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17/MHS01/266

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- Histology Assignment
- 1 With the aid of a diagram, write an essay on the histology of an Organ of Corti.

Organ of Corti

It is a specialised sensory epithelium that allows for the transduction of sound vibrations into neural signals. It is located on the basilar membrane and contains two types of hair cells. Organ of Corti is contained in the cochlear duct and it responds to sound stimulus.

The organ of Corti is an organ of the inner ear located within the cochlea which contributes to audition. It consists of a single row of inner hair cells, three rows of outer hair cells containing stereocilia as well as supporting cells which include Pillar cells, Phalangeal cells, Border cells and cells of Hensen. The primary function of this organ is audition and it is located in the scala media of the cochlea of the inner ear between the vestibular duct and the tympanic duct. These hair cells which it contains are mechanosensory cells.

The three rows of outer hair cells have stereocilia but no kinocilium on their apical border which is arranged in a graduated fashion with the shortest stereocilia on the outer rows and the longest in the center. This graduation is the most important anatomical feature of the organ of Corti due to its sensory cells superior tuning capability. These outer cells are in contact with a gelatinous mass called the tectorial membrane such in tectorin. They also synapse with bipolar neurons of the cochlear (spiral) ganglion of Cranial Nerve VIII (Auditory or Vestibulocochlear Nerve). Deiters cells called phalangeal cells separate these outer cells from the inner hair cells as well as support both hair cells. These outer hair cells serve as acoustic pre-amplifiers which improve frequency selectivity by allowing the organ of Corti to become attuned to specific frequencies like those of speech or music. The

inner hair cells however transduce sound from vibrations to neural signals via the shearing action of the stereocilia.

The supporting cells of the organ of Corti are Pillar cells, Phalangeal cells, Border cells and Cells of Hensen. The Pillar cells are divided into inner and outer pillar cells. These are tall ^(columnar) cells with wide bases and apical ends that are attached to basilar membrane. The central portions are depleted to form walls of inner tunnel while the apical portions contact each other.

The Phalangeal cells are also divided into Outer and Inner Phalangeal cells. Outer phalangeal cells are tall columnar cells that are attached to basilar membrane. Their apical portions are cup-shaped to support the basilar portions of outer hair cells along with efferent and afferent nerve fibres. They do not reach the free surface of organ of Corti and they contain space of Nuel (a gap around unsupported regions of the outer hair cells which is fluid-filled). Outer phalangeal cells communicate with inner tunnel. While the Inner phalangeal cells are located deep to the inner pillar cells and completely surround the inner hair cells.

Border cells delineate the inner border and slender cells that surround inner aspects of the organ of Corti. While the Cells of Hensen define the outer border and are found between the outer phalangeal cells and cells of Claudius.

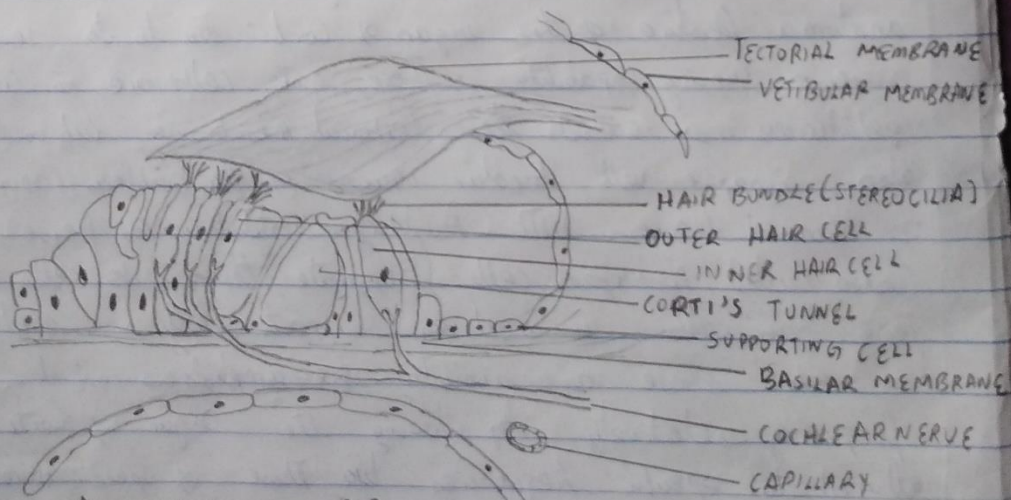


DIAGRAM OF ORGAN OF CORTI

Function:

The primary function of the organ of Corti is the transduction of auditory signals. When sound waves enter the ear via the auditory canal and cause vibration of the tympanic membrane which in turn causes vibrations within the ossicles which transfers the energy to the cochlea through the oval window. As the oval window moves it leads to movement of the round window causing displacement of cochlear fluid. This fluid (perilymph fluid) moves through the scala tympani and scala vestibule causing the basilar membrane (between scala media and scala tympani) to shift respectively to the tectorial membrane. These shifts move the stereocilia of hair cells and activate or deactivate receptors on the hair cell surface. This leads to opening of cations channels on hair cells, K^+ flow in, cells depolarize and voltage-gated calcium channels open. Influx of Ca^{2+} results in glutamate release from hair cells onto auditory nerve which sends information about the sound wave to the brain.

The organ of Corti is also capable of modulating the auditory signal. The outer hair cells achieve this through a process called electromotility where they increase movement of the basilar and tectorial membranes and in turn increasing the deflection of stereocilia in the inner hair cells.

Clinical Significance

Sensorineural Hearing Loss: This is the most common kind of hearing impairment. It is caused by overly loud sounds or certain ototoxic (toxic to ear) drugs which leads to damage to organ of Corti causing reduction of the active amplification function of the outer hair cells. The outer hair cells once damaged do not regenerate resulting in loss of sensitivity and an abnormally large growth of loudness in the part of the spectrum that the damaged cells serve. This is why hearing loss is been considered irreversible in mammals.