**MATRIC NUMBER: 18/MHS01/382**

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QUESTION: With The Aid Of Diagram, Write An Essay On The Histology Of An Organ Of Corti.



The Organ Of Corti

It is also known as spiral organ. This sensory organ of the hearing consists of hair cells and other epithelial structures supported by basilar membrane. It is spread like a ribbon along the entire length of basilar membrane. The organ of Corti is so called because (like other structures in the cochlea) it extends in a spiral manner through the turns of the cochlea. Its sensory hair cells have precisely arranged V-shaped bundles of rigid stereocilia. These important receptor cells of hearing transduce sound energy into electrical energy. The hair cells are so called because their free ‘upper’ or apical ends bear a number of ‘hair’. The hair are really stereocilia. Each cell is columnar or piriform. The hair cells are distinctly shorter than the rod cells. Their apices are at the level of the reticular lamina. Their lower ends (or bases) do not reach the basilar membrane. They rest on phalangeal cells. Both outer and inner hair cells have synaptic connections with afferent and efferent nerve endings with the inner row of cells more heavily innervated. The cell bodies of the afferent bipolar neurons constitute the spiral ganglion located in the bony core of the modiolus. The apical surface of each hair cell is thickened to form a cuticular plate, the edges of which are attached to neighboring cells. The hair cells are connected to the sensory fibers of CN VIII. There are two major types of hair cells present:

*Inner hair cells*: Inner hair cells form a single row and are richly supplied by afferent cochlear fibers. These are flask-shaped cells and relatively short. They are very important in the transmission of auditory impulses. Their nerve fibers are mainly afferent.

*Outer hair cells*: Outer hair cells are arranged in three or four rows and mainly receive efferent innervation from the olivary complex. These are long cylindrical cells which modulate the function of inner hair cells. Their nerve fibers are mainly efferent. They are about 12000 in total and each columnar outer hair cell bears a V-shaped bundle of stereocilia.

Differences between inner hair cells and outer hair cells.

|  |  |  |
| --- | --- | --- |
|  | Inner hair cells | Outer hair cells |
| Cell numbers | 3500 | 12000 |
| Rows | One | Three or four |
| Shape | Flask | Cylindrical |
| Nerve supply | Mainly afferent fibers | Mainly efferent fibers |
| Development | Early | Late |
| Function | Transmit auditory stimuli | Modulate function of inner hair cells |
| Ototoxicity & High intensity | More resistant | More sensitive and easily damaged |
| Generation of otoacoustic emissions | No | Yes |

The two major types of columnar supporting cells attached to the basilar membrane in the organ of Corti include:

*Inner and outer phalangeal cells:* they extend apical processes that surround and support the basolateral parts of both inner and outer hair cells and the synaptic nerve endings. The apical ends of phalangeal cells are joined to those of the hair cells by tight zonulae occludens, forming an apical plate across the spiral organ through which the stereocilia bundles project into the endolymph.

*Pillar cell (or rod cell):* has a broad base (or footplate, or crus) that rests on the basilar membrane; an elongated middle part (rod or scapus); and an expanded upper end called the head. The bases of the rod cells are greatly expanded and contain their nuclei. The bases of the inner and outer rod cells meet each other forming the base of the tunnel of Corti. The heads of these cells also meet at the apex of the tunnel. Here, a convex prominence on the head of the outer rod cell fits into a concavity on the head of the inner rod cell. The uppermost parts of the heads are expanded into horizontal plates called the phalangeal processes. These processes join similar processes of neighboring cells to form a continuous membrane called reticular lamina.

The outer hair cells of the spiral organ are covered from above by a gelatinous mass called the membrana tectoria. It consists of fine bundles of collagen (types II, V,IX and XI) associated with proteoglycans and forms during the embryonic period from secretions of cells lining this region. This material is probably secreted by cells lining the vestibular lip of the limbus lamina spiralis. a tunnel can be seen called the tunnel of Corti, which is situated between the inner and outer rod cells and contains a fluid called cortilymph. The base of the tunnel lies over the basilar membrane. To the internal side of the inner rod cells there is a single row of inner hair cells. The inner hair cell is supported by tall cells lining the tympanic lip of the internal spiral sulcus. On the outer side of each external rod cell there are three or four outer hair cells. The outer hair cells do not lie directly on the basilar membrane, but are supported by the phalangeal cells (of Dieters) which rest on the basilar membrane. To the outer side of the outer hair cells and the phalangeal cells, there are tall supporting cells (cells of Hensen). Still more externally the outer spiral sulcus is lined by cubical cells (cells of Claudius). A narrow space the cuniculum externum intervenes between the outermost hair cells and the cells of Hensen. A third space, the cuniculum medium (or space of Nuel) lies between the outer rod cell and the outer hair cells. The spaces are filled with perilymph (or cortilymph).

Sound waves collected by the external ear cause the tympanic membrane to vibrate, which moves the chain of middle ear ossicles and the oval window. The large size of the tympanic membrane to the oval window and the mechanical properties of the ossicle chain amplify the movements and allow the optimal transfer of energy between air and perilymph, from sound waves to vibrations of the tissues and fluid-filled chambers. Pressure waves within the perilymph begin at the oval window and move along the scala vestibuli. Each pressure wave causes momentary displacement of the vestibular and/or basilar membranes and the endolymph surrounding the organ od Corti.

The main mechanoreceptors for the sense of hearing are the more heavily innervated inner hair cells in the organ of Corti. The outer hair cells, with their stereocilia tips embedded in the tectorial membrane, are depolarized when stereocilia are deformed. Depolarization of the outer hair cells causes these columnar cells to shorten very rapidly, an effect mediated by prestin ( a transmembrane protein) abundant in the lateral cell membranes. Prestin undergoes a voltage-dependent conformational change that affects the cytoskeleton, rapidly shortening the cells when the membrane is depolarized and elongating them again with membrane hyperpolarization. Piston-like movements of the outer hair cell pull down the membrana tectoria against the stereocilia of the inner hair cells, causing depolarization of these cells which then send the signals to the brain for processing as sounds. This sequential role for outer and inner hair cells produces further cochlear amplification of the sound waves.