Anatomy of the ear
External ear

- Pinna or auricle
- External auditory canal
- Tympanic membrane
Auricle / Pinna

- Made of elastic cartilage
  Imp: Used as graft

- Elevations and depressions are present on the lateral surface of pinna

- No cartilage between tragus and crus helix
- Imp: Used for endaural approach
# External auditory canal

<table>
<thead>
<tr>
<th>Cartilaginous part</th>
<th>Bony part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer 1/3 (8 mm)</td>
<td>Inner 2/3 (16 mm)</td>
</tr>
<tr>
<td>Skin contains ceruminous glands and pilosebaceous with hair follicle</td>
<td>No glands or hair follicles</td>
</tr>
<tr>
<td>Fissure of santorini are deficiencies in this part hence infections from ear can spread to parotid and vice versa</td>
<td>Foramen of huschke: deficiency in the anteroinferior bony part [infections to and fro from parotid]</td>
</tr>
<tr>
<td>Isthmus – narrowing of the bony canal 6mm lateral to TM where foreign body gets impacted</td>
<td></td>
</tr>
</tbody>
</table>
• Is the external auditory canal straight??

• How do you pull the pinna to examine the eac ad tympanic membrane in
  1] adults ??
  2] children??
Nerve supply of pinna and external auditory canal
Nerve supply of external auditory canal

• Anterior wall and roof – auriculotemporal nerve
• Posterior wall and floor – vagus nerve
Tympanic membrane

- Partition between external ear and middle ear
- It is obliquely placed
- 9-10 mm tall
- 8mm wide
- 0.1mm thick
Parts of tympanic membrane

<table>
<thead>
<tr>
<th></th>
<th>Pars Tensa</th>
<th>Pars flaccida</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annulus</td>
<td>present</td>
<td>absent</td>
</tr>
<tr>
<td>No of layers</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Umbo and cone of light</td>
<td>Umbo in centre and cone of light in antero - inferior part</td>
<td>-</td>
</tr>
</tbody>
</table>

Diagram: Visual representation of parts of the tympanic membrane, including the umbo and cone of light.
Middle Ear Cleft

- Middle ear
- Eustachian tube
- Additus
- Antrum
- Mastoid air cells
Parts of middle ear

- **Mesotympanum**: portion of the middle ear that lies against pars tensa.

- **Epitympanum**: portion of the middle ear that lies against the pars flaccida.

- **Hypotympanum**: portion of the middle ear that lies below the annulus.

- **Protympanum**: portion of the middle ear that is against the eustachian tube.
## Middle ear anatomy

<table>
<thead>
<tr>
<th>Roof</th>
<th>Tegmen tympani</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor</td>
<td>Bone separating jugular bulb</td>
</tr>
<tr>
<td>Anterior wall</td>
<td>1. Communicates with ET</td>
</tr>
<tr>
<td></td>
<td>2. Bone separating carotid</td>
</tr>
<tr>
<td></td>
<td>3. Communicates with canal for tensor tympani</td>
</tr>
<tr>
<td>Posterior wall</td>
<td>Pyramid and aditus</td>
</tr>
<tr>
<td>Lateral wall</td>
<td>Tympanic membrane and outer attic wall called scutum</td>
</tr>
<tr>
<td>Medial wall</td>
<td>1. Impression of lateral semicircular canal</td>
</tr>
<tr>
<td></td>
<td>2. Promontory : impression of cochlea</td>
</tr>
<tr>
<td></td>
<td>3. Oval window.</td>
</tr>
<tr>
<td></td>
<td>4. Facial canal passing between semicircular canal and promontory</td>
</tr>
<tr>
<td></td>
<td>5. Round window</td>
</tr>
<tr>
<td></td>
<td>6. Processus cochlearformis</td>
</tr>
</tbody>
</table>
• Ossicles
• Malleus : The malleus has head, neck, handle (manubrium), a lateral and an anterior process
• Incus
• Stapes
• Intratympanic muscles:
  • Tensor tympanii – Mandibular nerve
  • Stapedius – Facial nerve
• Function – dampens loud sound
• Tympanic plexus:
  1] Tympanic branch of glossopharyngeal nerve
  2] Sympathetic plexus around the ICA

[Imp: In Freys syndrome section of tympanic branch of glossopharyngeal nerve can be done]
Blood supply of middle ear

- Middle ear is supplied by six arteries, out of which two are the main:
  - (i) Anterior tympanic branch of maxillary artery
  - (ii) Stylomastoid branch of posterior auricular artery

- Four minor vessels are:
  (i) Petrosal branch of middle meningeal artery (runs along greater petrosal nerve).
  (ii) Superior tympanic branch of middle meningeal artery traversing along the canal for tensor tympani muscle.
  (iii) Branch of artery of pterygoid canal (runs along eustachian tube).
  (iv) Tympanic branch of internal carotid
Mastoid antrum

- Additus : Attic communicates with antrum
- Mastoid air cells: Pneumatic or sclerotic or diploetic
Mac Evans triangle

- Important landmark for ?????
Korners septum

- Mastoid develops from the squamous and petrous bones.
- The petrosquamosal suture may persist as a bony plate — the Korner's septum.
- It separates superficial squamosal cells from the deep petrosal cells.
- Korner's septum is surgically important as it may cause difficulty in locating the antrum and the deeper cells; and thus may lead to incomplete removal of disease at mastoidectomy.
Anatomy of inner ear

- Inner ear
  - Bony labyrinth
  - Membranous labyrinth
Vestibule

- It’s the central chamber.
- In the lateral wall lies the oval window.
- In the medial wall lies 2 recesses:
  - Spherical recess – saccule.
  - Elliptical recess – utricle.
- Below the elliptical recess is the opening for aqueduct of vestibule through which passes the endolympahitic sac.
- Posteriorly it receives the openings of the 3 semi-circular canals through 5 openings.
Semicircular circular canals

- 3 semicircular canal
  1. Posterior
  2. Superior
  3. Lateral
- They lie at right angles to each other.
- Each has an ampullated end opening into vestibule.
- Non ampullated end of posterior and superior canals fuse to form the crus commune.
- The three semicircular canals open into vestibule through five openings
Cochlea

- Spiral shaped
- Takes 2.5 turns around central modiolus
- Modiolus is directed against the internal auditory meatus
- Around the modiolus, the ossious spiral lamina winds dividing the cochlea incompletely and gives attachment to the basilar membrane.
- The basal turn of the cochlea - promontory
Cochlea

- Bony cochlea has 3 compartments
  1. Scala vestibuli
  2. Scala media
  3. Scala tympani

- Scala vestibuli and scala tympani are filled with perilymph and communicate with each other at the apex of cochlea – helicotrema

- Scala media has endolymph
• Scala vestibuli is covered by foot plate of stapes
• Scala tympani is covered by secondary tympanic membrane or the round window. It is connected to the subarachnoid space through aqueduct of cochlea
Membranous labyrinth

- Semicircular canal duct
- Saccule
- Utricle
- Endolymphatic duct
- Endolymphatic sac
- Cochlear duct
Cochlear duct

- It's nothing but scala media
- Appears triangular in cross section
- It has
- Basilar membrane - contains organ of corti and separates it from scala tymani
- Reissenesers membrane – separates from scala vestibuli
- Stria vascularis: secretes endolymph
• Cochlear duct is connected to the saccule by ductus reuniens.
• The length of basilar membrane increases as we proceed from the basal coil to the apical coil.
• It is for this reason that higher frequencies of sound are heard at the basal coil while lower ones are heard at the apical coil.
Saccule and Utricle

- Vestibule
- Semicircular canals
- Saccule
- Utricle
- Cochlea (38mg/dl)
- Endolymphatic duct
- Endolymphatic sac (1600mg/dl)
Saccule and Utricle

**Utricle**
- The utricle lies in the **posterior** part of bony vestibule.
- The sensory epithelium of the utricle is called the macula and is concerned with linear acceleration and deceleration.
- It receives the five openings of the three semicircular ducts.
- It is also connected to the saccule through the utriculosaccular duct.

**Saccule**
- The saccule also lies in the bony vestibule, anterior to the utricle and opposite the stapes footplate.
- Its sensory epithelium is also called the macula. Its exact function is not known. It probably also responds to linear acceleration and deceleration.
• Semicircular ducts: They are three in number and correspond exactly to the three bony canals. They open in the utricle.

• The ampullated end of each duct contains a thickened ridge of neuroepithelium called crista ampullaris.
Endolymphatic duct

- Endolymphatic duct and sac:
- Endolymphatic duct is formed by the union of two ducts, one each from the saccule and the utricle.
- It passes through the vestibular aqueduct.
- Its terminal part is dilated to form endolymphatic sac which lies between the two layers of dura on the posterior surface of the petrous bone.
- Endolymphatic sac is surgically important. It is exposed for drainage or shunt operation in Meniere's disease.
• Duct of cochlea connecting with subarachnoid space ??
• Endolymphatic duct is formed by ?
• Cochlear duct is??
• Cochlear duct is connected to saccule by ??
• Scala media is seperated from scala tympani by ?
• Scala media is seperated from scala vestibuli by ?
 Fluid between bony and membranous labrynth is called ???????

 Fluid in membranous labrynth is called ?????
• Perilymph:
• It is present between bony and membranous labyrinth
• It communicates with CSF through aqueduct of cochlea
• Two theories regarding its formation:
• (i) It is a filtrate of blood serum and is formed by capillaries of the spiral ligament and
• (ii) it is a direct continuation of CSF and reaches the labyrinth via aqueduct of cochlea
• Endolymph:
• It fills the membranous labyrinth
• Produced and reabsorbed by the stria vascularis
Organ of Corti

- It is sense organ of hearing located on basilar membrane in scala media.
- It has hair cells which are receptors for hearing and transduce sound energy into electrical energy.
- Inner hair cells are in single row and transmit auditory impulses.
- Outer hair cells are in 3-4 rows and modulate function of inner hair cells.
- Deiter and hensen cells are supporting cells.
- Tectorial membrane overlies organ of corti.
<table>
<thead>
<tr>
<th></th>
<th>Endolymph</th>
<th>Perilymph</th>
<th>CSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na(^+) (mEq/L)</td>
<td>5</td>
<td>140</td>
<td>152</td>
</tr>
<tr>
<td>K(^+) (mEq/L)</td>
<td>144</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Protein (mg/dL)</td>
<td>126</td>
<td>200-400</td>
<td>20-50</td>
</tr>
<tr>
<td>Glucose (mg/dL)</td>
<td>10-40</td>
<td>85</td>
<td>70</td>
</tr>
</tbody>
</table>
Physiology of hearing

Dr Vyshnavi
Physiology of hearing

Mechanism of hearing has 3 parts

1] Mechanical conduction of the sound in conductive apparatus (Steps 1 and 2)

2] Transduction of mechanical energy into electrical impulses by sensory system of cochlea (Steps 3-5)

3] Conduction of electrical impulses to the brain
Impedance matching mechanism

• When sound travels from air in middle ear to fluid in inner ear, its amplitude is decreased by fluid impedance.

• Only 0.1% of sound energy goes inside inner ear.

• Middle ear amplifies sound intensity to compensate for this loss. It converts sound of low pressure, high amplitude to high pressure, low amplitude vibration.
Impedance matching

- **Areal ratio:** area of the tympanic membrane is much larger than the round window (21:1)

- **LEVER RATIO:** the length of the long arm of the malleus is much longer than the long arm of the incus. (1.3:1)

- **BUCKLING ACTION**
  force is transmitted from the centre of the tympanic membrane (i.e., the TM doesn't move as a plate)
• The greatest sensitivity of sound transmission is between 500-3000hz

<table>
<thead>
<tr>
<th>Component</th>
<th>Frequency Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAC</td>
<td>3000Hz</td>
</tr>
<tr>
<td>Tympanic membrane</td>
<td>800-1600Hz</td>
</tr>
<tr>
<td>Middle ear</td>
<td>800Hz</td>
</tr>
<tr>
<td>Ossicular chain</td>
<td>500-2000Hz</td>
</tr>
<tr>
<td>Effective vibratory area</td>
<td>45mm²/55mm²</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Foot plate area</td>
<td>3.2mm²</td>
</tr>
<tr>
<td>Areal ratio</td>
<td>14:1/17:1</td>
</tr>
<tr>
<td>Lever ratio</td>
<td>1.3:1</td>
</tr>
<tr>
<td>Total transformer ratio</td>
<td>14*1.3=18:1</td>
</tr>
<tr>
<td></td>
<td>17*1.3=22:1</td>
</tr>
</tbody>
</table>
Auditory pathway

- PNEUMONIC ???
# Functions of auditory pathway

<table>
<thead>
<tr>
<th>Part of pathway</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch or Frequency</td>
<td>Cochlea</td>
</tr>
<tr>
<td>Amplitude or intensity</td>
<td>Cochlear nerve</td>
</tr>
<tr>
<td>Feature detection</td>
<td>Higher auditory centres</td>
</tr>
<tr>
<td>Localisation of sound</td>
<td>Higher auditory centres</td>
</tr>
</tbody>
</table>
• Vestibular system:
  • 1]Peripheral receptors in membranous labyrinth
    A] - utricle and saccule – also called otolith organs. They act as stretch receptors and gravity acts a stimulus
    - these have sensory neuroepithelium which is sensory type 1 hair cells which is flask shaped and type 2 hair cells which are cylindrical shaped which are concerned with
    - linear acceleration
    - gravity
    - change of head position
    B] semicircular canals:
      - contains cristae are the ampullated end which is responsible for angular acceleration and deacceleration
    And it has otolith membrane
      - it is gelatinous mass embedded with otolith / otoconia
    These are crystals of calcium carbonate

• 2] vestibular nerve: fibres end in the vestibular nuclei while some end in cerebellum
<table>
<thead>
<tr>
<th>Movement</th>
<th>Responsive part of the inner ear</th>
</tr>
</thead>
<tbody>
<tr>
<td>1] Angular/rotational</td>
<td></td>
</tr>
<tr>
<td>2] Linear</td>
<td></td>
</tr>
<tr>
<td>- Horizontal</td>
<td></td>
</tr>
<tr>
<td>- Vertical</td>
<td></td>
</tr>
<tr>
<td>3] Sense of gravity or position of head</td>
<td></td>
</tr>
</tbody>
</table>
• Static equilibrium is a special sense which interprets the position of head permitting the CNS to maintain stability and posture when the head and body are not moving.

• It is detected by mechanoreceptors utricle and saccule which contain a macula.
Assessment of hearing
1] What is the frequency of normal hearing??

2] What frequencies are tested in audiometry?

3] What is loudness discomfort level
Level of sound which produces discomfort in the ear. It is at 95-105 db
Types of hearing loss

• Conductive hearing loss: disease which interferes with conduction of sound from external ear to stapediovestibular joint

• Sensorineural hearing loss: lesions from cochlea to central connections

• Mixed hearing loss: combination of both
Clinical tests for assessing

• Finger friction test
• Watch test
• Speech test
• Tuning fork test
Tuning fork test

1] Which tuning fork is used?? Why??

Forks of lower frequencies produce sense of bone vibration while those of higher frequency have a shorter decay time and are thus not routinely preferred.
To test air conduction (AC) –
- a vibrating fork is placed vertically, about 2 cm away from the opening of external auditory meatus.
- The sound waves are transmitted through the tympanic membrane, middle ear and ossicles to the inner ear.

To test bone conduction (BC), the footplate of vibrating tuning fork is placed firmly on the mastoid bone. Cochlea is stimulated directly by vibrations conducted through the skull bones. Thus, BC is a measure of the cochlear function only.
1] AC is a test of ?

2] BC is a test of ?
• Rinne:
  • Positive: AC is louder and longer than BC seen in normal and sensorineural hearing loss
  • Negative: BC is louder and longer than AC This is seen in conductive deafness
Weber test

• In this test, a vibrating tuning fork is placed in the middle of the forehead or the vertex and the patient is asked in which ear the sound is heard.
• Normally, it is heard equally in both ears.
• It is lateralised to the worse ear in conductive deafness and to the better ear in sensorineural deafness.
• Lateralisation of sound in weber test with a tuning fork of 512Hz implies a conductive loss in ipsilateral ear or a sensorineural loss in the contralateral ear.
Absolute bone conduction test

- Bone conduction is a measure of cochlear function.
- In ABC test, patient's bone conduction is compared with that of the examiner (presuming that the examiner has normal hearing).
- External auditory meatus of both the patient and examiner should be occluded (by pressing the tragus inwards), to prevent ambient noise entering through A C route.
- In conductive deafness, the patient and the examiner hear the fork for the same duration of time.
- In sensorineural deafness, the patient hears the fork for a shorter duration.
Schwabach's test

• Here again BC of patient is compared with that of the normal hearing person (examiner) but meatus is not occluded. It has the same significance as absolute bone conduction test.
<table>
<thead>
<tr>
<th>Test</th>
<th>Conductive</th>
<th>Sensosorineural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rinne</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Audiological tests

- Pure tones produced from the audiometer
- Intensity of the pure tone is increased or decreased in 5 db.
- Air conduction is tested from 125 hz to 8000 hz
- Bone conduction is tested from 250 to 4000 hz
- The charted graph is called an audiogram
Symbols used in audiogram

<table>
<thead>
<tr>
<th>Modality</th>
<th>Ear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right</td>
</tr>
<tr>
<td>AC unmasked</td>
<td>○</td>
</tr>
<tr>
<td>AC masked</td>
<td>△</td>
</tr>
<tr>
<td>BC unmasked</td>
<td>&lt;</td>
</tr>
<tr>
<td>BC masked</td>
<td>□</td>
</tr>
<tr>
<td>No response</td>
<td>○</td>
</tr>
</tbody>
</table>
Normal hearing
Conductive hearing loss
Sensorineural hearing loss
Noise induced hearing loss
Carharts notch otosclerosis
Masking

• It is done to prevent the non test ear to interfere during testing of the diseased ear
• For AC if the air bone gap is > 40 db it is done
• For BC it should be done always
Impedence audiometry
Impedence audiometry

• Consists of
• 1] tympanometry
• 2] acostic reflex measurment
# Types of tympanometry

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Normal</td>
</tr>
<tr>
<td>As</td>
<td>Sclerosis-Oto</td>
</tr>
<tr>
<td>Ad</td>
<td>Discontinuity of ossicles</td>
</tr>
<tr>
<td>B</td>
<td>Fluid in ear</td>
</tr>
<tr>
<td>C</td>
<td>Retracted tympanic membrane</td>
</tr>
</tbody>
</table>
Acoustic reflex

- Loud sound of 70 db above the threshold of hearing causes bilateral contraction of stapedial muscle.
- Useful for:
  1. To test hearing in infants and young children.
  2. To find malingers.
  3. To detect cochlear pathology
  4. To detect VIII nerve pathology
  5. To detect lesions of facial (VII) nerve
Special test for hearing

- Recruitment:
- It’s a phenomenon where there is abnormal growth in the loudness of the sound.
- Sounds of low intensity are heard as loud sounds.
- It is seen in lesions affecting cochlea like Menier's and presbycusis.
- This helps to differentiate from retrocochlear pathology.
SISI[short increment sensitivity index]

• Patients with cochlear pathology are able to appreciate small changes in the intensity of sound as compared to those of retrocochlear lesion or normal person.

• This test also differentiates cochlear from retrocochlear pathology
Threshold tone decay test

• It’s a test for retrochlear pathology
• Normal person hears a tone continuously for 60 sec while in patients with retrocochlear pathology they stop hearing earlier due to fatigue of the auditory nerve
Evoked response audiometry

- Electrocochleography:
  - It measures the potentials in the cochlea and the 8th nerve in the first 5 ms of auditory stimulation
- It has 3 components:
  - Cochlear microphonic
  - Summating potential
  - Action potential
- Normally the ratio of summating potential to action potential is less than 30% but in patients with menieres this ratio is increased
Bera

- It is a test to assess the auditory pathway from the 8\textsuperscript{th} nerve to brainstem
- Its non invasive test
- Clicks and tone bursts are used to elicit a response
• There are 7 waves produced in the first 10ms
• Wave I- Distal part of CN VIII
• Wave II -Proximal part of CN VIII near the brainstem
• Wave III- Cochlear nucleus
• Wave IV- Superior olivary complex
• Wave V- Lateral lemniscus
• Waves VI and VII- Inferior colliculus
• Delay in wave 5 is suggestive of acoustic neuroma
• A B R is used:
  • (i) As a screening procedure for infants.
  • (ii) To determine the threshold of hearing in infants; also in children and adults who do not cooperate and in malingerers.
  • (iii) To diagnose retrocochlear pathology particularly acoustic neuroma.
  • (iv) To diagnose brainstem pathology, e.g. multiple sclerosis or pontine tumours.
  • (vi) To monitor CN VIII intraoperatively in surgery of acoustic neuromas to preserve the function of cochlear nerve.
OAE

• These are low intensity sounds produced by the outer hair cells
• They travel in reverse direction
• Outer hair cells – basilar membrane-perilymph-oval window-ossicles-tympanic membrane-ear canal
• Presence indicates healthy cochlea
• Types of OAE
• Spontaneous OAE
• Evoked OAE:
  Transient evoked OAE
  Distortion product OAE
• OAE are absent in
  1] 50% of normal individuala
  2] middle ear disorders [as the sound travelling in the reverse direction cannot be picked up]
  3] when hearing loss exceeds 30 db
<table>
<thead>
<tr>
<th>Test</th>
<th>Normal</th>
<th>Cochlear lesion</th>
<th>Retrocochlear lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure tone audiogram</td>
<td>Normal</td>
<td>Sensorineural hearing loss</td>
<td>Sensorineural hearing loss</td>
</tr>
<tr>
<td>Speech discrimination score</td>
<td>90–100%</td>
<td>Below 90%</td>
<td>Very poor</td>
</tr>
<tr>
<td>Roll over phenomenon</td>
<td>Absent</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Recruitment</td>
<td>Absent</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>SISI score</td>
<td>0–15%</td>
<td>Over 70%</td>
<td>0–20%</td>
</tr>
<tr>
<td>Threshold tone decay test</td>
<td>0–15 dB</td>
<td>Less than 25 dB</td>
<td>Above 25 dB</td>
</tr>
<tr>
<td>Stapedial reflex</td>
<td>Present</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Stapedial reflex decay (page 109)</td>
<td>Normal</td>
<td>Normal</td>
<td>Abnormal</td>
</tr>
<tr>
<td>E.R.A</td>
<td>Normal interval between wave I &amp; V</td>
<td>Normal interval between wave I &amp; V</td>
<td>Wave V delayed or absent</td>
</tr>
</tbody>
</table>
Acute Suppurative Otitis media

- Definition: Inflammation of the middle ear cleft by pyogenic organisms
Routes of infection

1. Eustachian tube: MC.
2. Ear canal
3. Blood

1. Why is ASOM more common in children and infants ?????
Predisposing factors

1] Recurrent attacks of common cold, URTI
2] Exanthematous fever like measles, diptheria, whooping cough
3] Chronic rhinitis and sinusitis
4] Nasal allergy
5] Tumours of nasopharynx
6] Nasal packing for epistaxis
7] Cleft palate
## Bacteriology

### ASOM

Most common in infants and children are **Streptococcus pneumonia** and *H.influenza*. Sometimes Moraxella, *Staph.aureus*, and *E.coli*.

### CSOM

Aerobic and anaerobic and most commonly **multiple organisms**. Common aerobic organisms are *Pseudomonas aeruginosa*, *Proteus*, *Esch. coli* and *Staph*, *aureus*. Anaerobes include *Bacteroids fragilis* and *streptococci*.
1. Tubal occlusion

2. Pre-suppuration

3. Suppuration

4. Resolution
Stages of ASOM

1. Tubal occlusion

2. Pre-suppuration

3. Suppuration

4. Resolution
<table>
<thead>
<tr>
<th>Stage</th>
<th>Pathology</th>
<th>Symptoms</th>
<th>Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tubal occlusion</td>
<td>Oedema of ET leading to negative pressure and retraction of TM</td>
<td>Mild deafness and ear ache</td>
<td>Retracted TM</td>
</tr>
<tr>
<td>2. Pre-suppuration</td>
<td>Invasion of organisms and mild inflammatory exudate</td>
<td>Fever. Severe earache. Deafness</td>
<td>Cart wheel TM. (Congested TM)</td>
</tr>
<tr>
<td>4. Resolution</td>
<td>TM ruptures with release of pus</td>
<td>Everything decreases</td>
<td>Small perforation in antero-inferior pars tensa with hyperemia of TM</td>
</tr>
<tr>
<td>5. Complications</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Treatment:

• **Antibacterial therapy**: antibiotics to be given till there is reduction in fever, tympanic membranes looks normal and normal hearing. Minimum duration to be given for 10 days.

• Ampicillin or amoxycillin most commonly used.

• Inadequate therapy will lead to serous otitis media
• Nasal decongestants: to relieve eustachian tube edema.
• Oral decongestants
• Analgesics and antipyretics
• Ear toilet
• Dry local heat
• Myringotomy: indications
  1] Severe pain with bulging drum
  2] Incomplete resolution despite antibiotics
  3] Persistent effusion beyond 12 weeks
Acute necrotising otitis media

- Variant of ASOM seen in children suffering from
  - Measles
  - Scarlet fever
  - Influenza
• Rapid destruction of of whole tympanic membrane with its annulus, mucosa of promontory, ossicular chain and even mastoid air cells. There is profuse otorrhea.

• Healing is followed fibrosis or ingrowth of squamous epithelium.
Recurrent acute otitis media

- Children between 6 months – 6 years get recurrent upper respiratory tract infections 4-5 times a year.
• A 7 year old child presenting with acute otitis media does not respond to ampicillin. Examination reveals full and bulging tympanic membrane. The treatment of choice is

1] systemic steroid
2] ciprofloxacin
3] myringotomy
4] cortical mastoidectomy
You have seen a 10-month old infant who has had 5 episodes of fever. Vomiting and red bulging tympanic membrane for the past 4 months which responds quickly to amoxicillin and in 10 days the tympanic membrane looks normal. Your diagnosis would be:

- Acute otitis media
- Recurrent acute otitis media
- Otitis media with effusion
- Chronic suppurative otitis media
Non suppurative otitis media
[Secretory OM, Serous OM, Glue ear, OME]

- Definition: accumulation of non inflammatory exudate in the middle ear cavity

- Common in 2-6 years of age
Pathogenesis
• Etiology:
  1] Tubal occlusion due to various nasopharyngeal causes like adenoids, benign and malignant tumour
  Nasal cause – chronic rhinitis and sinusitis tonsillitis, palatal defects.

Unilateral serous otitis media: Most common cause is ????

2] Allergy –
  Mucosal edema of eustachian tubal orifice
3] Hypogammaglobulinemia
  predisposes to inflammatory response in the middle ear cavity
Symptoms: PAINLESS
1. Block sensation of the ear
2. CHL
3. Delayed speech
3. Poor school performance
4. Autophony
5. Nasal discharge and obstruction
Signs

- Dull lustreless tympanic membrane WITH ABSENT LIGHT REFLEX
- Retracted tympanic membrane
- Presence of fluid level
- Air bubbles
- Decreased mobility of the tympanic membrane
Conductive hearing loss + B-type impedance audiometry
• Treatment:
  • Watchfull waiting for 3 months as it is known for spontaneous resolution
  • If no change even after 3 months then myringotomy +/- grommet with treating underlying cause like adenoidectomy

Prevention of secretory otitis media:

Anti allergy treatment.
Decongestants.
**Middle ear aeration**: repeated valsalva or politzerisation

ROLE OF MEDICAL TREATMENT IS CONTROVERSIAL
Myringotomy and aspiration of fluid:

Where are incisions taken and what is Beer can technique? 

This device is used if fluid repeatedly recurs. What is it called?
• Role of tympanotomy and cortical mastoidectomy ? ????
• 6 Yearold child with recurrent URTI with mouth breathing and failure to grow with high arched palate and impaired hearing is treated with ?

1] tonsillectomy
2] grommet insertion
3] myringotomy + grommet
4] adenoidectomy + grommet
• 6 Year old child with recurrent URTI and impaired hearing is treated initially with ?
1] wait and watch
2] grommet insertion
3] myringotomy + grommet
4] adenoidectomy + grommet
<table>
<thead>
<tr>
<th>Asom</th>
<th>Som</th>
<th>Necrotising otitis media</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Cholesteatoma
• Cholesteatoma is a misnomer because it neither contains cholesterol and is not a tumor to call “oma”.

• Lining of the middle ear: Ciliated columnar or cuboidal. No where keratinised squamous epithelium (skin) is found in middle ear.

• Presence of keratinised squamous epithelium or “skin” in middle ear is called cholesteatoma.

• So Cholesteatoma is skin at wrong place.
So cholesteatoma is keratinising squamous epithelium.

That is “Keratin” + “Squamous epithelium”

Gross appearance:
Pearly white due to keratin
Theories for formation of cholesteatoma

- Congenital rests
- Wittmack's theory: Retraction pocket theory
- Ruedi’s theory: Basal cell hyperplasia theory
- Habermann’s theory: Epithelial invasion theory
- Sade’s theory: Metaplastic theory
Types of cholesteatoma.

1. Congenital: Found at three places: middle ear, petrous apex and CP angle. Intact tympanic membrane and no perforation is seen. Through the intact tympanic membrane white pearly mass is seen.

2a. Acquired, primary: Cholesteatoma in an ear which was previously normal.

2b. Acquired, secondary: Cholesteatoma in a previously pathological ear (old perforation).
Congenital cholesteatoma

- Commonly seen at three sites: Middle ear, petrous apex, Cp angle.
- Intact Tympanic membrane. The cholesteatoma is seen as white pearly mass through the tympanic membrane.

Acquired cholesteatoma

- Can occur at any site.
- Tympanic membrane perforation is seen.
Figure 11.3
Genesis of primary and secondary cholesteatoma.
What is this criteria called?

• 1. Whitish Mass
• 2. Normal tympanic membrane.
• 3. No history of otorrhoea or perforation.
• 4. No prior otological surgeries.
• Cholesteatoma has bone destroying property due to presence of enzymes – collagenase / acid phosphatase and proteolytic enzymes and not by pressure.

• Cholesteatoma spreads along the path of least resistance and dome of the lateral semicircular canal is the most common site.
• Which is the most difficult site to remove the cholestaetoma ???
Diagnosis

- Otoscopy – keratin flakes “white pearly”
- Examination under microscope
- CT scan of the temporal bone
- With audiological tests: Conductive hearing loss.
• Treatment is by: Surgery
• What is the surgery of choice?
A 30 year old male is having attic cholesteatoma with lateral sinus thrombophlebitis. Which of the following is operation of choice??

1] Intact canal wall mastoidectomy
2] Simple mastoidectomy with tympanoplasty
3] Canal wall down mastoidectomy
4] Mastoidectomy with cavity obliteration
• Cholesteatoma occurs in?
1] CSOM with central perforation
2] Masked mastoiditis
3] Coalscent mastoiditis
4] acute necrotising otitis media
CSOM

• Long standing infection of a part or whole of middle ear cleft characterized by ear discharge and a permanent perforation
• What is permanent perforation?
  Perforation is permanent when the edges of the perforation is covered by squamous epithelium and does not heal spontaneously
Types of CSOM
- Tubotympanic and Atticoantral
<table>
<thead>
<tr>
<th></th>
<th>Tubo-tympanic</th>
<th>Attico-antral</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cause</strong></td>
<td>Tubal cause , ASOM, allergy. (In children measles)</td>
<td>Cholesteatoma</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>Children</td>
<td>Adults</td>
</tr>
<tr>
<td><strong>Perforation</strong></td>
<td>Central</td>
<td>Attic</td>
</tr>
<tr>
<td><strong>Area involved</strong></td>
<td>Antero-inferior</td>
<td>Postero-superior</td>
</tr>
<tr>
<td><strong>Discharge quantity</strong></td>
<td>Profuse</td>
<td>Scanty</td>
</tr>
<tr>
<td><strong>Osteitis and granulation tissue</strong></td>
<td>Rare</td>
<td>Common</td>
</tr>
<tr>
<td><strong>Bone destruction</strong></td>
<td>Rare</td>
<td>Common of annulus, tympanic bone, ossicles, tegmen tympani</td>
</tr>
<tr>
<td><strong>Discharge smell</strong></td>
<td>Odourless and mucoid</td>
<td>Foul and purulent</td>
</tr>
<tr>
<td>Condition</td>
<td>Tubo-Tympanic</td>
<td>Attico-antral</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>---------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Osteitis and granulation tissue</td>
<td>Rare</td>
<td>Common</td>
</tr>
<tr>
<td>Ossicular necrosis</td>
<td>Rare</td>
<td>Common (Most commonly long process of incus)</td>
</tr>
<tr>
<td>Hearing loss</td>
<td>Mild-Moderate</td>
<td>Moderate to severe</td>
</tr>
<tr>
<td>Tegmen tympani erosion</td>
<td>Rare</td>
<td>Common</td>
</tr>
<tr>
<td>Intracranial complications</td>
<td>Rare</td>
<td>Common</td>
</tr>
<tr>
<td>Polyp</td>
<td>Pale</td>
<td>Red, fleshy</td>
</tr>
<tr>
<td>Safe/Unsafe</td>
<td>Safe</td>
<td>Unsafe</td>
</tr>
<tr>
<td>Tympanosclerosis</td>
<td>Common</td>
<td>Rare</td>
</tr>
<tr>
<td>Cholesterol granuloma</td>
<td>Rare</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Tubo-tympanic</td>
<td>Attico-antral</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Treatment</td>
<td>Treatment of primary pathology is the main stay.</td>
<td>Treatment is “Ear Surgery” depending on the extent of disease</td>
</tr>
<tr>
<td></td>
<td>+ Reconstructive surgery (Myringoplasty / Tympanoplasty)</td>
<td>+ Reconstructive surgery (Myringoplasty / Tympanoplasty/reconstruction of ossicular chain)</td>
</tr>
</tbody>
</table>
Treatment

• Examination under microscope: Very important
• Audiogram – to assess the degree of HL
• Culture and sensitivity of ear discharge
• Mastoid Xrays - Sclerotic and extent of bone destruction.
Medical treatment

- Aural toilet: Debris and aural polyp should be removed before local treatment. Do not avulse an aural polyp.
- Ear drops: Neomycin+polymyxin+chlormycetin or gentamycin is used
- Systemic antibiotics: Limited use only in acute exacerbation
- Keep ear dry
## Treatment

<table>
<thead>
<tr>
<th>Tubo-tympanic</th>
<th>Attico-antral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment of primary pathology is the main stay.</td>
<td>Treatment is “Ear Surgery” depending on the extent of disease.</td>
</tr>
<tr>
<td>+ Reconstructive surgery (Myringoplasty / Tympanoplasty)</td>
<td>(Modified radical mastoidectomy is most commonly done)</td>
</tr>
<tr>
<td></td>
<td>+ Reconstructive surgery (Myringoplasty / Tympanoplasty / reconstruction of ossicular chain)</td>
</tr>
<tr>
<td></td>
<td>Canal wall up procedure</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Meatus</td>
<td>Normal appearance</td>
</tr>
<tr>
<td>Dependence</td>
<td>Does not require routine cleaning</td>
</tr>
<tr>
<td>Recurrence or residual disease</td>
<td>High rate of recurrent or residual cholesteatoma</td>
</tr>
<tr>
<td>Second look surgery</td>
<td>Requires second look surgery after 6 months or so to rule out cholesteatoma</td>
</tr>
<tr>
<td>Patients limitations</td>
<td>No limitation. Patient allowed swimming</td>
</tr>
<tr>
<td>Auditory rehabilitation</td>
<td>Easy to wear a hearing aid if needed</td>
</tr>
</tbody>
</table>
Features Indicating Complications in CSOM

- **Pain**: Its presence is considered serious as it may indicate extradural, perisinus or brain abscess.
- **Vertigo**: It indicates erosion of lateral semicircular canal which may progress to labyrinthitis or meningitis.
- **Persistent headache**: It is suggestive of an intracranial complication.
• Facial weakness: indicates erosion of facial canal.
• Fever, nausea and vomiting (intracranial infection).
• Irritability and neck rigidity (meningitis).
• Diplopia (Gradenigo's syndrome).
• Ataxia (labyrinthitis or cerebellar abscess).
• Abscess round the ear (mastoiditis).
• Any long standing discharge that has stopped suddenly: ???? Good or bad and why ???

• Cholesteatoma hearer.

• Round window shielding effect: Hears well in presence of discharge.
• Scanty foul smelling painless discharge from the ear is characteristic feature of which of the following??

1] ASOM
2] Cholesteatoma
3] CSOM
4] foreign body ear
A man complains of foul smelling discharge from his ears for a few months. Otoscopy reveals white debris in the external ear canal. The most definitive treatment is:

- Antibiotics
- Myringoplasty
- Aural toilet
- Modified radical mastoidectomy
Spot the diagnosis?
Diagnosis?

- Painless Foul smelling ear discharge.
- Multiple ear perforations
- Facial paralysis.
- Severe hearing loss out of proportion to symptoms
Complications of Otitis media
[Acute and Chronic]
Routes of spread

1] direct bony invasion –either by hyperemic decalcification or by cholesteatoma

2] preformed pathway
- round window/oval window
- previous surgical defects/fractures
- patent sutures – petrosquamous suture

3] Hematogenous spread
Retrograde thrombophelbitis of venous sinuses
<table>
<thead>
<tr>
<th>Extracranial</th>
<th>Intracranial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mastoiditis</td>
<td>Meningitis</td>
</tr>
<tr>
<td>Pertrositis</td>
<td>Extradural abscess</td>
</tr>
<tr>
<td>Facial paralysis</td>
<td>Subdural abscess</td>
</tr>
<tr>
<td>Labrynthitis</td>
<td>Otogenic brain abscess</td>
</tr>
<tr>
<td>Osteomyelitis of temporal bone</td>
<td>Lateral sinus thrombophlebitis</td>
</tr>
<tr>
<td>Septicemia /Pyemia</td>
<td>Otitic hydrocephalus</td>
</tr>
</tbody>
</table>
## Most common complications

<table>
<thead>
<tr>
<th></th>
<th>Acute otitis media</th>
<th>Chronic otitis media</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Most common intracranial complication</strong></td>
<td>Meningitis</td>
<td>Intracerebral abscess</td>
</tr>
<tr>
<td><strong>Most common extracranial complication</strong></td>
<td>Mastoiditis</td>
<td>Postauricular abscess</td>
</tr>
</tbody>
</table>
Acute mastoiditis

• Its most common extracranial intratemporal complication of acute otitis media
• Organism – S Pneumoniae [most common]
  Staph aureus
  H influenza
  pseudomanas
Symptoms:

- Fever
- Pain behind the ear
- Ear discharge – Profuse and persistent discharge may be pulsatile
Signs:

- Tenderness in the mastoid region on the area of mac Evans triangle
- Sagging of the posterosuperior meatal wall.
- Perforation of the pars tensa
- Swelling over the mastoid pushes the pinna forward and downwards with obliteration of retroaurical sulcus
- Ironed out appearance of the mastoid – First sign of acute mastoiditis
- Positive reservoir sigs- discharge rapidly fills up after mopping the canal
Signs:

Seen in mastoiditis following ASOM

• There is mucopurulent or purulent discharge often pulsatile

• On otoscopy the discharge reflects light which is known as ??????
• Pulsatile otorrhoea is seen in???

• Light house effect is seen in???
• Hearing loss [Conductive type]
• Xray- clouding of the mastoid air cells
• Bony septa are destroyed
Abscess related to mastoiditis
Post auricular abscess-most common
Bezold's abscess- pus passes through mastoid tip and presents as a upper neck swelling [Mc location deep to SCM]
Zygomatic abscess-
Lucs abscess-Meatal abscess
Citellis abscess –Digastric triangle
Parapharyngeal and retropharyngeal abscess
Petrositis

- Infection from middle ear and mastoid spreads to the petrous temporal bone.

- Gradenigo's syndrome triad:
  - Lateral rectus palsy resulting in diplopia - 6th nerve involvement
  - Deep seated retroorbital pain - 5th nerve involvement
  - Persistent ear discharge of ipsilateral ear due to acute or chronic otitis media
Lateral sinus thrombophlebitis/Sigmoid sinus thrombophlebitis

• It’s a complication of -Acute coalscent mastoiditis or CSOM or Cholesteatoma
Lateral sinus thrombophlebitis

- **Hectic picket fence** type of fever with rigor
- **Greisingers sign**: edema over the posterior part of mastoid due to thrombosis of mastoid emissary vein
- **Pappiloedema**
- **Tobey Ayers test**: compression of IJV on the healthy side produces rise in CSF pressure
- **Crowe Beck test**: Pressure of the IJV on the healthy side produces engorgement of the retinal veins
- Tenderness over jugular vein
Tobey-Ayre's test

Compression of IJV

Thrombosed vein

Compression increases pressure

Compression does not increase pressure

Lumbar puncture & manometer

Normal retina

Retina with papilledema
Lateral sinus thrombophlebitis

- Imaging:
- Contrast enhanced CT scan shows sinus thrombosis and typical delta sign
- It may be seen on contrast enhanced MRI also
Otogenic brain abscess

• It’s the most common complication of CSOM

• Types: Cerebral abscess [MC] site:
  2. Cerebellar abscess
Clinical features of cerebral abscess

1] Due to raised ICT
   Head ache Vomiting, lethargy, drowsiness, confusion, stupor
   Papilloedema and bradycardia

2] Localising feature:
   Nominal aphasia, homonymous hemianopia, contralateral motor paralysis, epilepsy.
• Treatment of brain abscess:
• Medical: IV antibiotics, dexamethasone, and mannitol
• Surgical:
• Neurosurgical: drainage of brain abscess
• Otologic: Modified radical mastoidectomy for CSOM/cholesteatoma
Otosclerosis
Types of Otosclerosis

- What is it?
  It’s a disease of the bony labyrinth.

- What happens in it?
  Normal Endochondral bone of Otic capsule is replaced by irregularly placed spongy bone.
Types of Otosclerosis

1. **Stapedial**: Most common. Fistula ante fenestrum common site Conductive hearing loss

2. **Cochlear**: Round window common. SN hearing loss and tinnitus
Aetiology

• Hereditary – Autosomal dominant with incomplete penetrance
• Sex: F>M But in India male predominant
• Age of onset: 20-40 yrs
• Increases in pregnancy and during menopause
Vander hoeve syndrome

- Osteogenesis Imperfecta
- Otosclerosis
- Blue sclera
• Pathology
• Gross: chalky white grey yellow
• Microscopic:

<table>
<thead>
<tr>
<th>Immature active focus</th>
<th>Mature Active focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>More vascularity</td>
<td>Less vascularity</td>
</tr>
<tr>
<td>More osteoblast with cement substance</td>
<td>More fibrillar substance than cementum</td>
</tr>
<tr>
<td>Staine blue with H and E</td>
<td>Stains red</td>
</tr>
<tr>
<td>Blue mantles</td>
<td></td>
</tr>
</tbody>
</table>
Symptoms

<table>
<thead>
<tr>
<th></th>
<th>Stapedial</th>
<th>Cochlear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence</td>
<td>Common</td>
<td>Less common</td>
</tr>
<tr>
<td>Hearing Loss</td>
<td>Conductive</td>
<td>Sensorineural</td>
</tr>
<tr>
<td>Tinnitus, Vertigo</td>
<td>Rare</td>
<td>Common</td>
</tr>
<tr>
<td>Paracusis Wilsii</td>
<td>Common</td>
<td>No</td>
</tr>
</tbody>
</table>

• **Paracusis wilsii**: Hears better in noisy than in quite environment
Signs

- Tympanic membrane is normal.
- Tympanic membrane is mobile.

Active lesions have a flamingo-pink hue on the promontory and can be seen through an intact tympanic membrane. [Schwartzze sign]
## Stapedial Otosclerosis: Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rinne</td>
<td>Negative</td>
</tr>
<tr>
<td>Weber</td>
<td>Lateralised to abnormal ear</td>
</tr>
<tr>
<td>Absolute bone conduction</td>
<td>Normal (decreased in cochlear otosclerosis)</td>
</tr>
<tr>
<td>Gelle test</td>
<td>Absent</td>
</tr>
<tr>
<td>Tympanometry</td>
<td>A-Type graph</td>
</tr>
<tr>
<td>Stapedial reflex</td>
<td>Absent</td>
</tr>
<tr>
<td>Pure tone audiometry</td>
<td>Carharts notch</td>
</tr>
</tbody>
</table>
Audiometry

- AC - Lower frequencies are affected.
- BC - Maximum dip is seen at 2000Hz which is called Carhartz notch.
- Reverses after Stapedectomy
Tympanometry

- Absent stapedial reflex
Cochlear otosclerotic

- Characteristic CT appearance is pericochlear hypodense double ring
Treatment

Medical: Sodium flouride is given to arrest active focus and prevent further sensorineural loss due to cochlear otosclerosis

Surgical:
1. Stapedectomy with placement of prosthesis is the treatment of choice
2. Stapedotomy and placement of prosthesis
3. Stapes mobilisation
4. Lemperts Fenestration operation: reserved only for cases where footplate cannot be mobilised during stapedectomy
Stapedectomy
Points

• Tympanic membrane in otosclerosis is Fixed/mobile???
• Flamingo appearance of the tympanic membrane ??

• It indicates???
• How will you clinically confirm stapes fixation?
• Negative rinne at 1024 Hz
• Pure tone audiogram in patients with otosclerosis??
• When does carhart's notch disappears after??
• Successful stapedotomy
• How does NaF act?
• It stops the maturity of active focus and prevents further progress
• Indications for stapedectomy
• AB gap of 30 db
• Why is stapes mobilization abandoned now??
• Recurrence
• In otosclerosis tinnitus is due to ????
• All the following statements about sodium fluoride in otosclerosis is true
<table>
<thead>
<tr>
<th>Condition</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otosclerosis</td>
<td>NIHL</td>
</tr>
<tr>
<td>2000Hz</td>
<td>4000Hz</td>
</tr>
<tr>
<td>Only BC</td>
<td>Both AC and BC</td>
</tr>
<tr>
<td>Bilateral</td>
<td>Bilateral</td>
</tr>
</tbody>
</table>
Meniere’s disease
Definition

Meniere's disease is a disorder characterized by
1] spontaneous attacks of vertigo,
2] fluctuating sensorineural hearing loss,
3] tinnitus, and aural fullness
OVER PRODUCTION OR MALABSORPTION OF ENDOLYMPH

ENDOLYMPHATIC HYPERTENSION

GROSS ENLARGEMENT OF MEMBRANOUS LABYRINTH

ENDOLYMPHATIC HYDROPS
• Endolymphatic hydrops is most consistently found in the cochlear duct (scala media) and saccule as bowing of the Reissner membrane out toward the scala vestibuli and distension of saccule.

• When saccular distension is extensive, it can distort the utricle and semi circular canals in the vestibule and saccular membrane can bulge out to contact the foot plate of stapes either directly or via fibrous adhesions.

![Diagram of normal cochlear duct and distended cochlear duct with endolymph pushing the Reissner's membrane into scala vestibuli.](image)
Other predisposing factors

- Allergy
- Sodium and water retention
- Hypoadrenalism and hypopituitarism
- Hypothyroidism
# Menieres vs Otosclerosis

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<tr>
<th></th>
<th>Meneires disease</th>
<th>Otosclerosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pathology affects</td>
<td>Membranous labrynth</td>
<td>Bony labrynth</td>
</tr>
<tr>
<td>Age</td>
<td>35-60 years</td>
<td>20-30 years</td>
</tr>
<tr>
<td>Sex</td>
<td>Males</td>
<td>???</td>
</tr>
<tr>
<td>Laterality</td>
<td>Unilateral</td>
<td>??????</td>
</tr>
<tr>
<td>Hearing loss</td>
<td>Sensorineural</td>
<td>???</td>
</tr>
<tr>
<td>Onset of symptoms</td>
<td>Sudden</td>
<td>??????</td>
</tr>
</tbody>
</table>
## Cardinal features of Ménière’s

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertigo</td>
<td>Severe sudden vertigo accompanied by <strong>nystagmus</strong>, nausea <strong>vomiting</strong> and vagal disturbances like <strong>diarrhoea</strong>, cold sweat, pallor, bradycardia</td>
</tr>
</tbody>
</table>
| Hearing loss                 | a. Sensorineural hearing loss  
   b. Low frequency hearing loss  
   c. Distortion of sound (Displacusis)  
   d. Intolerance to loud sounds due to recruitment  
   e. Typically fluctuating |
| Tinnitus                     | Low pitched roaring type                                                                                                                   |
| Sense of fullness of ear     |                                                                                                                                            |
• All sensorineural hearing losses affect high frequencies first except for Meniere’s which involves the low frequency sounds first.

• Some cases of Meniere's disease show **Tullio phenomenon**. It is a condition where loud sounds or noise produce vertigo and is due to the distended saccule lying against the stapes footplate.

• Which other condition is this phenomenon positive ???
- Examination:
- Otoscopy: Normal
- Nystagmus—seen only during attack. Fast component is towards the healthy ear
- TFT— in favour of Sensorineural hearing loss
Pure tone audiometry:
- Characteristic involvement of lower frequencies initially later flat graph and then falling type.
- Recruitment is positive
- Speech audiometry: mainly to differentiate from retrocochlear lesion like acoustic neuroma
- Glycerol test: it’s a dehydrating agent when given orally reduces endolymphatic pressure and improves hearing
- Caloric tests: Canal paresis
- **THE DIAGNOSTIC TEST FOR MENIERES IS??**
Variants of Meniere's disease

- Cochlear: Present only with cochlear symptoms and no vertigo
- Vestibular hydrops: only vertigo with no cochlear symptoms
- Lermoyez syndrome: tinnitus f/b hearing loss and vertigo
- Tumarkins otolith crisis: sudden drop attack without loss of consciousness
Secondary Menieres

- Congenital and acquired syphilis
- Pagets disease
- Post stapedectomy
Treatment: General measures

• 1. Low salt diet (<1.5-2g /day)
• 2. Stop smoking as nicotine causes vasospasm.
• 3. Avoid excessive intake of water.
• 4. Correct hormonal imbalances like hypothyroidism, hypopituitarism.
• 5. Elimination of allergen (in 50% allergens are found)
## Pharmacological treatment

<table>
<thead>
<tr>
<th></th>
<th>Acute attack</th>
<th>Chronic phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vestibular sedatives</td>
<td>1. Dimenhydrinate, promethazine, prochlorperazine. 2. Diazepam suppresses activity of medial vestibular nucleus</td>
<td>1. Prochlorperazine</td>
</tr>
<tr>
<td>Vasodilators</td>
<td>1. Carbogen (5% CO2 with 95% O2). 2. Histamine drip</td>
<td>1. Nicotinic acid. 2. Betahistine (Vertin)</td>
</tr>
<tr>
<td>Other drugs</td>
<td>1. Atropine</td>
<td>1. Diuretics</td>
</tr>
</tbody>
</table>
Intratympanic Gentamycine therapy

- Gentamycin is vestibulotoxic.
- Main side effect: severe hearing loss in some patients.

- INTRATYMPANIC STEROIDS ALSO HAVE GOOD RESULTS IN MENIERES
Surgical management

Conservative procedures (preserve hearing)

- Decompression of endolymphatic sac.
- Endolymphatic shunt
- Sacculotomy (Ficks procedure)
- Cody tack procedure
- Cochleosacculostomy (cochlear duct is punctured)

Destructive procedure (Destroy hearing)

- Labrynthectomy
- Intermittent low pressure pulse therapy with Meniett devise.
Committee on Hearing and Equilibrium of the American Academy of Otolaryngology—Head and Neck Surgery (AAOHNS) classified the diagnosis of Meniere's disease as follows:


2. Definite:
   - Two or more definitive spontaneous episodes of vertigo lasting 20 minutes or longer.
   - Audiometrically documented hearing loss on at least one occasion.
   - Tinnitus or aural fullness in the affected ear.
   - All other causes excluded.

3. Probable:
   - One definitive episode of vertigo.
   - Audiometrically documented hearing loss on at least one occasion.
   - Tinnitus or aural fullness in the treated ear.
   - Other causes excluded.
Staging of Menieres

- It is based on average of the pure tone thresholds at 0.5, 1, 2, 3kHz (rounded to nearest whole) of the worst audiogram during interval of 6 months before treatment.

<table>
<thead>
<tr>
<th>Stage</th>
<th>PTA in four frequencies (0.5 k, 1 k, 2 k, 3 kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25 dB</td>
</tr>
<tr>
<td>2</td>
<td>26–40 dB</td>
</tr>
<tr>
<td>3</td>
<td>41–70 dB</td>
</tr>
<tr>
<td>4</td>
<td>&gt;70 dB</td>
</tr>
</tbody>
</table>
• Surgeries in ear
Surgeries in ear

• Myringotomy:
what is it ???
• Indications:
  1] ASOM- earache with bulging TM resistant to medical therapy associated with complication like facial palsy, labyrinthitis, meningitis
  2] Serous otitis media
  3] Aero otitis media [barotrauma]
  4] Atelectatic ear for middle ear aeration
• Incision
• ASOM – circumferential incision between the handle of malleus and tympanic annulus

• In SOM – radial incision anteroinferior or posteroinferior quadrant
Cortical mastoidectomy

• Schwartzte operation
  • What is removed ??

• What is left intact ??
• Indications:
• 1] Acute coalscent mastoiditis
• 2] incompletely resolved acute otitis media with mastoiditis
• 3] Masked mastoiditis
• 4] initial step to perform
  - Endolymphatic sac decompression
  - facial nerve decompression
  - cochlear implant
  - Translabyrynthine approach for acoustic neuroma
Radical mastoidectomy

• Everything is removed in the middle ear and mastoid antrum except footplate of stapes.
• Eustachian tube is obliterated with muscle piece or cartilage
• Indications:

1] extensive cholestaetoma with invasion into eustachian tube, petrous apex, hypotympanum.
2] cholestaetoma with failed previous surgery.
3] approach to petrous apex
4] removal of glomus tumour
5] carcinoma of middle ear – RM with RT as a substitute to temporal bone dissection.
Modified radical mastoidectomy

• What is removed???

• How is it different from radical mastoidectomy
• Indications:
  1] Cholesteatoma confined to the attic and antrum
  2] Localized chronic otitis media
Myringoplasty

• Closure of perforation of pars tensa

• Techniques
  • -underlay
  • -overlay
Tympanoplasty

Types:

Type 1: Myringoplasty
Type 2: Myringo-incudopexy
Type 3: Myringo-stapediopexy
Type 4: Cavum minor
Type 5: Fenestration
Type 6: Sono-inversion