Hair Cell Function

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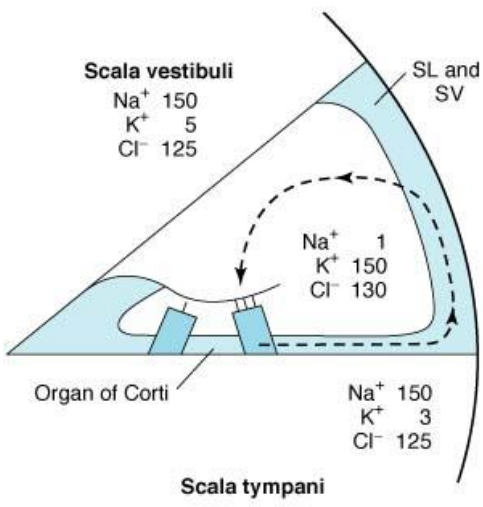
Hair cell STRUCTURE → see p. Ear11a >>
Corti organ STRUCTURE → see p. Ear13a >>

Hair cell's membrane potential is -60 mV; hair processes generate changes in membrane potential proportionate to displacement direction:

- when stereocilia are pushed **toward kinocilium**, membrane potential is decreased to -50 mV.
- when bundle of processes is pushed **away from kinocilium**, cell is hyperpolarized.
- displacing processes in direction ***perpendicular to this axis*** provides no change in potential.

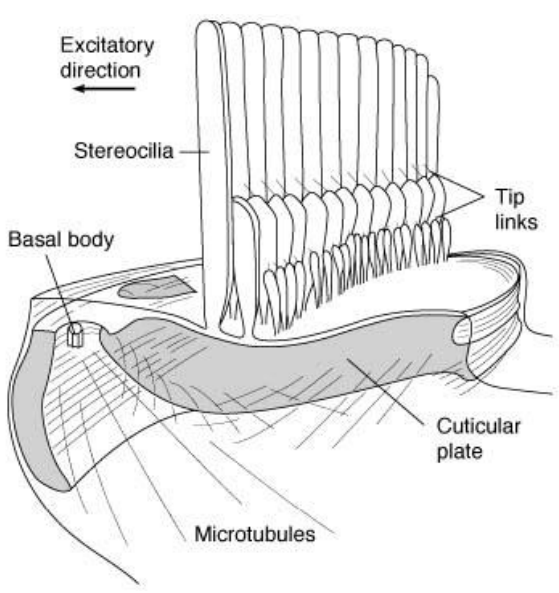
- **processes** of hair cells project into ENDOLYMPH whereas **bases** are bathed in PERILYMPH.
- PERILYMPH is formed mainly from ***plasma*** - resembles extracellular fluid.
- ENDOLYMPH is formed by ***stria vascularis*** and has high K^+ concentration and low Na^+ concentration; in addition, stria vascularis has unique **electrogenic K^+ pump** → ENDOLYMPH of scala media is electrically positive by +85 mV relative to PERILYMPH of scala vestibuli & scala tympani.



SL, spiral ligament. **SV**, stria vascularis.
dashed arrow indicates path by which K^+ recycles: hair cells → supporting cells → spiral ligament → secreted back into endolymph by stria vascularis.

Very fine processes called **TIP LINKS** tie tip of each stereocilium to side of its higher neighbor.

- at junction, higher stereocilium has **mechanically sensitive cation channels** (α-subunit of epithelial sodium channel may be involved);
- tension on each of channels is adjusted by "adaptation motor" made up of myosin in higher stereocilium;
- when shorter stereocilia are pushed toward higher, **open time of channels** increases; stereocilia displacement in opposite direction reduces channel open time.
- channels are ***relatively nonspecific*** cation channels, but since they are bathed in ENDOLYMPH (high K^+ concentration + strongly positive relative to cell inside → electrochemical gradient*), K^+ enters hair cell when they are open → hair cell depolarization → Ca^{2+} enters cell → excitatory synaptic transmitter (probably **GLUTAMATE**) release → afferent neuron depolarization.
- K^+ that enters hair cells is recycled back to ENDOLYMPH.



Arrow indicates direction in which pushing cilia increases ion influx into hairs.

* in general, there is no K^+ concentration gradient between endolymph and hair cell interior, but at least it does not impede K^+ movement into cell.

BIBLIOGRAPHY for ch. "Otology" → follow this LINK >>