Lecture 12  Genetic Hearing Impairment

Of all the disorders we’ve talked about, this is probably the most prevalent.

Prevalence of hearing impairment:
- 30 million Americans affected; 2 million are profoundly deaf

Deafness: about half is acquired and half is genetic/hereditary [diagram is not hers]
75% of genetic loss is non-syndromic (70% of this is autosomal recessive)
25% autosomal dominant; more than 50 loci for mutations
Small proportions are mitochondrial, chromosomal, X-linked. May be congenital or have post-natal onset (prelingual or post-lingual).

Anatomy of the ear:
- Outer ear: ear canal up to the ear drum (tympanic membrane)
- Middle ear: malleus, stapes, incus
- “conductive” hearing loss involves outer and/or middle ear
- Inner ear: vestibular system (balance) and cochlea

Conductive hearing loss involves the outer and middle ear
Sensorineural hearing loss involves the inner ear

Cochlea:
- Stereocilia: “hair” cells; the hair-like protrusion is an extension of the plasma membrane filled with rigid actin filaments. Individual protrusions on the ends are linked with “tip links.” Sound waves causes a mechanical force to pivot the stereocilia, causing a shearing motion because there are taller and shorter tips layered on each other, in order. Shearing causes the tip links to stretch; this stretching pulls open ion channels, which depolarize the cell.

Endolymph has high K+ concentrations; K+ recycling is important to cellular hearing functions, so mutations in this process can cause hearing problems.

Hearing Loss:
Normal aging tends to involve high-frequency hearing loss

Obstacles to studying genetic deafness:
- inaccessible to direct observation, as cochlea is embedded inside head; need to do an autopsy to really get at it

Deaf-deaf mating: tends to happen fairly frequently, due to the common language effect (i.e. sign language)

Guest Lecture by Dr. Marley Kenna

Incidence of Hearing Loss in Newborns: very high; much higher than incidence of metabolic disorders, for example.
Tests:
- Automated auditory brainstem response
- Otoacoustic emissions looks at sounds produced by outer hair cells
20/1,000 don’t pass screening for hearing impairment; 16 of these turn out to be fine

Early Hearing Detection Intervention (EHDI) Programs

Genetic heterogeneity with mutations causing deafness
- same or similar mutations can cause different symptoms
- 50 different mutations causing hearing impairment
- single phenotype can be caused by several mutations.

Usher syndrome: deaf/blind syndrome, accounts for 3-6% of childhood deafness