Anatomy of the ear:



<u>External ear</u> which consist of auricle and external auditory canal .

The auricle has a framework of cartilage except the lobule, the skin is closely adherent to perichonderium at the anterior surface of the auricle. The length of external auditory canal about 2.5 cm, the outer 1\3 is cartilage but inner 2\3 is bony.

Nerve supply

- V, VII, IX, and X cranial Ns.
- Lesser occipital n. c1.
- Greater auricular n. c2-c3.

Lymphatics

- pre and post auricular lymph nodes.
- Upper superficial cervical lymph nodes.

2. Middle ear cleft: consists of

Eustachian tube pass from anterior wall of tympanic cavity to the nasopharynx

the length of the tube about 3.7 cm

the lateral $1\3$ is bony and the medial $2\3$ is cartilaginous with membrane.

Tympanic cavity this is biconcave disc shaped cavity , antero-posterior diameter 1.3 cm , height 1.5, the width is 2mm of the centre .

Tympanic membrane have 3 layers:



Tympanic Membrane



- Thin membrane
- Forms boundary between outer and middle ear
- Vibrates in response to sound waves
- Changes acoustical energy into mechanical energy
- Outer epithelial layer.
- Middle fibrous layer.
- Inner mucosal layer.

Also the tympanic membrane divided in to 2 parts: the lower part (pars tensa)contain middle fibrous layer & upper part(pars flaccida) without fibrous layer and ,between them there is anterior and posterior malleular folds.

Medial wall of tympanic cavity contain

- i) Promontory is the bony projection covering the basal turn of cochlea.
- ii) Oval window occupied footplate of stapes
- iii) Round window closed by membrane

iv) Facial n.

v) Horizontal semicircular canal.

Anterior wall of tympanic cavity contain 3 openings from above.

1.canal of huguier (for chorda tympanic n.)

2.canal for tensor tympani muscle.

3.orifice of eustachian tube .

Posterior wall have opening as aditus connect epitympanum to mastoid antrum, below aditus is the pyramid via its pass tendon of stapedius muscle.

Ossicles

3 bones inside the tympa. Cavity:

1.malleus has head, neck anterior and lateral processes and handle.

2. incus has body, short process and long process.

3.stapes has head, neck, anterior and posterior crura and footplate with held in oval window.

Intratympanic muscles :



- 1.tensor tympani m.
- 2.stapedius m.

3.Aditus ad antrum , aditus is opening in the posterior wall of tympanic cavity connect epitympanum to mastoid antrum and mastoid air cells.

Relation of middle ear cleft to known the complication

- 1. Temporal lobe of brain.
- 2. Labyrinth(inner ear).

- 3. Facial n.
- 4. Lateral sinus(intracranial venous sinus).
- 5. Jugular bulb.
- 6. Cerebellum.
- 7. V & VI cranial ns.

Nerve supply of middle ear cleft :

<u>Sensory</u> from 1X n. via tympanic plexus with received also from VIII N.

<u>Motor</u> 1.mandibular branch of V to tensor tympani muscle.

2.stapedial branch of VII n. to stapedius tendon muscle.

Inner ear





It lies in Temporal bone ,called labyrinth consist of:

Osseous labyrinth has 3 parts:

- 1. Vestibule =between middle ear & internal auditory canal.
- Bony semicircular canals =3 in no. posterior, superior & lateral.
- 3. Cochlea = has 2 & half turns its snail shell in shape.

<u>Membranous labyrinth</u> consist of communicate sacs & ducts within the bony labyrinth .

1. Saccule & utricle in the bony vestibule.

- 2. Membranous semicircular ducts in the bony semicircular canals.
- 3. Cochlear duct in the bony cochlea.

These sacs containing endolymph.

Organ of conti neuroepithelial structures arranged along the inner edge of the basilar membrane of the membranous labyrinth.

Physiology of hearing



_For physiological purposes the ear is divided into 2 parts

- <u>Conductive apparatus</u> these are external ear ,tympanic membrane ,chain of ossicles, eustachian tube & labyrinth fluid .
- 2. <u>Sensory neural apparatus</u>

Organ of corti, auditory division of viii n. & central connection.

Conduction of sound waves to the inner ear by one of three ways

- Ossicular chain
- Directly via round window.
- Bone conduction via sckull.

The acoustic energy is collected by large area of tympanic membrane applied via the ossicles to the small area of stapes footplate. The ratio of these areas 14:1, also there is lever action of the ossicular chain has mechanical advantage 1.3:1 so both of them give advantage of 18:1 lead to increase in the force applied by stapes footplate according to this ratio.

<u>Tympanic muscles reflexes</u> contraction of these muscles lead to increase stiffness of middle ear apparatus , contraction reflex due to to exposed the ear to sound at 90 dB or above, that reflex protect the inner ear from acoustic trauma .

there is NO reflexes in case of explosion because there is no time for performance.

Functional examination of hearing

Tunning fork test forks of 256 hz and 512 hz are commonly used. 1. Rinne test



The patient is usually asked to say wether the vibrating fork louder by air conduction(AC) close to the meatus , or by bone conduction(BC) with base of fork on the mastoid bone . so when the fork become inaudible by(AC) transferring to (BC) the order is reversed start by (BC) then (AC)

Normal subject =AC better than BC (rinne +ve) Conductive deafness =BC better than AC (Rinne –ve) Sensorineural deafness =AC better than BC (Rinne +ve) often the bone conduction not heard.

2. Weber test

When the fork put on the forehead to see the difference between the two ears , so in conductive deafness the heard in or towards the deafened ear, but in SND the sound heard towards better ear. Rinne test become –ve when there is hearing loss in this ear more than 30 dB., but in weber test we can see lateralization of the sound to more conductive deaf ear when the difference about 15 dB, so it is more sensitive test.

 Absolute bone conduction (ABC) test
Done by obstructing the external auditory meatus by finger and compare between (BC) of patient & that of examiner so seen if there is SNHL or not.

Pure tone audiometry

The most generally used technique which determined threshold of hearing for tones of several seconds duration . so the pure tones delivered to the ear under test via suitable earphone(AC) or by vibrator applied to the mastoid (BC)the frequency tested from (125 hz- 8000 hz) and the intensities from (-10 dB to 120 dB)by this curve we can see the type & degree of deafness in graph.



frequency in hz