Name: Jekey-Green, Tamuno-imim Sokari

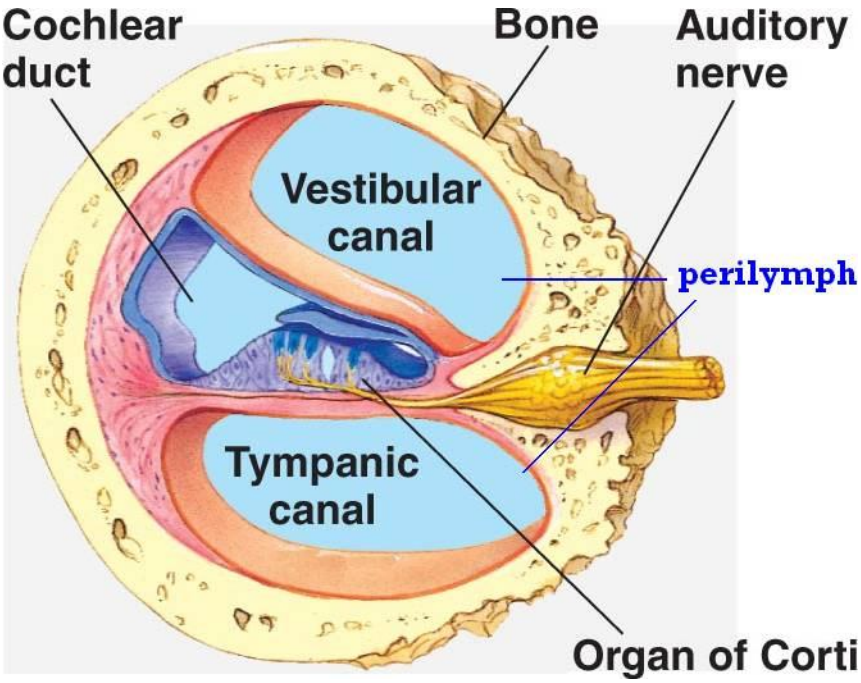
Matric no: 17/MHS01/169

300 level, MBBS

Neurohistology

With the aid of a diagram, write an essay on the histology of the organ of corti

The organ of Corti is a specialized sensory epithelium that allows for the transduction of sound vibrations into neural signals. This highly varied strip of epithelial cells allows for transduction of auditory signals into nerve impulses' action potential. Transduction occurs through vibrations of structures in the inner ear causing displacement of cochlear fluid and movement of hair cells at the organ of Corti to produce electrochemical signals. The structure is localized in the Scala media and is formed by series of hair cells, nervous terminations of spiral ganglion and supporting cell. Mutations in an alpha-tectorin, which encodes a protein specific to the tectorial membrane, cause deafness



The cochlear duct contains the organ of corti which detect sound. The cochlear duct is a triangular tube that is suspended in the middle of the spiraling bony labyrinth of the cochlea, thus subdividing the space into three spiraling sub-compartment or scalae

Elements of the cochlear duct that

- The vestibular membrane: also called reissner membrane is the tissue separating the cochlear duct from the scala vestibule
- The stria vascularie: is a stratified epithelium along the outer wall of the cochlear duct that is unique in that is Vascularized
- The basilar membrane: extends from the tip of the osseous spiral lamina of the central modiolus to the outer wall of the cochlear and separates the cochlear duct from the scala tympani. **The organ of corti rest on the basilar membrane and it is under the tectorial membrane**

The organ of corti consist of two kinds of hair cell and various supporting cells in complex arrangement. The organ of Corti is overlain by the gel-like tectorial membrane, produced and maintained by the columnar cells found atop the spiral limbus just medial to the organ of Corti. Only the stereocilia of the outer hair cells appear to be in contact with the tectorial membrane.

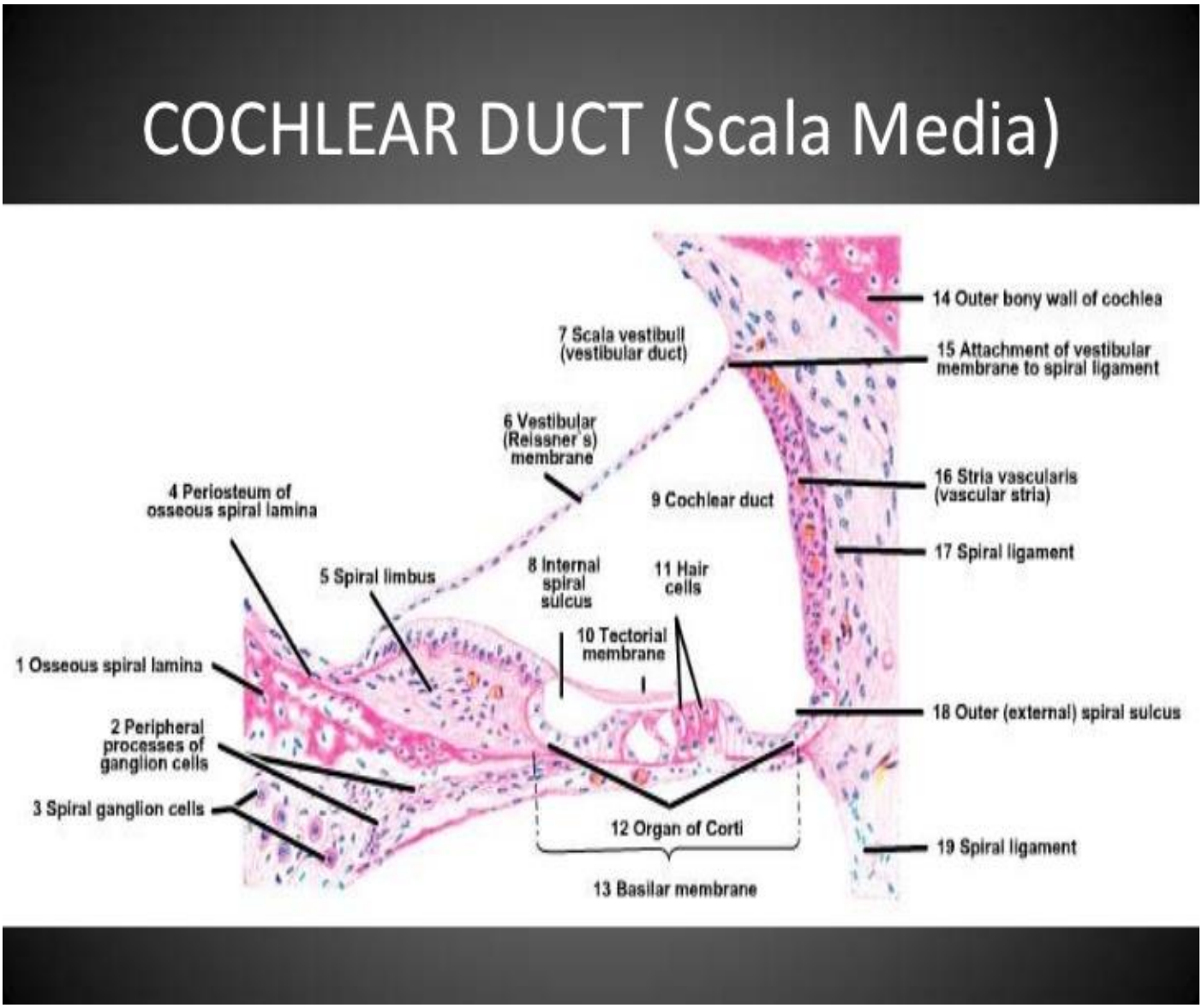
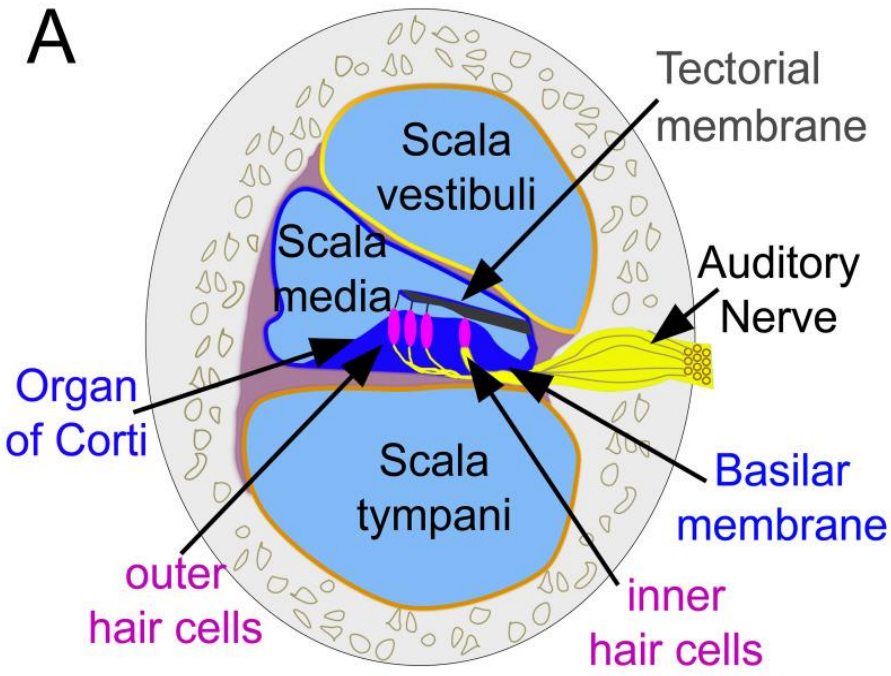


Diagram of the cochlear duct and its elements

Shearing movements between the basilar membrane with the sensory epithelium and the tectorial membrane cause receptor potentials to be produced in the hair cells, by means of deflections of their stereocilia



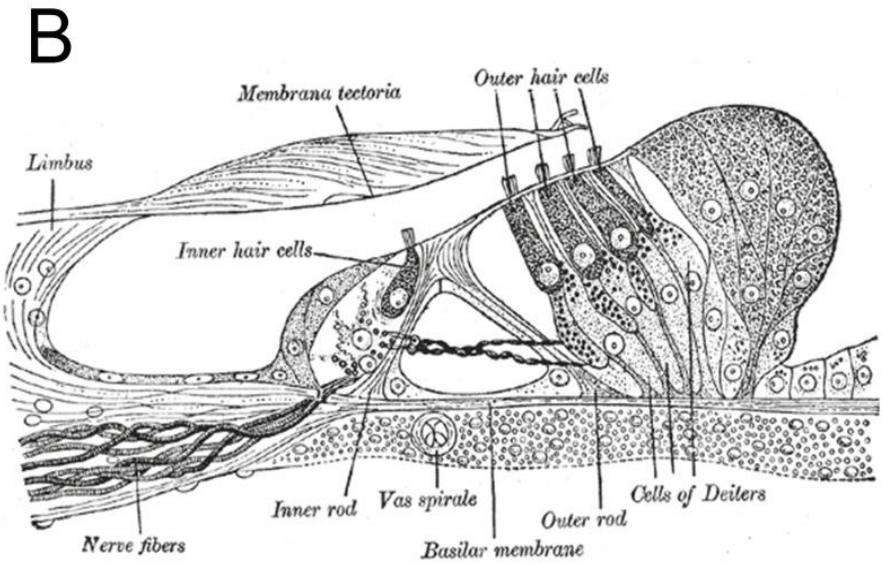


Diagram of the organ of Corti

The organ of Corti contains

I. The Outer hair cells surrounds by outer phalangeal cells. There are three rows of outer hair cells. The apices of these cells and their pharyngeal cells are joined

together to form the reticular membrane (also called reticular lamina or apical cuticular plate) that separates endolymph in the scala media from the underlying corticolymph and perilymph of the scala tympani. Lateral to the outer hair cells and pharyngeal cells are other support cells. The outer hair cells account for only approximately 5-10 % of the sensory input into the auditory system. **The primary function of the outer hair cells is actually to contract when stimulated,** thus "pulling" on the tectorial membrane thereby stimulating the inner hair cells.

II. Outer and inner pillar cells outline a triangular shaped tunnel, called the inner tunnel, which is filled with perilymph-like fluid called corticolymph

III. The inner hair cells are in a **single row** close to the inner pillar cells. The inner hair cells account approximately 90-95% of the sensory input into the auditory system

IV. Nerve fibers enter the organ of Corti through opening in a shelf of bone extending from the modiolus like the thread of a screw. The nerve fibers pass between supporting cells to synapse with the hair cells

V. Supporting cells: These cells are of different types:

- Corti pillars,
- Hensen cells : forms the outer rim of the reticular lamina
- Deiters cells: outer hair sits in the socket of the Deiters cells
- Cladius cells: Theses cells extend from the Hensen's cells to the spiral prominence epithelium, forming the outer sulcus. They are in direct contact with the endolymph of the cochlear duct

Function of Corti

The function of the organ of Corti is to change (transduce) auditory signals and minimize the hair cells' extraction of sound energy. It is the auricle and middle ear that act as mechanical transformers and amplifiers so that the sound waves end up with amplitudes 22 times greater than when they entered the ear.

Auditory transduction

In normal hearing, the majority of the auditory signals that reach the organ of Corti in the first place come from the outer ear. Sound waves enter through the auditory canal and vibrate the tympanic membrane, also known as the eardrum, which vibrates three small bones called the ossicles. As a result, the attached oval window moves and causes movement of the round window, which leads to displacement of the cochlear fluid. However, the stimulation can happen also via direct vibration of the cochlea from the skull. The latter is referred to as Bone Conduction (or BC) hearing, as complementary to the first one described, and which is instead called Air Conduction (or AC) hearing. Both AC and BC stimulate the basilar membrane in the same way.

An electrical signal is then sent through the auditory nerve and into the auditory cortex of the brain as a neural message.

Cochlear amplification

The organ of Corti is also capable of modulating the auditory signal. The outer hair cells (OHCs) can amplify the signal through a process called electromotility where they increase movement of the basilar and tectorial membranes and therefore increase deflection of stereocilia in the IHCs.

A crucial piece to this cochlear amplification is the motor protein prestin, which changes shape based on the voltage potential inside of the hair cell. When the cell is depolarized, prestin shortens, and because it is located on the membrane of OHCs it then pulls on the basilar membrane and increasing how much the membrane is deflected, creating a more intense effect on the inner hair cells (IHCs). When the cell hyperpolarizes prestin lengthens and eases tension on the IHCs, which decreases the neural impulses to the brain. In this way, the hair cell itself is able to modify the auditory signal before it even reaches the brain.

Clinical correlates

Hearing loss the organ of corti can be damaged by excessive sound levels, leading to noise induced impairment. The most common type of hearing impairment, sensorineural hearing loss, includes as one major cause of reduction of the function in the organ of corti.

Specifically, the active amplification function of the outer hair cells is very sensitive to damage from exposure to trauma from overly-load sounds or to certain ototoxic drugs. Once outer hair

cells are damaged, they do not regenerate and the result is a loss of sensitivity and an abnormally growth of loudness in the part of the spectrum that the damaged cell serve.

Arterial supply

The labyrinthine artery is the main supplier of oxygenated blood to the cochlea and therefore the organ of Corti. This artery is also known as the auditory artery or internal auditory artery. The labyrinthine artery most commonly originates from the anterior inferior cerebellar artery (AICA). AICA most commonly originates from the basilar artery. Occasionally, about 15% of the time, the auditory or labyrinthine artery, can branch off directly from the basilar artery. Less commonly, this artery may originate from the superior cerebellar or vertebral artery.

The labyrinthine artery follows the vestibulocochlear nerve from its point of origin into the internal acoustic meatus where it further divides into two branches, the anterior vestibular artery, and the common cochlear artery. The common cochlear artery will then divide into two more arteries, the proper cochlear artery, and the vestibulocochlear artery. The vestibulocochlear artery then gives off the vestibular ramus and the cochlear ramus