
Clinically significant macular edema (CSME)

Fovea or FAZ (foveal avascular zone).



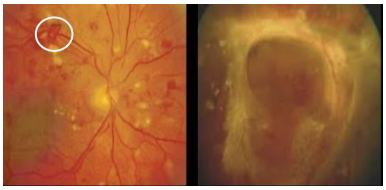
Fundus fluorescein angiography: Delineation of the vascularity of retina.

A. Normal.
B. Ischemic retina (dye will not pass through the ischemic area).



Mild Moderate

- **Proliferative diabetic retinopathy (PDR):**
  - Early (**neovascularization**, fan-like and disorganized).
  - Advanced (when it progresses & bleeds, it will form fibrosis which is attached to the retina. When it contracts it will pull on the retina causing tractional retinal detachment).

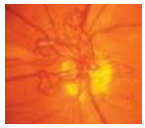


Early Advanced

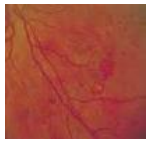
    - **Advanced** proliferative diabetic retinopathy = there should be tractional retinal detachment.
    - The neovascularization forms on the retinal surface (superficial).
  - Symptoms:
    - Symptomatic.
    - It can also cause macular edema & macular ischemia.

  - **Neovascularization:**
    a. **NVD: neovascularization of the disc.**
    b. **NVE: neovascularization elsewhere.**

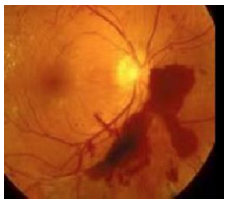
NVD:

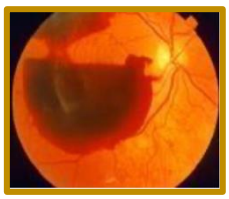


NVE:



  - Fragile (intra-retinal or **vitreous hemorrhage**).
  - Associated with fibrous proliferation which can cause at a later stage tractional retinal detachment (TRD).



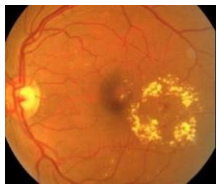


Vitreous hemorrhage.
Cause: Diabetic retinopathy.

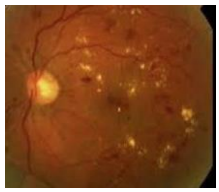
Types	
Nonproliferative diabetic retinopathy (NPDR)	**Proliferative diabetic retinopathy (PDR)**
– Most patients (95%) have NPDR. This is the earliest stage of retinopathy and it progresses slowly. Because so many diabetic patients have NPDR, this stage is commonly described as "background retinopathy." The earliest signs of retinal damage arise from capillary wall breakdown, seen on the fundus exam as vessel microaneurysms. Injured capillaries can leak fluid into the retina and the aneurysms themselves can burst, forming **"dot-and-blot hemorrhages."** – Dot-blot hemorrhages look small and round because they occur in the deep, longitudinally-oriented cell layers of the retina. This contrasts with the **"flame hemorrhages"** of hypertension that occur within the superficial ganglion nerve layer, and thus spread horizontally. – Recall the vascular section of this lecture: With worsening retinopathy and vessel damage, the retina begins to show early signs of ischemia. **Cotton-wool spots**, indicate ischemia/infarction of the superficial retinal nerve fibers. As vessel damage progresses, you can also see beading of the larger retinal veins and other vascular anomalies.	– With ongoing injury to the retinal vasculature, eventually the vessels occlude entirely, shutting down all blood supply to areas of the retina. In response, the ischemic retina sends out chemicals that stimulate growth of new vessels (fragile and easy to bleed). This new vessel growth is called neovascularization, and is the defining characteristic of proliferative retinopathy. Far fewer patients have proliferative retinopathy, which is fortunate as this stage can advance rapidly with half of these patients going blind within five years if left untreated. – The most common cause of blindness in diabetic patients is from macular edema. Macular edema occurs in about 10% of patients with diabetic retinopathy and is more common with severe retinopathy. On exam the macula looks mildly elevated, and you can see past evidence of edema in the form of yellow- colored "hard exudates." These exudates are fatty lipids that are left behind after past macular swelling subsides.

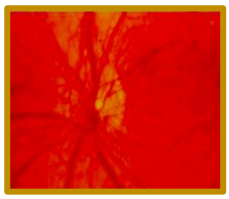
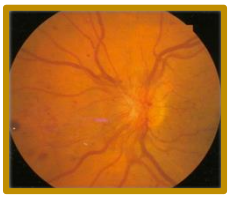
- Diabetic Macular Edema:
  - Retinal edema threatening or involving the macula.
  - Evaluate: location of retinal thickening relative to the fovea and the presence and location of exudates.

- In clinically significant macular edema:
  - We have 2 classes because the management is different.
- Focal macular edema:
  - Circinate ring, exudate in a circular fashion.
  - Treated with **focal** laser.


Circinate ring in focal macular edema.

- Diffused macular edema:
  - Haphazardly diffused exudates and thickening → diffuse macular edema.
  - Treated with **grid** laser or injection.





Diagnosis: proliferative diabetic retinopathy (neovascularization at the optic disc).
Management: Pan-retinal photocoagulation.

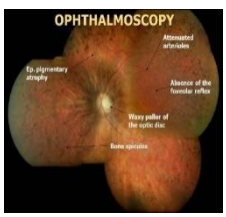
♦ **Treatment:**
- Laser.
  - For PDR → pan retinal photocoagulation (treat the hole retina except the macula).
- Intravitreal steroid injection.
- Intravitreal anti-VEGF injection.
  - Avastin.
  - Lucentis.
  - Eylea.
- Pars plana vitrectomy.
  - For patients having vitreous hemorrhage or tractional retinal detachment.

- **Retinitis pigmentosa"العشى الليلي" : Video**

♦ **General characteristic:**
- A group of genetic disorders affecting the retinal ability to respond to light.
- Most are legally blind (central visual field of less than 20 degrees) by 40s.
  - Legal blindness is 20/200 vision & worse.
- **X-linked recessive:**
  - Males: more often and more severe.
  - Females: carry the genes and experience vision loss less frequently.
- **Target photoreceptors** and associated with pigmentary changes in the RPE, which may be primary or secondary to the photoreceptor loss.

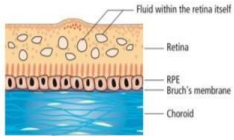
♦ **Symptoms:** Slow loss of vision:
- **Nyctalopia: loss of night vision,** sometimes with progression > tunnel vision.
- **Tunnel vision** "loss of peripheral vision".
- Blindness.

Extra

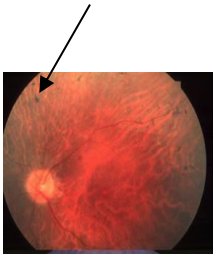
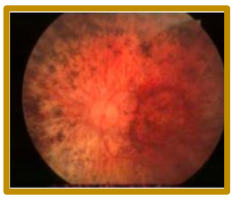
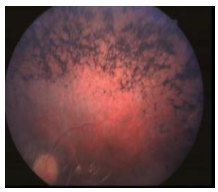
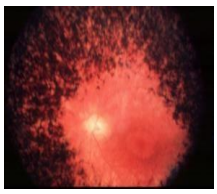


♦ **Signs:**
- Visual acuity varies from: 20/20 to no light perception (NLP) at all.
- +-APD (afferent pupillary defect).
- **PSCC** (posterior sub-capsular cataract).

Extra



- RPE hyperpigmentation (bone spicules), it is the dark part of the eye, alternate with atrophic regions.
- Attenuation of the arterioles "thinning".
- Waxy pallor of the optic nerve head.
- **Cystoid macular edema** (CME) in severe cases of RP.

RP stages and signs			
Early stage	2nd stage	3rd stage	4th stage "severe"
• Black spots in periphery "bone spicules, why? RPE clumping" 	• bone spicules Increased more and more • Start to loss photoreceptors • Waxy disc appearance. • Attenuation of arteriole  **Diagnosis: RPE hyperpigmentation (bone spicules) & waxy disc appearance.** **Test: VF, color testing.** **Treatment: carbonic anhydrase inhibitors.** **Retinal changes secondary to photoreceptors loss.**	• More loss of photorecept or • More clumping of RPE 	• Severe photoreceptors loss • Tunnel vision • Severe RPE loss and clumping • Bone spicules • Waxy pallor • Circumferential involvement of retina. It will spare the macula. • Cystoid macular edema. 

- **Investigation:**
  - VF test (it shows constricted visual field & in advanced stage tunnel vision).
  - Color testing (mild blue-yellow axis color defects).
  - Dark adaptation study (reduced contrast sensitivity relative to VA).
  - Genetic subtyping.
  - OCT to look for (CME).
  - FFA florican angiography.
  - ERG electroretinography is an eye test that detects function of the retina including photoreceptors.
  - EOG electrooculography to record eye movement.
- Systemic associations: rule out systemic association (important):
  - **Hearing loss & RP:**
    - Usher syndrome (IMPORTANT)
      - Usher syndrome is a condition characterized by partial or

total hearing loss and RPE (common).

- Alport syndrome is a genetic condition characterized by RP, kidney disease, and hearing loss.
- Refsum disease is an autosomal recessive neurological disease that results in the over- accumulation of phytanic acid in cells and tissues.

- **Kearns-Sayre Syndrome** (IMPORTANT)**:**
  - External ophthalmoplegia (thus restricted ocular motility).
  - Lid ptosis (unilateral or bilateral).
  - **Heart block.**
  - Pigmentary retinopathy.

- **Abetalipoproteinemia** is a disorder that interferes with the normal absorption of fat and fat- soluble vitamins (↓vitamin A →RP).
- **Mucopolysaccharidoses.**
- **Bardet-Biedl syndrome** genetic disorder characterized principally by obesity, RP, pigmentosa, hypogonadism, and kidney failure in some cases.
- **Neuronal ceroid lipofuscinosis** lysosomal storage disorders characterized by dementia, RP, and epilepsy.

♦ **Treatment:**

- Unfortunately, nothing can be done to prevent the progression of the disease, but associated ocular problems can be treated:

- CAI: CME (carbonic anhydrase inhibitor for CME).
- Vitamins.
- Cataract: surgery.
- Low vision aids.
- Gene therapy!!

Extra
What's the difference between a PCO and a PSC cataract? • PCO: posterior capsular opacification. This is an "after cataract" that forms on the back surface of the posterior capsule after successful cataract surgery. This opacity can be cleared with a YAG laser. • PSC: posterior subcapsular cataract. This is a cataract that forms on the back portion of the lens. These tend to occur more often in diabetics and those on steroids, and tend to be visually significant because of their posterior position.
What drops are given after a cataract surgery? Usually an antibiotic, such as ciprofloxacin or vigamox. Also, a steroid is given to decrease inflammation.
What retinal findings do you see with glaucoma? You see increased cupping of the optic disk, usually in a vertical pattern that goes against the ISNT rule. You can sometimes see hemorrhages at the disk and "undermining" of the blood vessels as they exit the disk.
What's the difference between open-angle and closed-angle glaucoma? How about chronic versus acute glaucoma? • Open angle is a common, chronic condition where aqueous drainage is impaired. • Closed-angle glaucoma is caused by acute closure of the iridocorneal angle leading to blockage of ALL aqueous drainage – an ophthalmologic emergency that can quickly lead to blindness.
What are the retinal signs of diabetic retinopathy. How do they compare to, say, hypertensive retinopath?. With diabetic retinopathy you typically see a lot of dot-blot hemorrhages, cotton-wool spots, and hard exudates. Hypertension usually has more flame hemorrhages and vascular changes such as arterial-venous nicking and copper/silver wiring.
How do we categorize diabetic retinopathy? As either NPDR (nonproliferative diabetic retinopathy) or PDR (proliferative diabetic retinopathy) depending upon the presence of neovascularization.

Questions:

1. **Which one of these in NOT an indication of photocoagulation surgery?**
   A. Micro aneurysm.
   B. Neovascularization elsewhere.
   C. Neovascularization on optic nerve.
   D. Significant macular edema.

2. **A 45-year-old male with a history of renal transplant on steroid therapy complaining of gradual painless diminution of vision both eyes, on examination there is lens opacity. What is the most likely diagnosis?**
   A. Nuclear cataract.
   B. Dot cataract.
   C. Posterior subcapsular cataract.
   D. Cortical cataract.

3. **75 years old man is complaining of decrease in visual acuity for the last 5 years, on examination red reflex was present, there is retinal pigment changes and retinal atrophy, what is the diagnosis?**
   A. Retinitis pigmentosa.
   B. Retinal detachment.
   C. Macular degeneration.
   D. Proliferative retinopathy.

4. **A 30-year-old male presented with night blindness, tunnel visual field, cystoid macular edema and cataract. What is the diagnosis?**
   A. Vitamin A deficiency.
   B. Retinitis pigmentosa.
   C. Retinal detachment.
   D. Diabetic Retinopathy.

5. **A 65 years old male presented with gradual reduction in his central vision, which one of the following is the most likely diagnosis?**
   A. Central retinal artery occlusion.
   B. Central retinal vein occlusion.
   C. Age related macular degeneration.
   D. Retinal detachment.

Answers: 1: A 2: C 3: C 4: B 5: C

Good luck!