

Download B.PHARM NOTES and free video lectures

YouTube: @reeteshpharmaclases

Web: www.medpharm12.com

Facebook: @pharmainfoworld

Instagram: Pharmacology_tips_tricks

UNIT-IV

ANATOMY AND FUNCTION OF EAR

The ear is the organ of hearing and balance. The parts of the ear include

External or outer ear, consisting of

- a) **Pinna or auricle.** This is the outside part of the ear.
- b) **External auditory canal or tube.** This is the tube that connects the outer ear to the inside or middle ear.
- c) **Tympanic membrane (eardrum).** The tympanic membrane divides the external ear from the middle ear.

Middle ear (tympanic cavity), consisting of

Ossicles: Three small bones that are connected and transmit the sound waves to the inner ear. The bones are called

- a) Malleus
- b) Incus
- c) Stapes

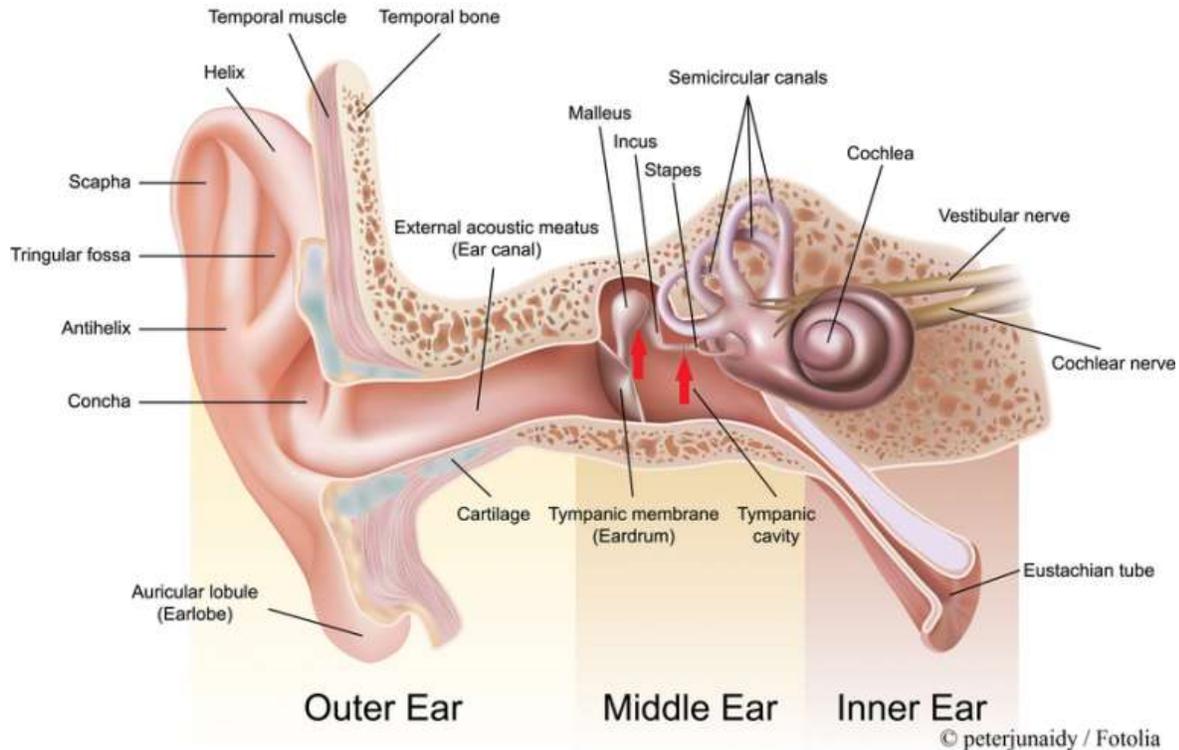
Eustachian tube

A canal that links the middle ear with the back of the nose. The eustachian tube helps to equalize the pressure in the middle ear. Equalized pressure is needed for the proper transfer of sound waves. The Eustachian tube is lined with mucous, just like the inside of the nose and throat.

Inner ear, consisting of

- a) **Cochlea.** This contains the nerves for hearing.
- b) **Vestibule.** This contains receptors for balance.
- c) **Semicircular canals.** This contains receptors for balance.

Anatomy of the Ear



EXTERNAL EAR

External ear is composed of auricle and external auditory canal (meatus).

1. Auricle (pinna)

- Auricle is composed of thin plate of elastic cartilage covered by layer of skin.
- The funnel like curves of auricle collects sound wave and direct them to middle ear.
- The deepest depression called concha which is partly covered by two small projection; tragus in front and antitragus behind.

2. External auditory meatus

- External auditory meatus is slightly curved canal of about 2.5 cm long extending from floor of concha to tympanic membrane (ear drum).
- The meatus is lined with skin continuous with auricle. It contains two glands; sebaceous gland and ceruminous gland.
- Ceruminous gland are modified sweat gland that secretes cerumen (wax).

3. Tympanic membrane

- It is oval bluish grey membranous structure located on medial part of auditory meatus.
- It separates external and middle ear.
- It is a stretchable organ capable for vibration.

- It receive sound wave and amplify into appropriate magnitude.

MIDDLE EAR

Middle ear is small chamber between tympanic membrane and inner ear. It consists of tympanic cavity and contains ear ossicles.

1. Tympanic cavity

- a) Tympanic cavity is a narrow irregular air filled space in temporal bone. It is separated from external ear by tympanic membrane and medially from inner ear by bony wall.
- b) It has two opening; oval window and round window.
- c) In the anterior wall of tympanic cavity is an auditory tube, commonly called as Eustachian tube.

2. Eustachian tube

- a) Eustachian tube leads downward from tympanic cavity to nasopharynx.
- b) It is about 4 cm long.
- c) The mucus membrane lining the nasopharynx is also continuous with membrane of tympanic cavity through Eustachian tube. As a result of which infection from nose or throat may spread to middle ear causing Otitis media.
- d) The main purpose of Eustachian tube is to maintain equal air pressure on both side of tympanic membrane by permitting air to pass from nasal cavity to middle ear.

3. Ear ossicles

- The three ear ossicles (**malleus, incus** and **stapes**) form a chain of lever extending from tympanic membrane to inner ear.
- The ear ossicles transmit sound wave from ear drum to inner ear.
- Ear ossicles communicate the ear drum with internal ear through fenestra ovalis (oval window).

The ear ossicles are

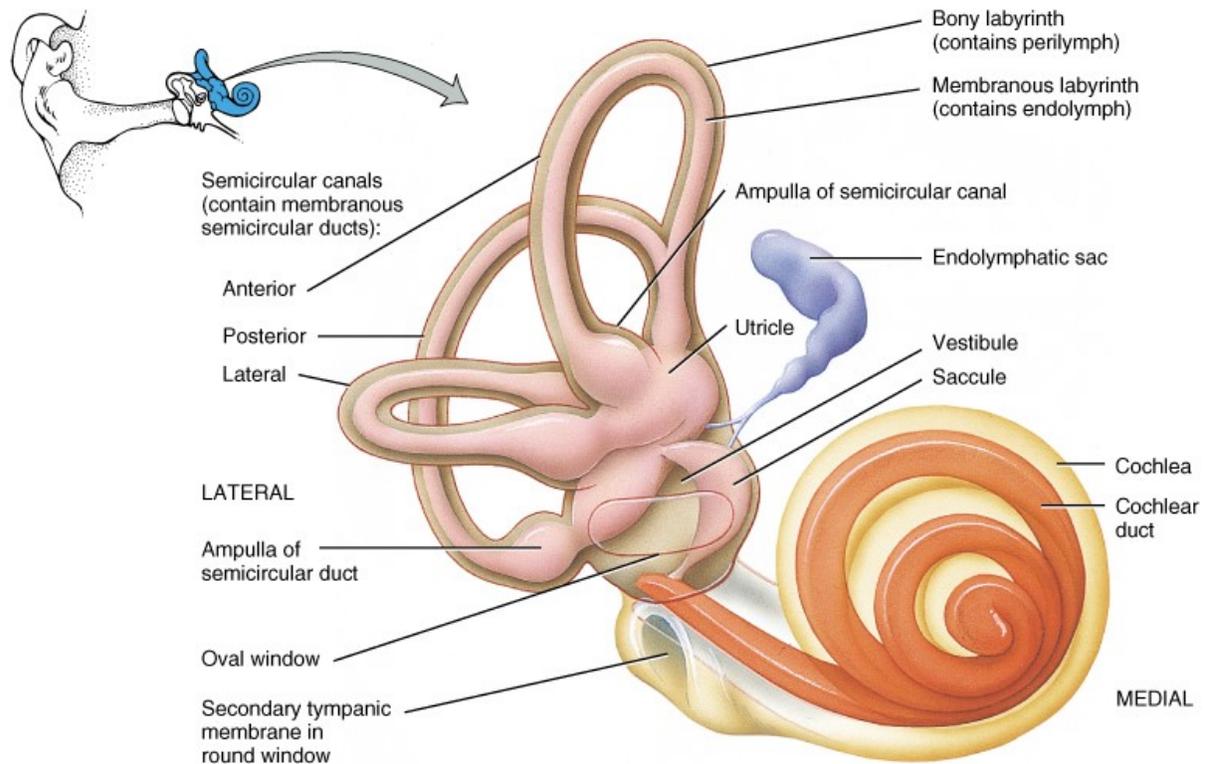
- a) **Malleus:** it is hammer shaped bone whose handle is in contact with tympanic membrane and the head form movable joint with incus
- b) **Incus:** it is middle anvil shaped bone.
- c) **Stapes:** it is medial stirrup shaped bone. It head articulate with incus and foot plate fits into oval window. Stapes is the smallest bone in human body.

INNER EAR

The inner ear is also called as labyrinth because of its intricate structure of interconnecting chamber and passage.

It consists of two main structural parts one inside the other.

1. Bony labyrinth
2. Membranous labyrinth



1. Bony labyrinth

- It is a series of hollow channels. It is filled with perilymph.
- Bony labyrinth consists of vestibule, three semicircular canal and spirally coiled cochlea.

2. Membranous labyrinth

- It is surrounded by bony labyrinth. It is filled with endolymph and also contains the sensory receptors for hearing and equilibrium.
- Membranous labyrinth consists of three semi-circular ducts as well as utricle, saccule and cochlear duct, all are filled with endolymph enclosed by bony labyrinth.
- It also contains sensory receptors (cristae, ampullaris maculae and organ of corti).
- Semi-circular ducts are located within semicircular canal of bony labyrinth.
- Perilymph is located in space between duct and bony wall of semicircular canal.

Vestibule

- Vestibule is the expanded part nearest the middle ear.
- It has two sacs; larger upper utriculus and smaller lower sacculus.
- The macula consists of otolith membrane having otolith (small crystal of CaCO_3) which concerned with balancing of body.

Semicircular canal

- It is associated with equilibrium or balancing not for hearing.
- There are three semicircular canals arises from utriculus; anterior, posterior and lateral canals

- The anterior and posterior canals opens at one end to form common duct called crus commune. One end of each semicircular canal is swollen to form ampulla.

Cochlea

- It is spiral shaped resembling snail's shell, wounded $2\frac{3}{4}$ times.
- It is the main hearing organ.
- It is connected with cerebrum by vestibulo-cochlear nerve.
- Cochlea is divided into 3 spiral fluid filled chamber.

i. Scala vestibuli

- It communicate with vestibule.
- It contains perilymph

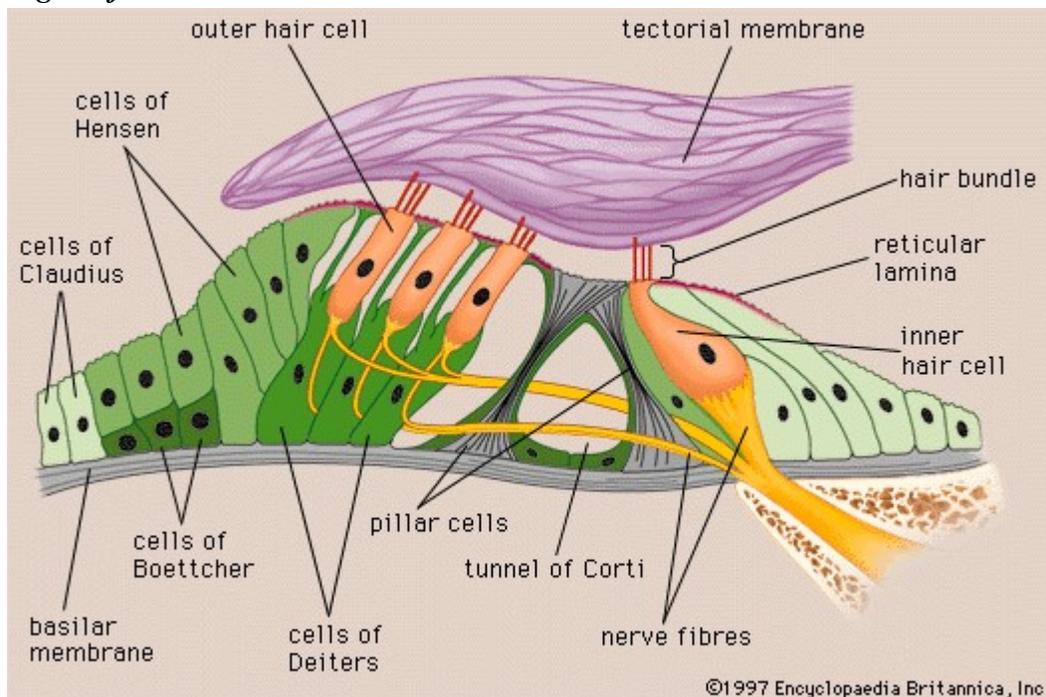
ii. Scala tympani

- It ends at round window of tympanic cavity.
- It contains perilymph.

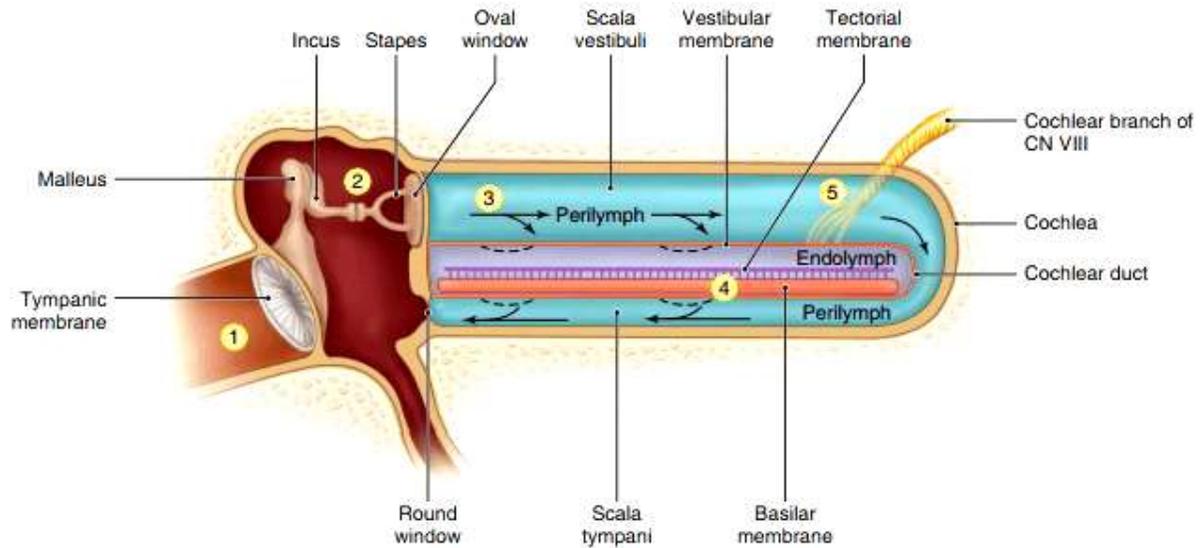
iii. Scala media or cochlear duct

- It lies between scala vestibuli and scala tympani.
- It contains endolymph.
- Scala media or cochlear duct is separated from scala vestibuli by vestibular membrane and from scala tympani by basilar membrane.
- The basilar membrane has organ of corti formed about 24000 receptor auditory cells.

Organ of corti



Physiology of hearing



Steps in Hearing

1. Sound waves enter external auditory meatus

2. Eardrum vibrates

3. Auditory ossicles (malleus, stapes) transmit vibrations

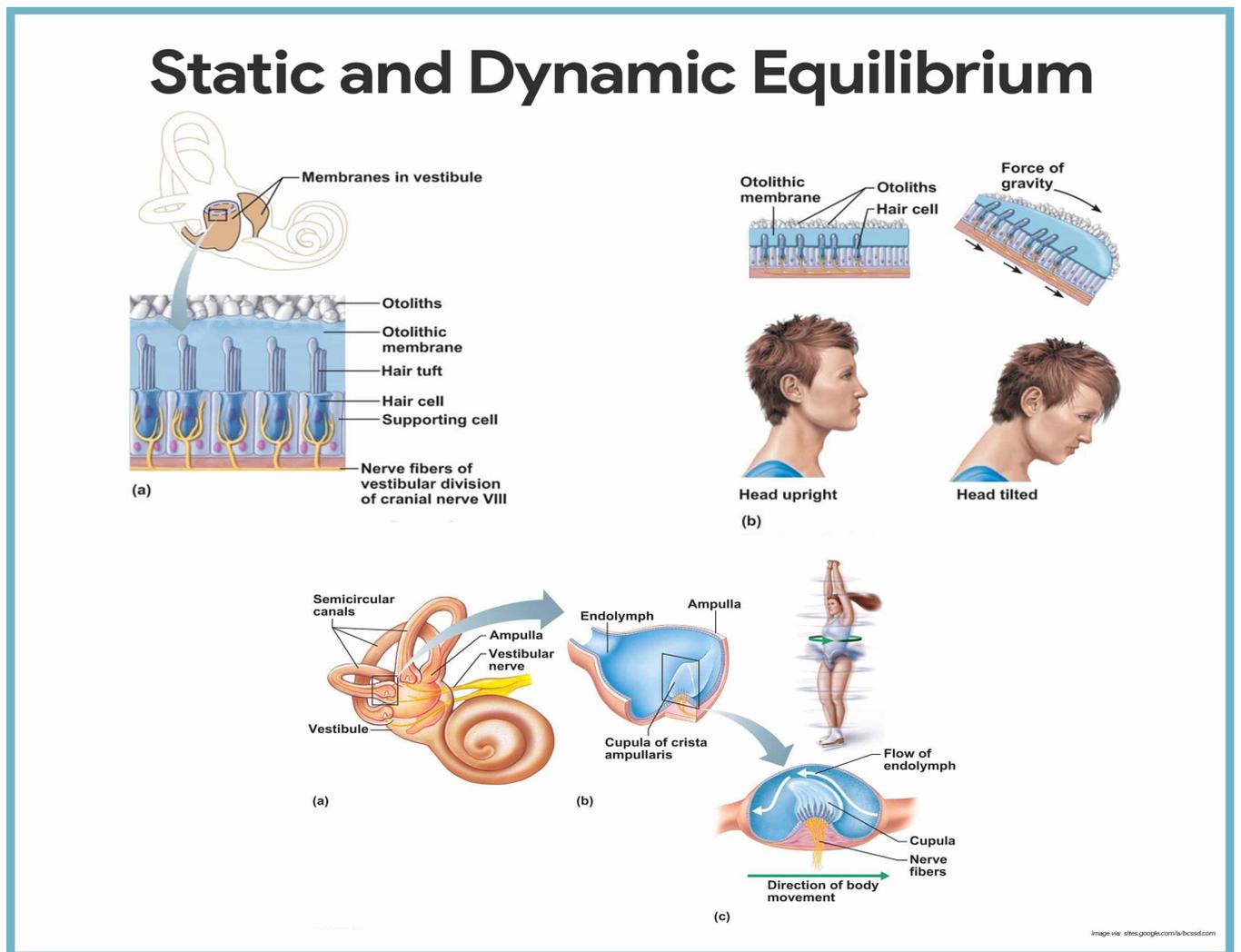
5. Organs of Corti contain receptor cells (hair cells) that deform from vibrations

6. Impulses sent to the temporal lobe interpret sensory impulses

(Round window dissipates vibrations within the cochlea)

Mechanisms of Equilibrium

The equilibrium receptors of the inner ear, collectively called the vestibular apparatus, can be divided into two functional arms- one arm responsible for monitoring static equilibrium and the other involved with dynamic equilibrium.



Static Equilibrium

Within the membrane sacs of the vestibule are receptors called maculae that are essential to our sense of static equilibrium.

Maculae: The maculae report on changes in the position of the head in space with respect to the pull of gravity when the body is not moving.



Otolithic hair membrane: Each macula is a patch of receptor (hair) cells with their “hairs” embedded in the otolithic hair membrane, a jelly-like mass studded with **otoliths**, tiny stones made of calcium salts.



Otoliths: As the head moves, the otoliths roll in response to changes in the pull of gravity; this movement creates a pull on the gel, which in turn slides like a greased plate over the hair cells, bending their hairs.



Vestibular nerve: This event activates the hair cells, which send impulses along the vestibular nerve (a division of cranial nerve VIII) to the cerebellum of the brain, informing it of the position of the head in space.

Dynamic Equilibrium

The dynamic equilibrium receptors, found in the semicircular canals, respond to angular or rotatory movements of the head rather than to straight-line movements.

- **Semicircular canals.** The semicircular canals are oriented in the three planes of space; thus regardless of which plane one moves in, there will be receptors to detect the movement.
- **Crista ampullaris.** Within the ampulla, a swollen region at the base of each membranous semicircular canal is a receptor region called crista ampullaris, or simply crista, which consists of a tuft of hair cells covered with a gelatinous cap called the **cupula**.
- **Head movements.** When the head moves in an arc like or angular direction, the endolymph in the canal lags behind.
- **Bending of the cupula:** Then, as the cupula drags against the stationary endolymph, the cupula bends- like a swinging door- with the body's motion.
- **Vestibular nerve:** This stimulates the hair cells, and impulses are transmitted up the vestibular nerve to the cerebellum