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Ear I-II

A2 Presented by Dr. Salman Habib

★ Lecture Objectives:

- Anatomy of the ear
- Physiology of the External, Middle and Inner ear
- Otitis Externa
- Malignant Otitis Externa
- Otitis Media

Color Index:

Important Original content Doctor's notes[439] Doctor's notes[441] Golden Notes Extra

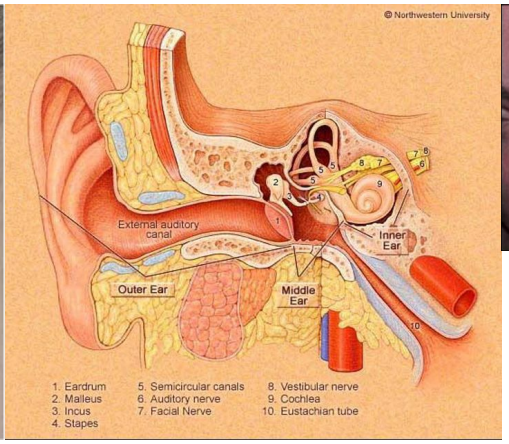
Anatomy of the Ear

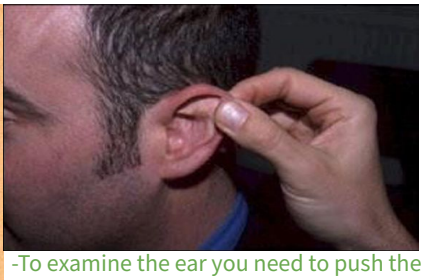
1. **External ear**: Composed of the pinna (auricle) , external auditory meatus, tympanic membrane (squamous part)=skin , develops from 1st pharyngeal cleft & arch
2. **Middle ear**: Composed of tympanic membrane (mucosal part), eustachian tube, ossicles, nerves (tympanic plexus, chorda tympani), muscles (tensor tympani, stapedius) develops from 1st pharyngeal pouch & 1st and 2nd arches
3. **Inner ear**: Composed of Cochlea, vestibule and semicircular canals (semicircular canals for angular acceleration and the saccule for linear acceleration). develops from Ectoderm of hindbrain

External Ear

Pinna/Auricle:

- **Lobule**: has no cartilage, less risk of infection or spread of infection to the perichondrium and causing deformity, hence perichondritis (infection of cartilage) can affect the whole ear except the lobule.
- **Cartilage**: we can't use cartilage of the helix and antihelix in reconstruction surgery because it will affect the shape of ear.
- **Helix**: gives us the firmness of the ear.
- **Anti Helix**: its importance prevent us from having protruding ear (Bat ear), also helps in hearing.
- **Concha & Cymba**: cartilages supporting th pinna on the skull, also can be taken and used in Tympanoplasty (بـروبـع الطبلة)and Rhinoplasty procedures because these cartilages can be used without changing the shape of the ear.
- **Tragus**: can be taken and used in tympanoplasty but we leave the seen 2 mm (see pic) to not change the shape of the ear.
- **External auditory meatus**: made of cartilaginous and bony part , The ear canal is not straight but has an anterior hump. What if the ear canal is straight with no hump? Water will enter easily while swimming, air entry will cause the patient to have dizziness

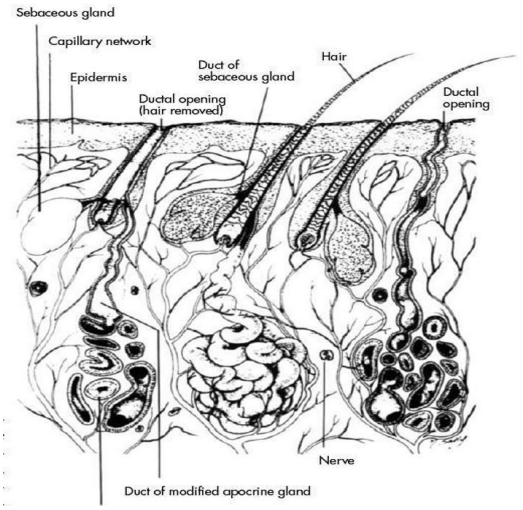




-To examine the ear you need to push the ear upward and backward to make it straight and see the tympanic membrane , if you do it correctly the patient won't feel any pain when you examine

-While using the otoscope try to not touch the external ear canal because it so painful

Anatomy of the Ear Con.



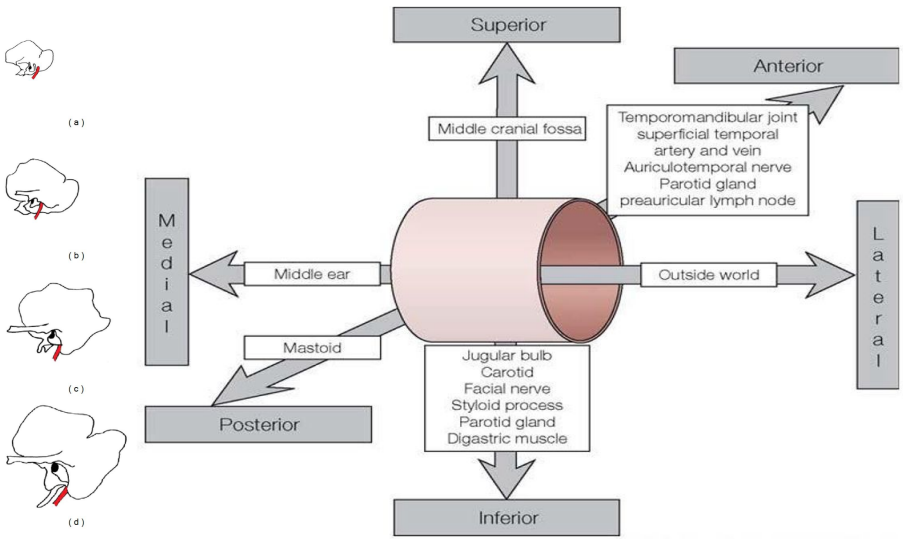
1. **Lateral third (outer ⅓) of canal length:**
   - Cartilaginous.
   - Hair follicles.
   - Ceruminous glands which produces wax.
   - Sebaceous glands.

   together called the apopilosebaceous unit
2. **Medial two thirds (inner ⅔) is osseous:**
   - Bony.
   - Develops after birth.
   - If we see wax in the medial part of the external ear this will usually mean that the patient used a q-tip for example and pushed the wax inside.

Anatomical Relations of External Auditory Canal

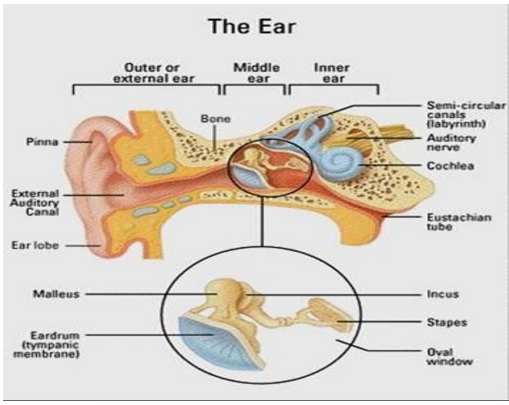
Superior: Middle cranial fossa
Inferior: Jugular bulb - Carotid Artery - Facial nerve - styloid process - Parotid gland (Deep part) - Digastric muscle
Anterior: Temporomandibular joint (pain from it or teeth radiate to the ear) - superficial temporal artery & vein - Auriculotemporal nerve - Parotid gland (Superficial part) - preauricular lymph node.
Posterior: Mastoid
Medial: Middle ear (Tympanic membrane)
Lateral: Outside world

Posterior belly of Digastric muscle originate from the mastoid process of temporal bone.
The digastric muscle is weak in infants before they become able to elevate their heads because at birth the mastoid bone is flat with time it will become more prominent and tightens the digastric muscle which is attached to it The importance of this is during surgery in infants below 2 years if you open behind the ear you might face the facial nerve which exists between the mastoid and the styloid but once the mastoid becomes bigger and well formed it will protect the facial nerve



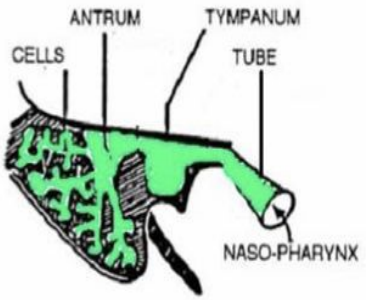
Anatomy of the Ear Con.

1 Middle Ear Cleft:(Might come in Exam)



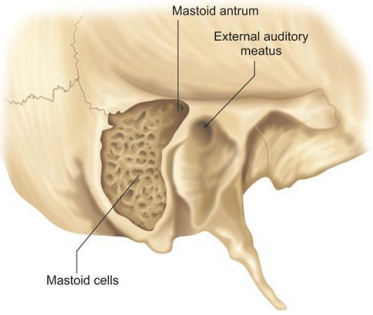
- Eustachian (Pharyngo-tympanic) Tube.
- Tympanum (Middle Ear Cavity).
- Mastoid Antrum and Air Cells.
- Middle ear cleft:
  - is the middle ear cavity + Eustachian Tube + mastoid
- Barotrauma → retraction → perforation

2 Eustachian tube:

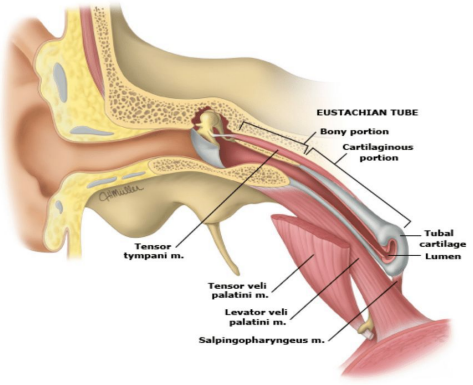


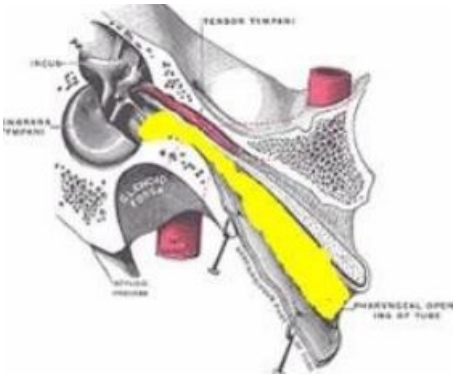
- **Connects the middle ear cavity with nasopharynx "nasal cavity" (upper aerodigestive tract).**
- Is the conduit through which air is exchanged between the middle ear space and upper aerodigestive tract & open at torus tubarius.
- Parts of Eustachian Tube:

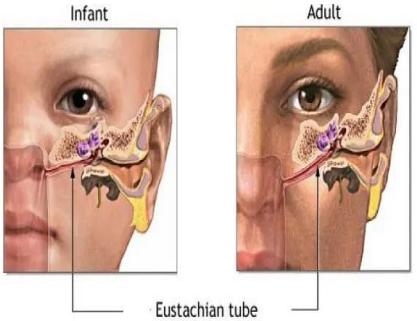
1. Proximal 1/3 is boneyard part.
2. Distal 2/3 is fibrocartilaginous, collapsed at rest.
3. Junction between 2 parts is isthmus, narrowest part of the tube.



- The tube permits aeration of the middle ear and if it is obstructed fluid may accumulate in the middle ear causing deafness.
- **Normally always closed. But in case of: Yawning, eating, Swallowing (When you swallow sometimes your ear makes a sound this is the ET)** → the ET open up actively by contraction of salpingopharyngeus muscle & passively by Tensor tympani. (it releases the tension in tubal cartilage).
- What are the muscles that control the opening of the eustachian tube?
  - (1) tensor veli palatini, (2) levator veli palatini, (3) salpingopharyngeus muscle.
- **It also opens when there's change in pressure to equalize the pressure in the middle ear** e.g., while on airplanes or while diving..
- The tube is shorter, wider and more horizontal in the infant than in the adult.
- The tube is normally closed and opens on swallowing because of movement of the muscles of the palate. This movement is impaired in cleft palate children "because of the absence of tensor palatini muscle" who often develop accumulation of middle-ear fluid (otitis media with effusion).
- Barotrauma is trauma related to the pressure it either happens at the level of the eustachian tube and affect the tympanic membrane or at the level of the inner ear affecting the oval window and cause dizziness and hearing loss.

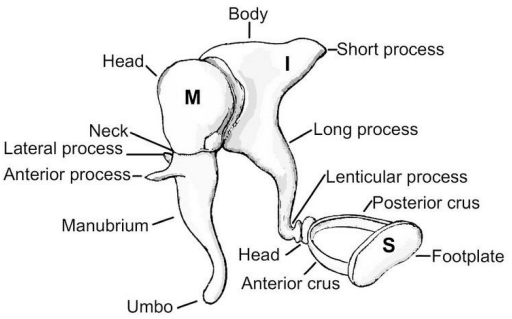






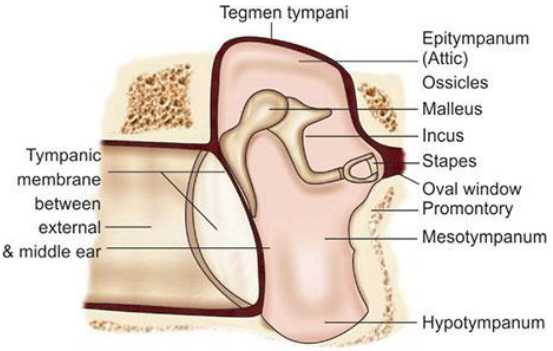
Anatomy of the Ear Con.

Contents of the Middle Ear Cavity



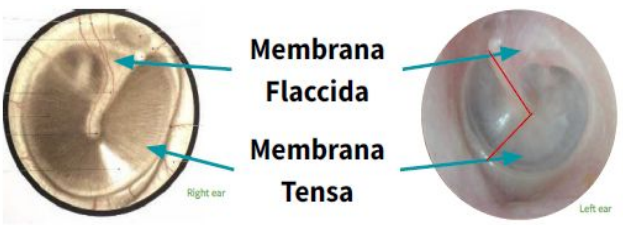
- Air.
- Ossicles (Malleus, Incus, & Stapes).
- Stapedius muscle is attached to the neck of stapes.
- Tensor tympani muscle is attached to the neck of the malleus.
- Incus long process is the most common bone to get eroded in case of blood supply got affected, the weakest, the most prone to infections.
- Muscles (Tensor Tympani & Stapedius).
- Stapedius muscle is more powerful in controlling the noise than tensor tympani muscle.
- If the noise exceed the normal limit of muscle contraction you might start hearing the contractions of the muscle.
- Nerves (Chorda Tympani & Tympanic Plexus). 7 and 8 cranial nerve.
- Chorda tympani is a branch of the facial nerve and it innervates the taste of anterior ⅔ of the tongue this is why when we injure both nerves (right & left) the patient will lose taste sensations.
- Tympanic plexus is the reason why we have radiating pain to the ear for example from the throat or the occiput.

Tympanic membrane



- The tympanic membrane is divided into 2 parts:
- **Pars Tensa** (80%)
  - 3 layers: skin, fibrous tissue and mucosa.
- **Pars Flaccida** (20%) No fibrous tissue only squamous mucosa.
- Clinical correlation: if we had a chronic eustachian tube dysfunction the first part to get retracted is the pars flaccida causing retraction because of negative pressure pocket which can enter the middle ear and cause acquired cholesteatoma.
- The most common cause of acquired cholesteatoma is eustachian tube dysfunction.
- We could also divide the Tympanic membrane to 3 parts:
- **Epitympanum:** superior aspect of the tympanic membrane.
  Most common site for acquired cholesteatoma , affect the head of malleus and incus.
- **Mesotympanum:** area of the middle ear medial to the tympanic membrane.
  Most common site for congenital cholesteatoma (not related to -ve pressure).
- **Hypotympanum:** area of the middle ear inferior to the tympanic membrane.
  cholesteatoma may extend to it (rare) , which is an area we might forget to check, this site is common for tumour more than cholesteatoma.
- How to know if the tympanic membrane is for a left or right ear?
  1. Look for the malleus, the reflection of light forming an arrow, the direction where the opening of the arrow is pointing toward (left or right) is your answer.
  2. you can look for the anterior hump which is formed by TMJ if it's on the right then this is the right ear.

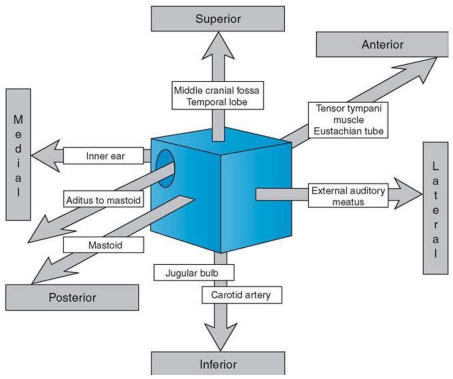
Right ear

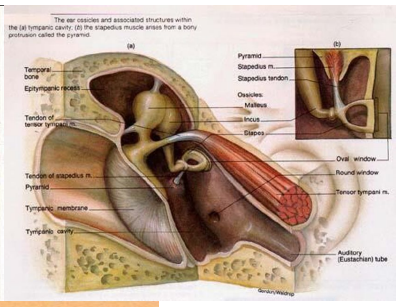


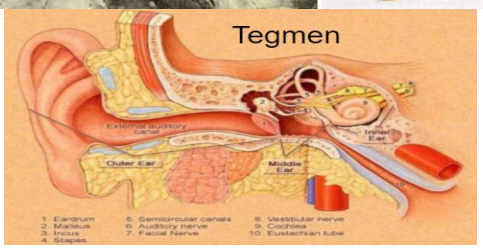
Anatomy of the Ear Con.

Walls of Tympanic Cavity

- Roof skull base “Tegmen”.
- Floor.(inferiorly) Eustachian tube , jugular vein and carotid artery.
- Anterior wall.
- Posterior wall. Mastoid
- Lateral wall. Tympanic membrane
- Medial wall. Cochlea (basal part)
- The function of muscles of the middle ear is to control the sound, how? Loud sound→Muscles contraction (stapedius is stronger)→Decrease the vibrations reaching the ossicle → Noise trauma prevented.
- Contraction of the stapedius muscle restrict the movement of the stapes (**stapedial reflex).**
- Importance: We sometimes want to to check whether the stapes is fixed, stable or if it has otosclerosis, therefore we do stapedial reflex test. The presence of involuntary muscles contractions in response to loud sound means the patient is normal or might have mild conductive hearing loss. If it’s absent it means the patient might have severe conductive hearing loss (25-30 dB).
- Conduction hearing loss : tympanic membrane + bones.
- Sensorineural hearing loss: cochlea + nerves.
- Before we go to surgery we should study the anatomical relationship because in case of low tegmen and high jugular vein + carotid > we may injure the dura.







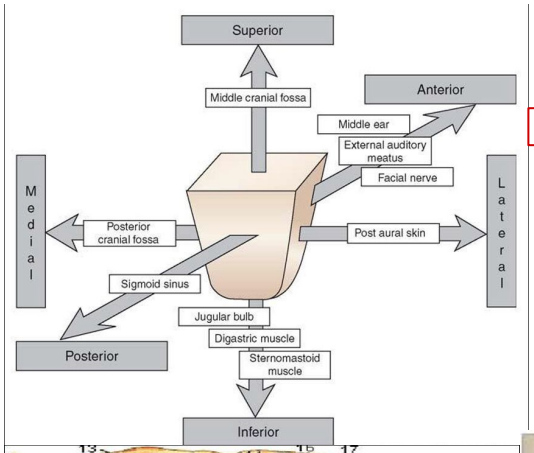
Mastoid Antrum & Air cells

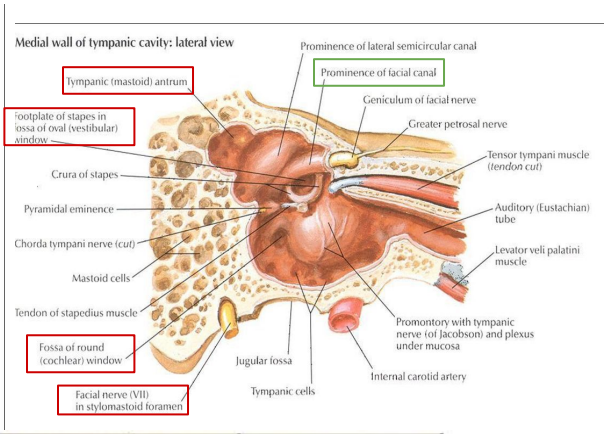
- Air-containing cells of the mastoid process are continuous with the air in the middle ear.
- **Attic**: opening between the middle ear from the epitympanum to the mastoid bone.
  - The first area to get eroded in acquired cholesteatoma is the attic and it’s seen on CT.
- **Antrum**: air space in the mastoid which contain the largest air cells.
- **Aditus**: the entrance to the antrum behind flasidis para.
- Why do we have air cells/sinuses? to make the skull light and it is imp for anatomical landmark of cochlear implant.
- In case of sensorineural hearing loss we give hearing aid If doesn’t work and the patient still doesn’t hear we go for cochlear implant.
- A cochlear implant is very different from a hearing aid. Hearing aids amplify sounds so they may be detected by damaged ears. Cochlear implants bypass damaged portions of the ear and directly stimulate the auditory nerve. Signals generated by the implant are sent by way of the auditory nerve to the brain , It is electroid insert it in the mastoid to round window and it is blind producer after that we do tests to make sure that the electroid is in the round window.

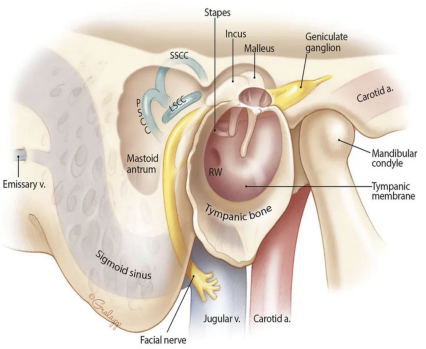
Anatomy of the Ear Con.

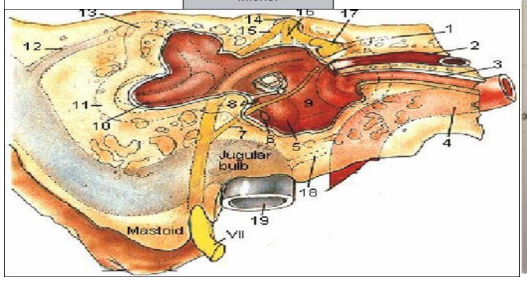
Anatomical relation of Mastoid Antrum

- Round window is below the oval window by 2 mm.
- The facial nerve passes above the oval window
- Cochlear window: bulges from the cochlea with sound.









Opens on the epitympanum (opens to the middle ear)

Lining of the Middle Ear

- Mucous membrane: Ciliated columnar anteriorly and cuboidal or flat elsewhere.

Anatomical relation of Middle Ear

- Floor: internal jugular vein and common carotid.
- Roof: skull.
- Lateral: tympanic membrane.
- Posterior: mastoid air cells.
- Medial: promontory of the cochlea.

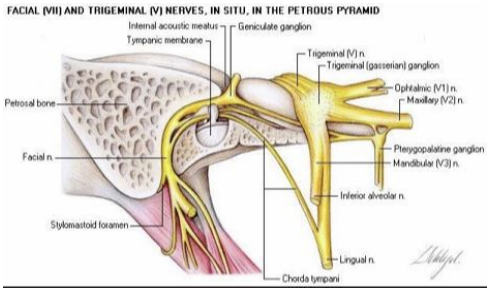
Anatomy of the Ear Con.

Sensory Supply of the External & Middle Ear

- Cervical II & III (great auricular and lesser occipital).
- V cranial nerve (auriculotemporal).
- IX cranial nerve (tympanic or Jacobson's).
- X cranial nerve (auricular or Arnold's), on irrigation , Suction and cold drop → stimulate vasovagal attack
- VII cranial nerve.

❖ **Sensibility externally:**

1. Great auricular nerve (**C2,C3**) : lobule, lateral/inferior auricle.
2. Auricular branch of vagus (**Arnold's**) : concha, Post canal wall.
3. Auriculotemporal nerve (**V3**) : tragus. anterior helix, Ant canal wall.
4. Lesser occipital (**C2**) : medial surface of pinna.
5. TM supplied mainly by **V3 (anterior)** and **X (posterior)** on lateral aspect, **IX on medial** aspect.
6. **Facial** nerve: concha, Post canal wall.



Nerve supply:

- Sensory nerve supply of the middle ear mucosa:
  1. Tympanic branch of the glossopharyngeal nerve.
  2. Auriculotemporal branch of the trigeminal nerve.
- Motor nerve supply of the middle ear muscles:
  1. Stapedius muscle supplied by the stapedial branch of the facial nerve.
  2. Tensor tympani supplied by the mandibular division of the trigeminal nerve.

Facial nerve pathway:

- Exit the brain and enter internal auditory canal (meatal part of facial nerve) then travel across the bones in the ear:
  1. labyrinthine segment: most narrow area.
  2. tympanic segment: most dehiscent area.
  3. mastoid segment: most iatrogenically injured (usually not direct injury rather it's the heat from the drill that might affect the nerve).
- The nerve terminates by splitting into five branches: Temporal, Zygomatic, Buccal, Marginal mandibular and Cervical.

Referred Earache not an ear problem

Definition: Pain in the ear due to a disease in an area supplied by a nerve that also supply the ear.

- Cervical II & III: Cervical spondylosis, neck injury (disc, muscle spasm) etc.
- V (Trigeminal) cranial nerve: Dental infections, sinonasal diseases "maxillary sinus" etc.
- IX (Glossopharyngeal) cranial nerve (branch of CN 9 called jacobson in the promontory): Tonsillitis, pharyngitis, laryngitis, laryngeal cancer, esophageal foreign body, post-tonsillectomy, carcinoma etc.
- X (Vagus) cranial nerve: Tumors of hypopharynx, larynx & esophagus.
- One of the signs of recurrence tumors in larynx & pharynx is ear pain.
- Auriculotemporal nerve (V3): any patient that has dental issue or TMJ, tonsillitis ,URTI so when they present with ear pain I have to examine those, dental, pharynx, oropharynx, cervical

*The doctor asked about these nerves at the end of the lecture. (From 438)
Why this is imp because patient may present with ear pain while they have different disease not related to ear for example patient has disk will come to ENT clinic with ear pain instead of ortho because of sensory nerve distribution.

Anatomy of the Ear Con.

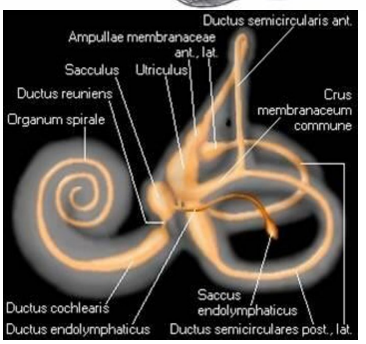
Inner Ear

Osseous Labyrinth parts

- Bony Cochlea.
- Vestibule.
- Bony semicircular canals. Circular motion

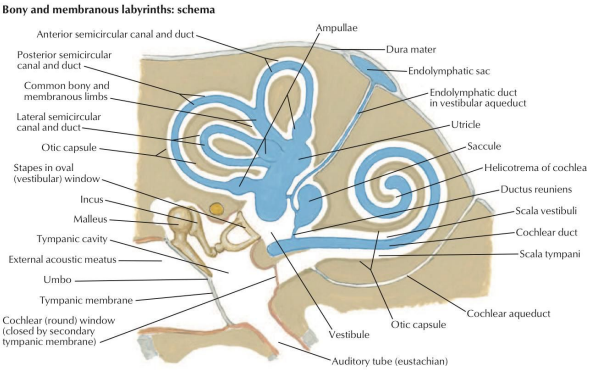
Contents of the Bony Labyrinth

- . **Perilymph**: extracellular like fluid; found in **scala tympani** and **vestibuli**: K+= 4mEq/L,Na=139mEq/L Perilymph: (outside the inner ear) extracellular like fluid)
- Between the bony and membranous labyrinths.



Membranous Labyrinth parts

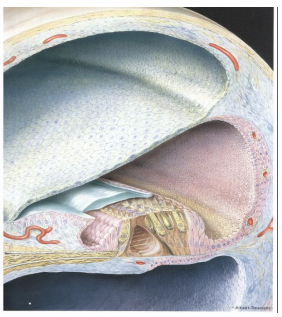
- Cochlear duct.
- Saccule and utricle.
- Membranous semicircular canals.



Contents of Membranous Labyrinth

- .**Endolymph**:intracellular like fluid;found in **scala media**;contributes to positive DC resting potential of 80 mV in scala media;produced from **perilymph by Marginal cells of stria ventricularis;**absorbed within the endolymphatic sac: K+=144mEq/L,Na+=13mEq/L(fluid in membranous labyrinth).
- **Sensory Epithelium:**

1. Cochlea : Organ of Corti.
2. Utricle & Saccule (vestibule): Maculae. Respond to changes in the position of the head with respect to gravity and speed (linear acceleration) e.g., in the elevator, utricle"horizontal" & saccule"vertical". Fluid can move right & left.
3. Semicircular Canals: Cristae. Respond to rotational movements (angular acceleration). Fluid can move right & left.



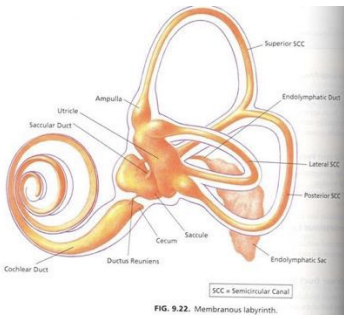
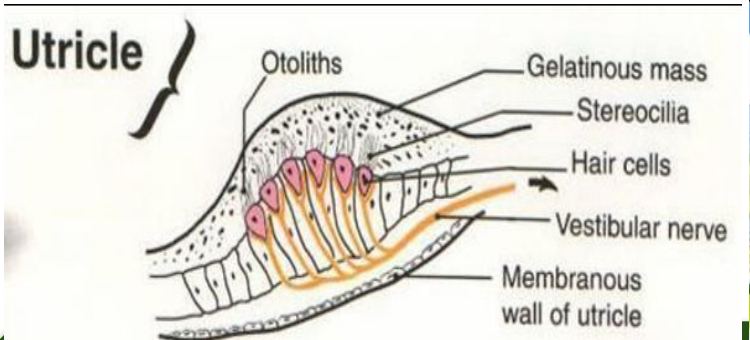
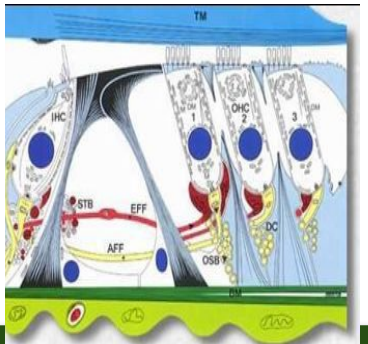
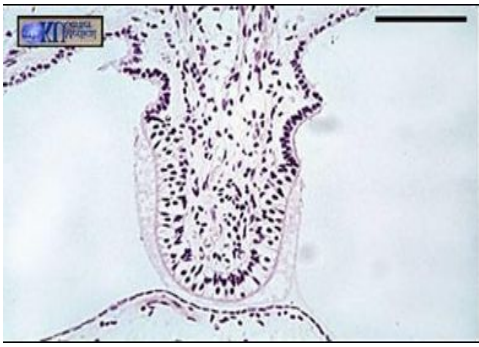


FIG. 9.22. Membranous labyrinth.

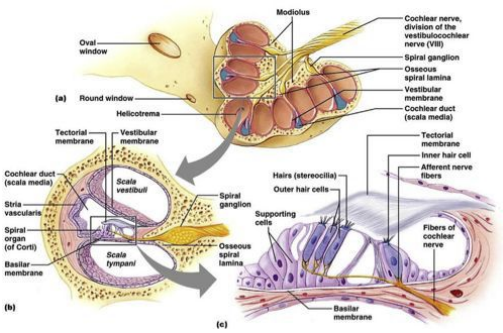






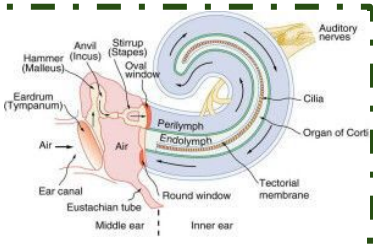
Anatomy of the Ear Con.

Inner Ear



Blood supply of inner ear:
Basilar artery→ Anterior inferior cerebellar artery →
Labyrinthine artery → Common cochlear & anterior vestibular

Cochlea



- Cochlea has two windows (round & oval).
- The bony cochlea contains three compartments:

1. Scala vestibuli.
2. Scala tympani.
3. Scala media or the membranous cochlea or cochlear duct.

- Scala media is the most important one because it contains the organ of corti
- How do we hear? See this video exactly as the doctor explained ;) cause I'm tired writing notes
- The scala vestibuli and scala tympani are filled with perilymph and communicate with each other at the apex of cochlea through an opening called helicotrema.
- Scala vestibuli is closed by the footplate of stapes which separates it from the air-filled middle ear.
- The scala tympani is closed by secondary tympanic membrane; it is also connected with the subarachnoid space through the aqueduct of cochlea.
- The scala media is filled with endolymph.
- Scala media has ticlorial membrane and hair cells so with the fluid movement it will move and produce sound.
- Cochlea contain 2 and Half turn basal , middle , epical and The first turn we will see when open inner ear is basal turn that contain two window (oval and 2 ml below it there will be round window these two windows are important
- 439 Dr said this is imp , Vibrations lead to stimulation of a specific location on the basilar membrane, depending on the sound frequency (tonotopy).

-High-frequency 250-500 sounds stimulate hair cells at the base of the cochlea(basal turn)
-Middle-frequency 1000-2000 sounds stimulate hair cells at middle turn
-Low-frequency 4000-5000 sounds stimulate hair cells at the apex of the cochlea (apical turn)

Vestibular apparatus

- In the utricle and saccule we have organ that moves and cause inflation and deflation with up & down movement it's called Macula.
- semicircular canal has bulla at the end that had crystal.
- the lateral Semicircular canal is the most prominent one so it's the first can be affected by diseases because the most close to external so any ear diseases that eat the bone or cholesteatoma it is the first to be effected.
- Benign positional vertigo in people who had road traffic accident or prolonged surgery and during transportation the head has been shaken forcefully. Trauma to the head concussion of the inner ear: each semicircular canal contains fluid and below the fluid there is gelatinous material which contains crystals "calcium tubercles", They give the sense of going up & down depending on gravity .
- Posterior semicircular canal BPPV is Most common type of BPPV (up to 95% of cases).
- What if one of these crystals gets out of the gelatinous material and flows in the fluid above? If we are sitting still there will be no problem but if we start moving, it will make the patient feels dizziness, for example if the patient turned from left to right he may start feeling like spinning because that crystal that got out is floating in fluid also the patient might feel nauseated, why nauseated? Because his eyes will tell him that the image is not moving but the ears are saying that the image is moving leading to feeling discrepancy which leads to nausea that's why these patients tend to close their eyes in order to stop the nausea.
- Positive Dix-Hallpike test (diagnostic test) : positional vertigo and nystagmus triggered during the maneuver.
  - Posterior canal BPPV: upbeat nystagmus with ipsiversive torsional nystagmus component.
  - Anterior canal BPPV: downbeat nystagmus with ipsiversive torsional nystagmus.
- If the Dix-Hallpike maneuver is negative, the supine head roll test should be performed to assess for lateral canal BPPV this is called head shaking test.
- However we should advice them not to close their eyes instead they should activate the other parameters which are proprioception and vision this will overcome the nausea in a shorter period.
- (Therapeutic test) is Epley maneuver.

Anatomy of the Ear Con.

The vestibulo-cochlear nerve

➔ **Central Connections of Cochlear Nerve**

● The principal human auditory cortex is located deep within the sylvian fissure on the superior surface of the temporal lobe The primary auditory cortex is often referred to as Brodmann area 41.

➔ **Central Connections of Vestibular Nerve**

● 2 parts superior & inferior: the inferior supplies the sternocleidomastoid and ocular muscle.

● Superior innervates anterior and lateral semicircular canals and utricle.

● Inferior innervates posterior semicircular canal and saccule.

● How can we test the vestibular nerve? by testing the sternocleidomastoid & inferior ocular muscle

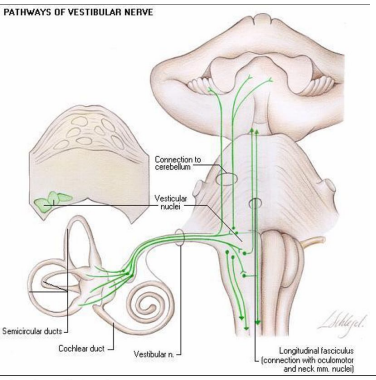
● When you see internal auditory canal we will see 4 nerve (facial , cochlear, superior vestibular , and inferior vestibular)

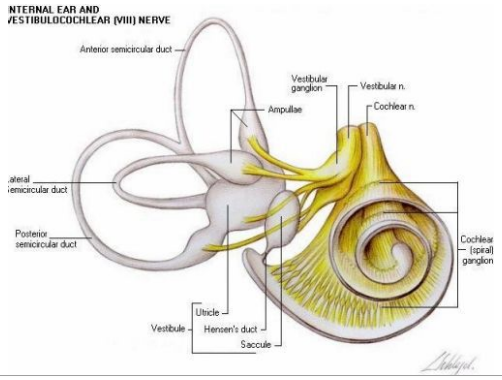
To remember the location 439 dr: this imp question

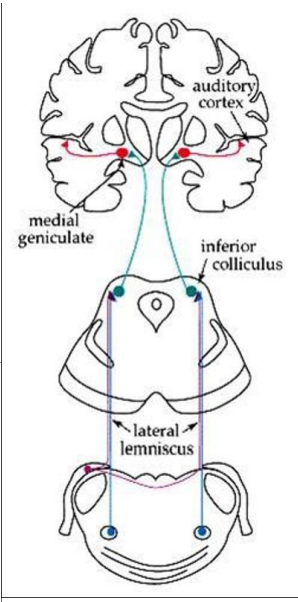
● Anteriorly :

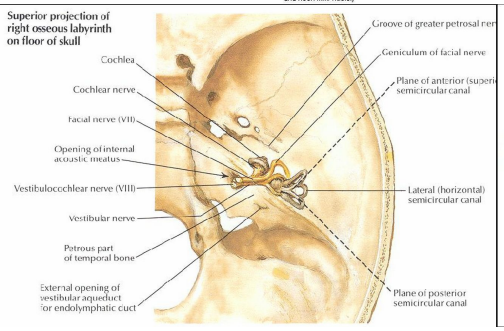
1. C7 Facial nerve >أب سفن > upper anterior
2. Cochlear nerve > cook down > down anterior

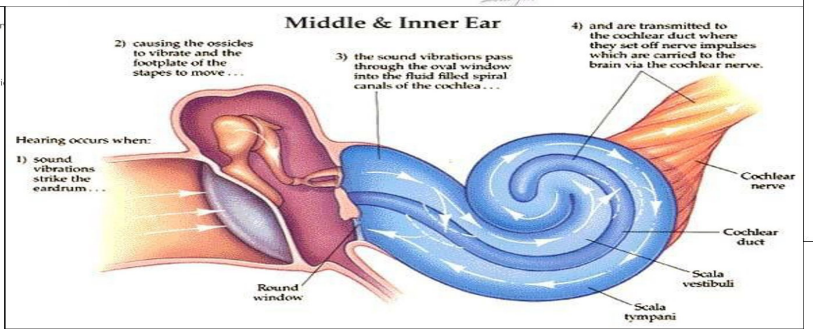
● Posteriorly : Superior and inferior vestibular nerve











Note takers heaven

Physiology of the Ear

Function

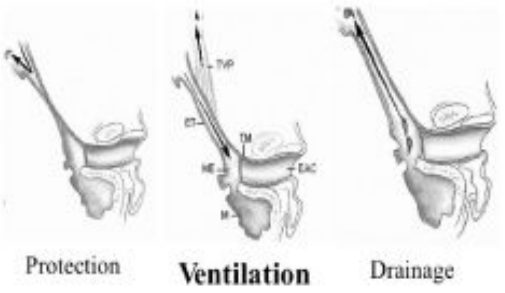
External Ear

- Protection of the middle ear: Curvature, Cerumen.
- Auditory functions: Sound conduction and amplification (500 Hz), Increase sound pressure by the resonance function and direct the sound.

Eustachian Tube

439 doctor asked about the function

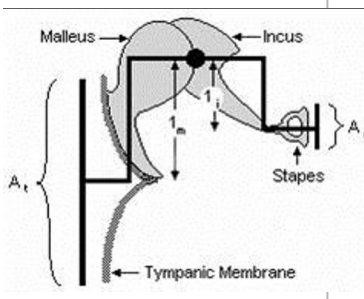
- Protection: From anything that comes from the nasopharynx to go into the middle ear (any nasal secretion)
for example in flu > the organism may go to middle ear if the Eustachian tube is open
- Ventilation: to equalize the pressure
- Drainage: in case of acute OM or any regular discharge from the middle it won't go to the nose but down to the nasopharynx.



Middle Ear

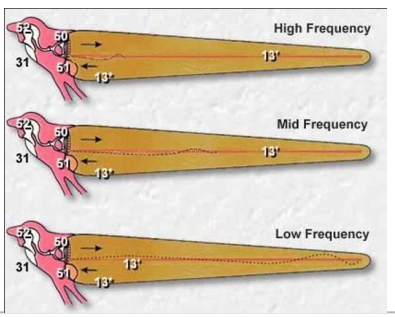
- Conduction of sound. Magnification of sound (2000 Hz) as we get closer to the cochlea. Because the tympanic membrane is a big space going into the oval window which is a much smaller space this will cause magnification of sound.
- Transformer mechanism: Hydraulic action, Ossicular leverage.
- Protection to the inner ear:
  - (Stapedial reflex): In case of loud sound the muscle will contract to reduce the sound reaching the inner ear to avoid noise trauma.

Incus erosion cause the most significant conductive loss (60dB).
Impedance matching: concentration of the TM movement into the Oval window which is shown in the picture.



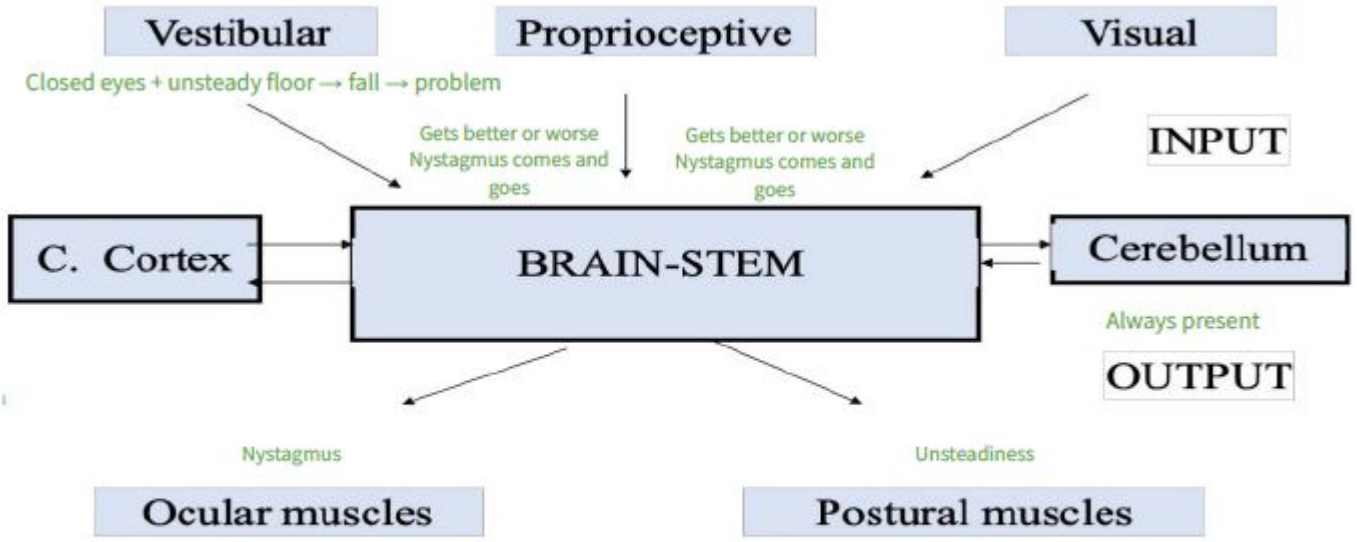
Inner Ear

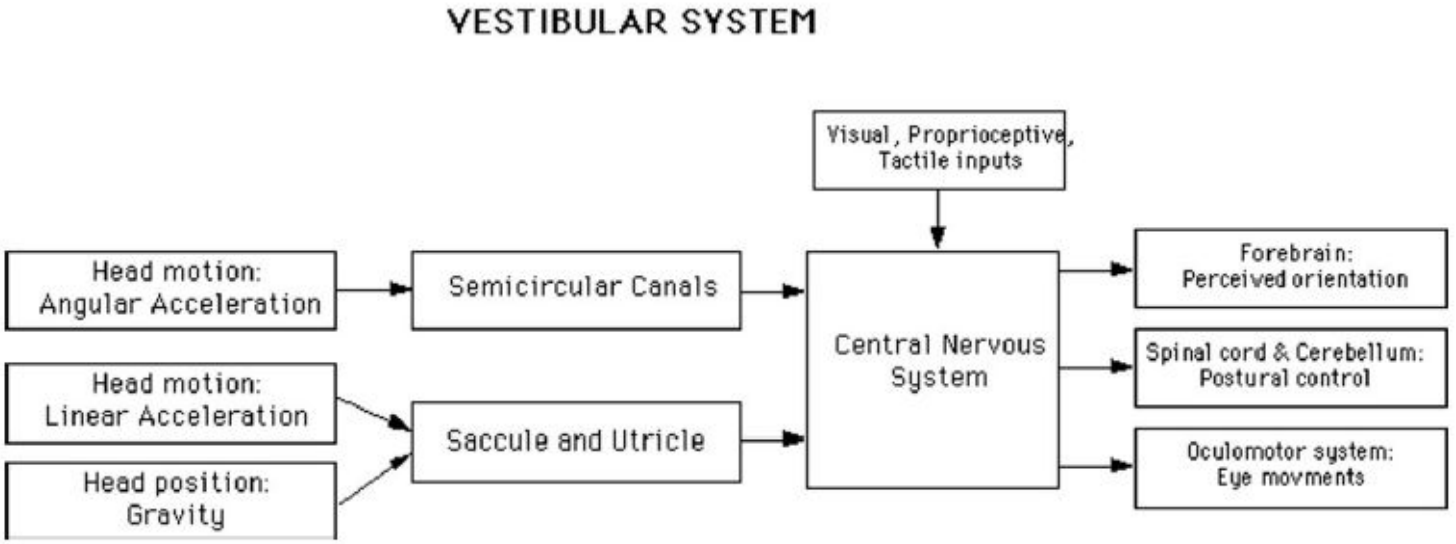
- Hearing Function: Transduction of sound to action potentials.
- Vestibular Function: Participate in maintaining body balance.
- Basal cochlea movement→ high frequency
e.g: with toxic drugs - surgeries - noise induced hearing trauma
- Apical part movement → low frequency,
If audiogram shows a problem with the low frequency sounds this means the problem is in the apical part



Anatomy & Physiology of the Ear Con.

The Balance System





Balance system

- Central part (brain , cerebellum mainly).
- Peripheral part (vision , proprioception , vestibular).

- Dix - hallpike maneuver → **diagnostic.**
- Epley maneuver → **relieve (management).**

Brain stem: is the center of balance. It's connected to Cerebellum to coordinate muscle tone and Cerebral cortex for the feeling of space.

- Input: Proprioceptive (sensation), visual & vestibular
- Output: gives information to: postural muscles and ocular muscle So, you have to make sure when someone comes to you with imbalance it's not b/c of the cerebellum by testing it, then rule out the (peripheral) proprioception

➔ Testing the vision: by closing the eye

➔ Testing the proprioception: by asking him - to stand on sponge

When you do so (closing the pt. Eyes and making him stand on sponge) you're eliminating the vision and the proprioception effects and after it you can make sure you're testing only the vestibule.

Diseases of the external ear

Dr. explained them quickly

➔ Anotia (Atresia):

- Definition: It's the total absence of the (pinna) auricle most often with narrowing or absence of the external auditory meatus.
- Bone conduction is preserved yet suffer from maximum hearing loss
- No auricles + canal atresia. (no external ear).
- CT; to check if there is other malformations (internally).
- Treatment:
  - Reconstruction of the ear.
  - Prosthetic ear (otoplasty), usually used in tumor patients
  - **Good sensory hearing → bone hearing aid.**

➔ Microtia:

- Definition: underdeveloped pinna. Either upper or lower part
- It's a condition in which the external portion of the ear (the auricle) is malformed.

➔ Accessory Auricle:

- It's a type of ear anomaly in the **tragus** area. as if skin tag
- Treatment: Plastic reconstruction,
- It can present with no effect. usually in syndromes

➔ Preauricular Sinus:

- Most common embryological defect,run in families.
- common (skip genetic) , يكون عند الاجداد بعدين الاحفاد
- About 20% of the population.
- Characterized by a nodule, dent or dimple located adjacent to external ear
- The manifestation (e.x., cyst) depends on the depth of the sinus.
- Susceptible to infection.
- Treatment : incision and drain is not enough we should remove the whole tract
- Indication for surgery:
  - Repeated infections, at least two.

➔ Protruding Ear (Bat Ear):

- The scaphoid fossa is concave instead of it's normal convex shape
- Antihelix pulls ear back while helix pushes it forward; **Antihelix is absent.**
- Note: There is no direct blood supply to the cartilage!
- Treatment: An incision behind the ear is made to reshape the cartilage (setback otoplasty) , over correction > lead to telephone ear

Diseases of the external ear con.

This whole page covered by other doctors and not mentioned in dr.salman habib lecture

➔ **Trauma to the Auricle:**

Etiology >

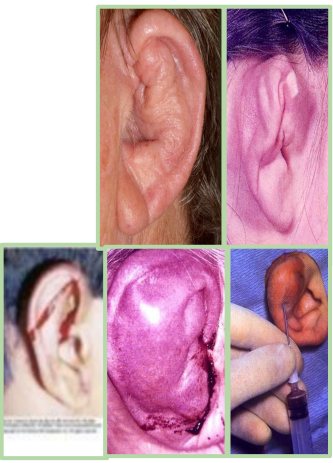
- Trauma with a sharp object results lacerations and/or perforation of the ear (e.g., due to earring misplacement, ear piercing)

Pathophysiology >

- trauma to the ear → bleeding from the perichondral vessels → accumulation of blood and serous fluid between the perichondrium and the cartilage → subperichondrial hematoma≤≥
- Hematoma auris **blood inside has to be drained to prevent necrosis to the cartilage**

Complication : Cauliflower ear. (as shown in the image)

- Treatment: Excise fibrous tissue, apply pressure, dressing, drain.
- When we treat hematoma? Immediate incision and drainage! So, don't develop into cauliflower ear (necrosed cartilage) . same as septal hematoma should be treated immediately to prevent necrosis (common in children after trauma)

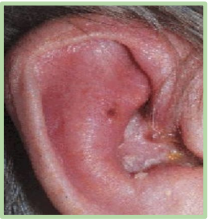


➔ **Perichondritis of the Pinna:**

- Definition: Perichondritis is inflammation of the perichondrium, a layer of **connective tissue**, which surrounds cartilage (helix, anti-helix,and concha) with spared lobule area IMP, while in case of Erysipelas the whole auricle is affected.
- Usually follow trauma to the cartilage (hematoma auris, surgical "mastoid surgery", frostbite, burn) or otitis externa **& piercing**
- Etiology: commonly caused by **Pseudomonas** & staph aureus.
- Symptoms: Fever, pain, redness and swelling (causes narrowing and further low hearing level).
- Treatment: immediately by parenteral antibiotics & drainage.
- Any cartilaginous organ that forms a hematoma must be drained as early as possible).
- If it is due to piercing the stud should be removed.
- Complications of Perichondritis or Trauma:
  - Cauliflower ear (End stage of untreated haematoma).
  - The ear can be exposed to trauma and lacerations leading to the formation of Hematoma, so if anything happens between the skin and cartilage →Hematoma (Number 1 killer of the cartilage, why? Because the blood will not be able to reach the cartilage) → Ischemia → Necrosis → Ear deformity.

➔ **Erysipelas of the Pinna:**

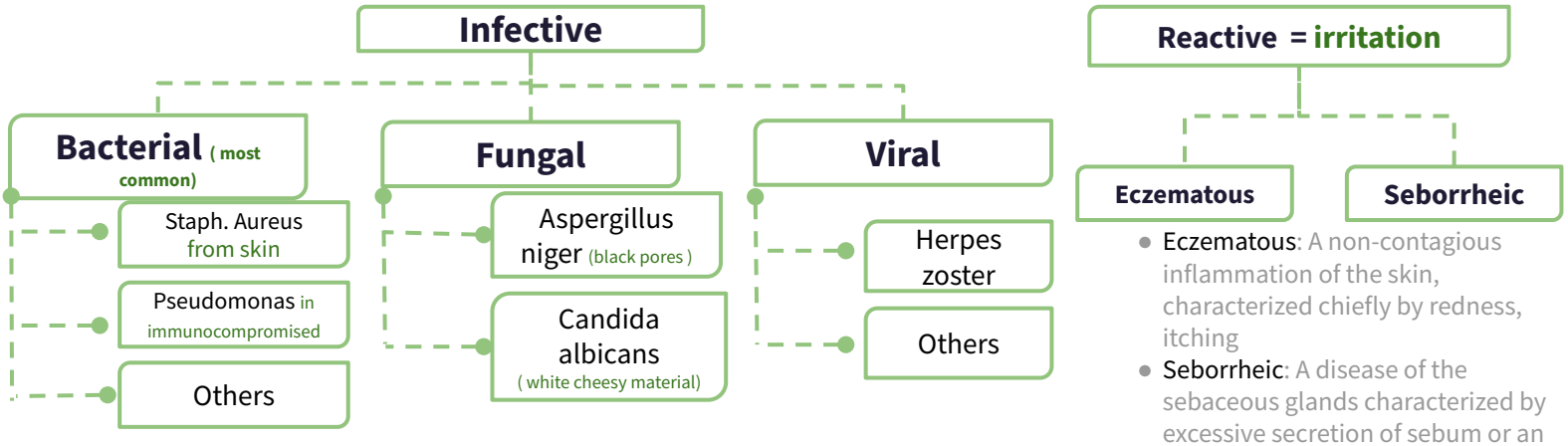
- Definition: skin infection with staph and there is redness.
- **includes all the skin**



Diseases of the external ear con.

Otitis Externa

- An acute (Less than 3 months) or chronic (more than 3 months) infection of the whole or a part of the skin of the external ear canal.
- Organisms enter the apo pilosebaceous unit by break in skin.
- Commonly caused by fingernail or Q-tip to relieve itching.
- **Periosteal lining of bony canal** displaced by swelling.
- Subacute or chronic develops if AOE not treated adequately.



- Eczematous: A non-contagious inflammation of the skin, characterized chiefly by redness, itching
- Seborrheic: A disease of the sebaceous glands characterized by excessive secretion of sebum or an alteration in its quality, resulting in an oily coating, crusts, or scales on the skin. It's usually painless

- Itching
- Pain: very severe, evoked by movement of the jaw, can radiate to the throat.
- Fullness.
- Tenderness and swelling, absent in otitis media.
- Otorrhea: Ear discharge (very little and scanty, not mucoid, however if it contains mucus it is originating from the middle ear).
- Deafness (Hearing loss): external ear completely obstructed (Rare).
- Changes in the lumen and skin of EAM (external auditory meatus).
- Fever

Physical Exam:

- Redness, swelling, sometimes you can't see the TM because of the swelling, protrusion, discharge, preauricular or face or neck extension.
- Gently tug up and back: if true AOE, patient will not tolerate.
- Clean canal thoroughly and examine under Microscope.

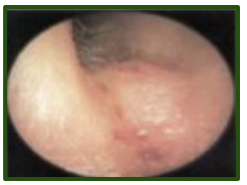
Diseases of the external ear con.

Clinical Types of External Ear Infections

Last 3 diseases is not covered by dr.salman habib

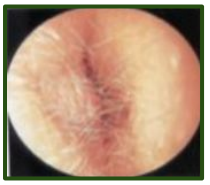
Localize O.E (furuncle)

- Small rounded swelling in the external canal & it's localized to the hair follicle
- Furunculosis: ear hair infection
- Staphylococcus aureus
- **Treatment:** incision and drainage if there's an abscess and local antibiotics



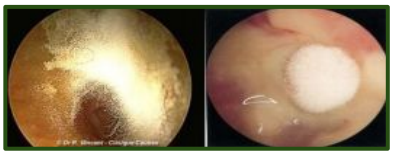
Diffuse infective O.E.: (swimmer's ear)

- Staphylococcus aureus.
- Treatment > Whole canal is become edematous so drops will not be effective because of edema , insted we put a sponge (ear wick) inside the ear once it dilated remove it , dr: السوال حا للدوعه السابوه
- Put a sponge that sucks the antibiotic drops



Otomycosis: fungal infection of the ear

- Fungal infection (More in those who take Abx for a long time)
- How to differentiate between aspergillus & candida?
  - Aspergillus has black heads (spores forming, hyphae)
  - candida is totally white (cheesy, cotton like)
- Fungal vs. Bacterial
  - Fungal: Less pain, more itching & NO fever.
- Management: suction then antifungal cream. Cleaning is the most imp step.



Bullous Myringitis:

- Inflammatory condition involves the lateral surface of the TM and the medial portion of the canal wall causing separation of one layer of the tympanic membrane "bullous". (contain serous fluid not abscess)
- It typically occurs in association with upper respiratory (viral) infections and is more common in winter.
- Clinical feature: Severe otalgia Serosanguinous otorrhea - Hearing loss
- It is very painful so we will not drain it, we give local analgesic until it spontaneously resolves. Antibiotics are ineffective.
- Do not touch, if we open it will turn the viral to bacterial that end up with perforation

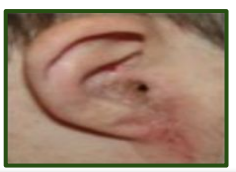
The hallmark clinical finding is: Bulla over TM and medial canal with serous or serosanguinous fluid.

Herpetic O.E:

- **A reaction happen in the nerve supplying the auricle**
- Herpes zoster oticus is a specific form of herpes zoster that presents with pre-eruptive ("pre-herpetic") lesion reactivated from either the trigeminal or cervical ganglions. Characterized by: **PAINFUL vesicles**
- Management: Steroids + Acyclovir
- Complications: Facial n. paralysis.
- Small vesicles + facial weakness + discharge = Ramsay Hunt syndrome or HSV. Dr: imp question

Eczematous and seborrheic: O.E.

- Swelling, redness, crust formation and oozing of discharge.
- If the eczema is only in the canal, keep on mind tympanic membrane perforation due to discharge. Painless.
- Treatment > steroid then avoid dryness

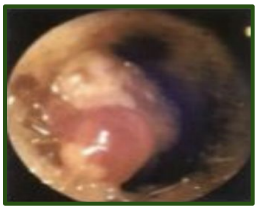


Diseases of the external ear con.

◀ Management of the External Ear Infection

- Swab for culture and sensitivity.
- Ear toilet: cleaning of any discharge. debridement of debris, pus and cerumen . So drops can go inside
- Keep the ear dry. Suction cleaning (Fungal infection = Suction) or the antifungal won't go inside so we have to debride.
- Local medications: antibiotics: Anti-pseudomonal drops – Ciprodex.
  - Ear wick (without pushing more than the length of the cotton > to avoid injury, infection and cotton dislodge).
  - Local analgesia to control pain
- Systemic medications: in immunocompromised as in diabetics.
- Surgery may be required in chronic cases (narrowing, fibrosis or medialization of the TM) because of failure of treatment because there is usually thickening in the skin and closure of the canal.
- Avoid using Q-tips and if you must use it don't insert it further into the bony part.
- Recommendations regarding prevention.
  - 1. Avoid instrumentation.
  - 2. Keep H2O out of the ear when possible.
- IN CASE OF:
  - Aspergillus Niger ➔ Give antifungal drops.
  - Herpetic O.E Tx: ➔ Acyclovir if < 3 days, Steroids to reduce inflammation. If it's reactive local steroids.

◀ Necrotizing (Malignant) Otitis Externa

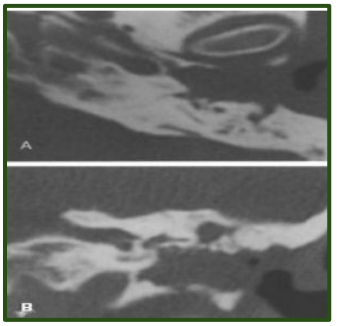


- An acute Pseudomonas infection (most common cause in immunocompromised patient) of the skin of the external ear canal which has spread to the adjacent bone. (Deep seated pain for more than a month).
- Risk factor : elderly , DM , immunocompromised
- skull base osteomyelitis is the new name.
- It is a malignant but NOT a cancer.
- Clinical Features: Diabetes, advanced age, severe otalgia > 1 month **(at night) Nocturnal headache**, granulation tissue, **cranial nerve involvement** (can involve the trigeminal or hypoglossal nerve with absent gag reflex , facial nerve palsy in osteomyelitis)
- It has a triad: dr: imp
  - Ear discharge "Several weeks of purulent otorrhea with granulations",
  - Headache (esp at night), notorial pain (severe headache and ear pain) , not relieved by simple analgesia
  - Immunocompromised patients: HIV, uncontrolled DM or elderly.
- It occurs mostly in elderly diabetic patients especially uncontrolled , post radiation , chemotherapy . Immunocompromised) Important!
  - We can add this to triad > cranial nerve involvement (facial ,glossopharyngeal = aspiration and issue with swallowing)

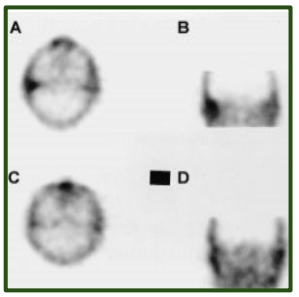
Diseases of the external ear con.

◀ Necrotizing (Malignant) Otitis Externa

- **Clinical Findings:**
  - Lower Cranial nerve palsies (VIII, IX, X, XI, XII) (check the gag reflex), and 25% VII
  - No signs of acute inflammation & No swelling.
  - On Ex: Granulation tissue in EAC, sequestra and Foul-smelling discharge from the floor of the external Auditory canal.
  - It can infect the base of the skull, the cranium Causing meningitis, brain abscess.
  - Almost always caused by Pseudomonas; can be fungal in HIV
  - Granulation tissue at the junction of the bony and cartilaginous portions of the canal + immunocompromised pt ➔ Dx as Malignant Otitis Externa!



- **Diagnosis:**
  - CBC > high reactive CRP (measure it before and after giving medication to know if there is response or not)
  - always we do CT although it doesn't tell us the definitive dx, that's why we rely on nuclear scan Bone (Petrous) scan to rule out osteomyelitis.
  - Bony erosion on contrast-enhanced CT and bone scan showing active infection to rule out other pathology such as cholesteatoma
  - MRI useful for soft-tissue diagnosis, but not for F-U
  - Bone scan is sensitive, but not specific (Tc-99m most sensitive , used as diagnostic) and Gallium (used for follow up)



◀ Treatment

Avoid ear wash in diabetic Pts

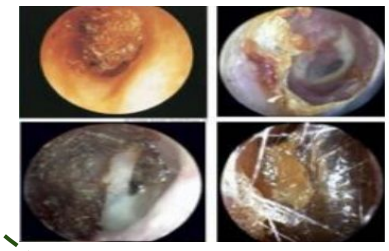
- **Medical Treatment:**
  - Culture and biopsy.
  - Antipseudomonal antibiotic. At least 6 weeks. ceftazidime
  - Blood-sugar control. (most important part of treatment).
  - Frequent debridement and anti-pseudomonal ear drops (local treatment).
  - ID and Endocrinologist consultation.
- **Surgical Treatment:**
  - Reserved for clear failures of above medical treatment.
  - The role of surgery remains controversial (e.g. if we need to take biopsy).
- Treatment of osteomyelitis : we should admit them
  - Antibiotic (e.x.,ceftazidime) I.V for six week
  - Control blood sugar
  - Clean the ear as much as can

Diseases of the external ear con.

◄ Miscellaneous Conditions of External Ear

Wax

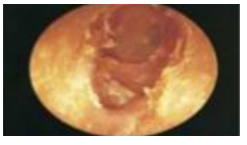
- We always remove wax before examination
- Could be liquidy soft, scaly, hard
- Normally is expelled from the canal aided by movements of the jaw
- When accumulated it may cause deafness, earache or tinnitus
- **Function:** Protect the ear from some bacterial & fungal infections (it's acidic)
- Irritative cleaning of the ear may result in eczematous or seborrheic otitis externa
- Wax on tympanic membrane is very dangerous, it could be hiding retraction behind especially in parus flaccida or cholesteatoma
- **Treatment:** is by removal using syringing very rare nowadays → anything you do it in ear will (cause vasovagal + there will be stimulation to the lateral semicircular canal bc of the water temperature that we are using), suction , irrigation or instrumentation each one has advantages and disadvantages
- In irrigation-hard wax- we insert water in the ear to washout the wax but we have to make sure of the temperature of the water is the same as the body temperature to avoid dizziness (if it is more or less than body temp by 7 degrees it will cause dizziness). It can cause vasovagal attack in some.
- Crocodile forceps/ ear forceps Hock.

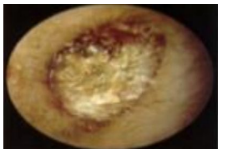



Crocodile forceps

Keratosis Obturans

- Accumulation of desquamated epithelium (skin not wax) in the bony canal. (the difference b\w it and cholesteatoma that in the latter one we have normal skin in abnormal place).
- It is excessive scaling of the skin causing very hard wax, is how we differentiate with external ear cholesteatoma
- It may be associated with sinusitis, bronchiectasis, or primary ciliary dyskinesia. (hair cell syndromes) hair is immotile so dead skin will accumulate.
- Unlike cholesteatoma, it doesn't cause bony erosions but it lead to compression **"pressure necrosis"** and widening of the canal. so, periosteum and cortex is intact , it will not invade the bone by secreting enzyme and activate osteoclast like cholesteatoma) .
- Usually cause deafness and pain.
- Treatment is **periodic removal.**





Diseases of the middle ear

◀ Acute Otitis Media

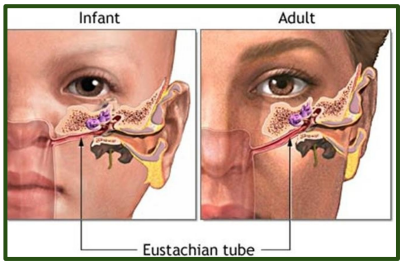
- Acute infection of the mucous membrane lining of the middle ear cleft.
- Most common bacterial infection of childhood. Estimated 85% of all children experience at least one episode of AOM (Acute Otitis Media).

◀ Predisposing Factors of the Middle Ear Infection

- Age: common in children as their Eustachian tube is more horizontal and shorter in relation to their head.
- Male sex
- Bottle feeding: more likely to have milk regurgitation (because children tend to drink while lying) in middle ear
- Climate: increase in humidity increase the risk
- Allergic Rhinitis
- Crowded living conditions (one infected will infect others)
  - For example in kindergarten bc the infection rate is increased
- Smoking within the home
- Heredity
- Associated conditions:
  - Cleft palate, why? tensor palatini muscle is absent and its job to open ET When you swallow. The muscles of the palate are affected and not well developed, so cleft palate must go for surgery.
  - Immunodeficiency, ciliary dyskinesia, down syndrome (muscle is weak) & cystic fibrosis.

◀ Route of the Middle Ear Infection

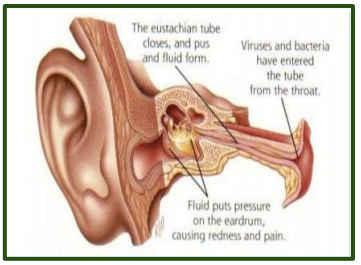
- Eustachian tube (very common) URTI through Eustachian tube to middle ear.
- External auditory canal (rupture).
- bloodborne.



◀ Bacteriology of the Middle Ear Infection (acute)

(First 3 are most common)

- Streptococcus pneumonia
- Haemophilus influenzae
- Moraxella (branhamella) catarrhalis
- Streptococcus pyogenes & Staphylococcus aureus related to the skin
- Pseudomonas related to immunocompromised



Diseases of the middle ear con.

◀ Clinical Pictures of the Middle Ear Infection

Dr said remember the steps

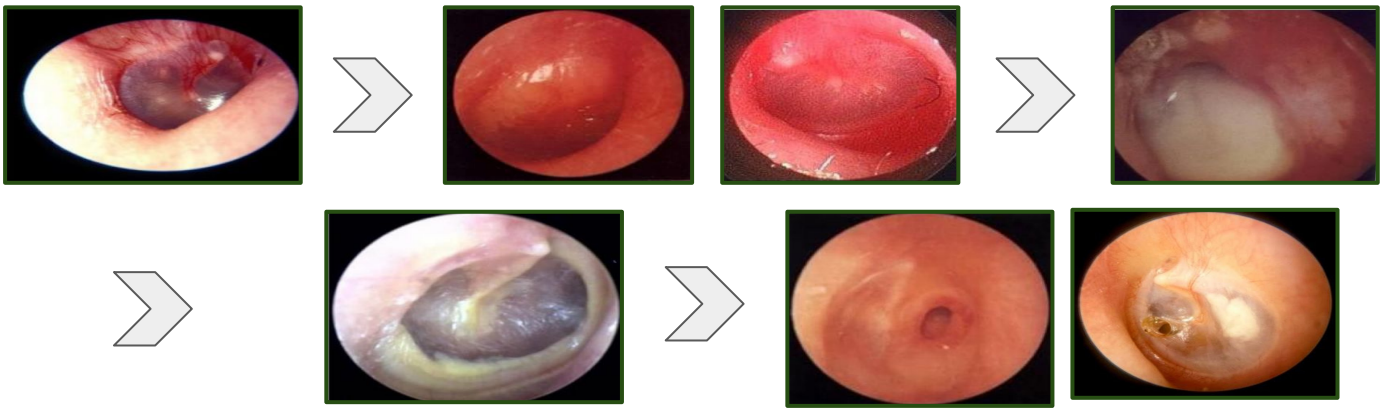
1. **Tubal occlusion:** produces early signs of acute otitis media.
    a. Discomfort / **Autophony** (hearing own voice louder) / Retracted drum caused by pressure difference / There is mild deafness / Tinnitus in children, not adults.
    b. First thing to happen in otitis media is redness/congestion → bulge (severe pain) → rupture if untreated → pus → abnormal/normal healing or perforation.
2. **Exudative inflammation:** fever, earache, deafness, congested drum
3. **Suppurative inflammation:** of the middle ear: Fever, severe earache, deafness, and bulging drum, pus behind it.
4. **Tympanic membrane rupture:** Otorrhea, Temperature and earache subside (pain relief), perforated drum and Mucopurulent (discharge) if not treated
5. **Resolution:** Either the rupture will persist, and it will discharge from time to time (chronic otitis media) Or close spontaneously ("retraction") common

- Tympanosclerosis "if not treated will retract if it was severe > adhesive otitis media (tympanic membrane reaching the promontory" or the cochlea

Complication of acute and chronic OM:

- Extracranial: Acute mastoiditis ,Chronic mastoiditis, Postauricular abscess, Bezold abscess, Temporal abscess, Petrous apicitis, Labyrinthine fistula, Facial nerve paralysis, Acute suppurative labyrinthitis.

- Intracranial: Meningitis, Brain abscess, Subdural empyema, Epidural abscess, Lateral sinus thrombosis, Otitic hydrocephalus, Encephalocele and cerebrospinal fluid leakage.



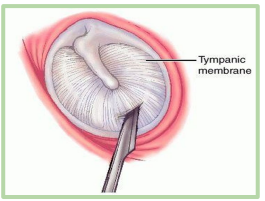
Tubal occlusion → Bulging → Suppurative inflammation (redness) → Rupture of the tympanic membrane (discharge) → It either resolve totally with minimal retraction or it is still perforated.

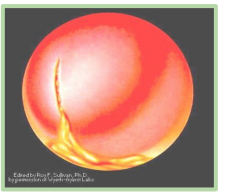
Diseases of the middle ear con.

◄ Pathophysiology of the Middle Ear Infection

Inflammation of the Eustachian tube (most commonly caused by viral URT infection)lead to narrowing lead to block no ventilation to middle ear lead to congestion of mucosal lining lead to accumulation of fluid if its small amount it resolve if not this fluid has 2 ways to go : rupture the tympanic membrane or go to the mastoid.

◄ Treatment of the Middle Ear Infection





- Symptomatic
- Analgesia
- Antimicrobials (broad spectrum)
  - **1st line: Amoxicillin** if allergic to penicillin & cephalosporins you give **clarithromycin**.
  - 2nd line: Amoxycillin/clavulanic acid (B-lactamase bacteria).
  - Trimethoprim-Sulfamethoxazole.
  - Cefaclor, cefixime.
  - Erythromycin-sulfisoxazole.
- Decongestant.
  (to help open the eustachian tube and get rid of the pus in the middle ear).
- Myringotomy (for adult only)
  (tympanic membrane controlled incision in **severe cases**) +/- tube.
  If the incision Is parallel to the fibers the healing will be faster بصير افتحها احسن من هي بوتح بتوسها بعدين
- Ear toilet and local antibiotics.
- Bulging + severe pain + adult > open small opening to relieve the pain.
- If not → nasal steroid spray so eustachian tube opens and remove the pus + oral ABx.
- Senario: child diagnosed with acute otitis media , give antibiotic orally and he was treated well . On examination the tympanic membrane is intact but there is fluid behind membrane. What is the next step ? No need for antibiotic because it is sterile fluid not pus almost it will resolve by 2 - 6 week if not > we have to treat. Why the duration is imp for children > because it will affect the language and articulation .
- Treatment (nasal sprays, myringotomy under GA (imp) and put ventilation tube تجلس من ستة أشهر الى سنة بعدين تطيح من نفسها) especially in patients with conductive hearing loss caused by fluid behind tympanic membrane or recurrent otitis media = بعدين في مسكله في eustachian tube

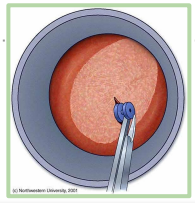
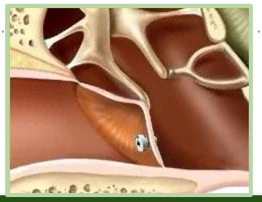
◄ Recurrent Otitis Media

- Three or more attacks over a 6-months period or (six attacks in a year).
- O.M. + diffusion > sterile fluid in the middle ear, or dysfunctioning Eustachian tube like in down syndrome or cleft palate.

◄ Treatment of the Recurrent Middle Ear Infection

- Long-term low dose antimicrobials.
- Ventilation tube insertion, in the inferior part which allows the air to enter the middle ear and drainage (open) of fluid from the Eustachian tube.
- The ventilation tube is inserted inferiorly to avoid injury to the ossicles.

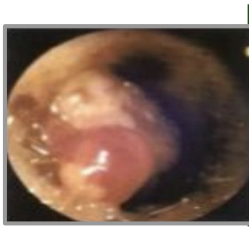
EXTRA: (Myringotomy with pressure equalization tube) Most common in acute otitis media after resolving there will be fluids. Pediatrics last for 3-6 weeks if more it will affect speech, so we drain through eustachian tube

Dr. Salman Habib notes

- Anatomy: IMP relations to remember in external auditory canal
  - posterialy: mastoid.
  - anteriorly : temporomandibular joint.
  - Inferiorly: jugular bulb, carotid, facial nerve.
  - Superiorly: middle cranial fossa

- Severe Infection from external auditory canal could spread to brain, blood vessels and bone
- Small amount of wax protect the ear, yet if it accumulates in the ear it will block the ear
- External auditory canal is 2.5 long.
- From the 3 layers that forms the tympanic membrane the fibrous layer is the one that that stretches and transmit sound
- Q doc: what is the middle ear cleft? Answer:
  - Eustachian (Pharyngo-tympanic) Tube.
  - Tympanum (Middle Ear Cavity).
  - Mastoid Antrum and Air Cells.
- Qdoc: what is hypotympanum? it is air cells lies under the infracochlear area (appear as black holes in pics)
- IMP: in recurrent ear infection the most sensitive area to erode is long process of the incus
- Tumor in the larynx or the pharynx could cause intermittent ear pain due to (referred earache)
- In organ of corti:
  - Inner hair cells has 90% afferent nerves (main cells of hearing) + resist infection
  - Outer hair cells has 90% efferent nerves (supporting cells) + it is sensitive for medication and sounds
- Case from doc: pt with C.C of ear pain for more than one month the, shares a history that he had an ear wash in the past in addition to that he suffers from diabetes. Otoscopy shows this pic
- What is the most likely diagnosis? Necrotizing (malignant)otitis externa



Lecture Quiz

Q1-A 19-year-old Caucasian woman attends the outpatient clinic with a 2-day history of left-sided earache. The pain has worsened in the past 24 hours and she describes some seepage from the affected ear. Over the past few weeks her left ear has felt 'blocked' and she has been using cotton wool buds to clean them. Her hearing is not impaired. She is afebrile (36.7°C). On examination, the pain is worsened on superior movement of the auricle. There is a scanty discharge emerging from the left ear. Which of the following is the most likely diagnosis?

A. Acute otitis externa
B. Chronic otitis externa
C. Acute otitis media
D. Mastoiditis
E. Chronic otitis media

Q2- Management of ear pain The patient in Question 1 is due to undergo treatment for her 2-day history of ear pain. Which of the following is most appropriate therapy?

A. Discharge with advice to stop using cotton wool buds
B. Discharge with combination of acidifying and antibiotic ear drops
C. Discharge with oral analgesics
D. Referral to ENT specialist for myringotomy
E. None of the above as the ear canal is 'self-cleaning'

Q3-A 6-year-old Asian boy is brought to the paediatric emergency department by his mother. She is worried because the boy is lethargic and has been complaining of right-sided earache all day. There have been no similar attacks in the past. On examination, he looks unwell, and his temperature is 39.0°C, pulse rate is 110 beats/min and blood pressure is 90/40 mmHg. There is no cervical lymphadenopathy. Otoscopic examination reveals a bright red right tympanic membrane. You decide to take a microbiology swab. Which one of the following is the most likely pathogen?

A. Group B streptococcus
B. Haemophilus influenzae
C. Mycobacterium tuberculosis
D. Moraxella catarrhalis
E. None of the above

Q4-The patient is Question 3 is to undergo treatment for his ear infection. Which one of the following options is most appropriate therapy?

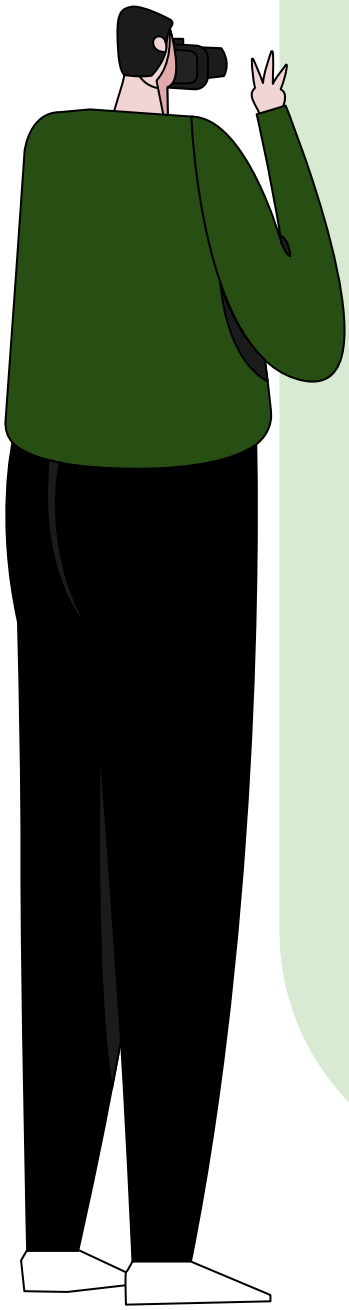
A. Immediate myringotomy
B. Advice on hygiene and antipyretics
C. Refer to ENT for tympanostomy tube
D. Oral antibiotics (amoxicillin) for 5 days
E. Antibiotic (amoxicillin) ear drops

Q5-Which of the following statements regarding necrotising otitis externa are true?

A. It tends to run an indolent course.
B. It tends to be bilateral.
C. It spares cranial nerve VII.
D. It is caused by streptococcal infection.
E. It should be suspected in elderly diabetics.

5.E
4.D
3.B
2.B
1.A

THANK YOU!



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Special Thanks to

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