NOTES
HEARING LOSS

GENERALLY, WHAT IS IT?

PATHOLOGY & CAUSES

- Decrease in ability to perceive sound
- Variable etiology
  - External, middle, inner ear, associated neurological input/processing structures

SIGNS & SYMPTOMS

- Hearing loss
- Balance issues, headache, tinnitus

DIAGNOSIS

OTHER DIAGNOSTICS

- Bedside (otoscopy to Rinne) and formalized (audiogram) testing

Otoscopy

Whisper test

- Examiner speaks in whispered voice 0.61m/2ft away → individual covers far ear with hand → examiner whispers word/phrase → individual repeats word/phrase

Finger rub

- Examiner speaks closer to pinna → individual indicates if sound heard

Weber

- Distinguishes between conductive, sensorineural hearing loss
- Examiner places vibrating tuning fork (128Hz) at apex of head → individual indicates loudest side
  - One ear preferred/louder indicative of possible hearing loss

Rinne

- Compares air, bone conduction of sound
- Examiner places vibrating tuning fork (512Hz) at mastoid process → individual indicates when vibration heard → examiner moves vibrating tuning fork outside of pinna → individual indicates if vibration heart
  - Bone conduction (mastoid placement of tuning fork) > air conduction (i.e. individual cannot hear vibration after first step complete) indicative of possible hearing loss

Audiogram

- Pure tones of varying frequencies (Hz) at varying volume of sound
- Plot individual's 50% correct response rate (dependent on volume) for each frequency

TREATMENT

- Specific to underlying etiology; some etiologies irreversible

GENERALIZED INTERPRETATION OF RINNE AND WEBER TESTING

TEST	NORMAL TEST	CONDUCTIVE HEARING LOSS	SENSORINEURAL HEARING LOSS
RINNE	Air conduction (AC) > bone conduction (BC)	BC > AC	AC > BC (both ↓)
WEBER	Midline/equal in both ears	Lateralizes to diseased ear	Lateralizes to normal ear

CONDUCTIVE HEARING LOSS

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PATHOLOGY & CAUSES

- Disability of sound waves
  - Unable to be amplified, transmitted by external/middle ear

CAUSES

Bony outgrowth

- *Exostoses:* form at suture lines of external auditory canal bony suture lines; associated with repeated cold water exposure (e.g. swimmers)
- *Osteomas:* form at tympanosquamous suture line

Cerumen impaction

- ↑ Incidence in elderly

Congenital

- *Microtia:* malformation/absence of auricle; 1st, 2nd branchial arch derivative; mild-moderate conductive hearing loss
- *External auditory canal atresia:* associated with craniofacial diseases (e.g. Treacher Collins syndrome, Robin sequence, Crouzon syndrome)
- Commonly of ossicular chain (most commonly malformation of stapes) → inability to reverberate → ↓ sound wave transmittance to oval window

Eustachian tube dysfunction

- Results in abnormal pressure/reflux/clearance of middle ear contents
- Shorter eustachian tubes in children → ↑ reflux of nasopharynx contents → otitis media
  - Higher incidence in children with abnormal craniofacial anatomy (e.g. Down syndrome, Treacher Collins syndrome)

Otitis externa

- AKA swimmer's ear
- Commonly bacterial
  - *Pseudomonas aeruginosa* (most common pathogen)
- Chronic/repeated infections → polyps (can occlude external auditory canal)

Otitis media

- Infection → effusion → poor transmittance of sound wave in middle ear → hearing loss
- Highest incidence
  - 6–18 months of age
- *Microbiology:* *Staphylococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*
- *Risk factors:* daycare, bottle feeding
- *Complications:* mastoiditis, cholesteatoma, permanent hearing loss → deafness

Otosclerosis

- Bony overgrowth of stapes to oval window → inability to vibrate → inability to conduct sound waves; can be autosomal dominant with variable penetrance

Trauma

- Complete external auditory canal occlusion

Tumors of middle ear

- Cholesteatomas (most common overall)
  - Desquamated, stratified, squamous epithelium in middle ear space
  - Accumulation → erosion of middle ear contents (ossicular chain) → surrounding structures: external auditory canal (EAC), mastoid bone
- Squamous cell carcinoma (most common malignant tumor)

Tympanic membrane perforation

- Common; due to trauma/barotrauma to ear/face

SIGNS & SYMPTOMS

- Decreased perception of sound
  - Especially poor perception of low-frequency sound
  - Overcome by volume of stimulus

DIAGNOSIS

OTHER DIAGNOSTICS

- History, associated symptoms
- Otoscopy
- Special testing
  - Weber (localization of vibration to affected ear)
  - Rinne (abnormal; bone conduction > air conduction)
- Audiogram
  - Universal/low-frequency deficit in pure tone discrimination

TREATMENT

- Specific to underlying etiology

MEDICATIONS

- External ear
  - *Mild:* topical acidifying agent, glucocorticoid
  - *Moderate/severe:* topical/oral antibiotics
- Middle ear
  - Pain control (e.g. ibuprofen, acetaminophen), antibiotics

SURGERY

- External ear
  - If repeat infections/↑ size
- Middle ear
  - Tissue graft
  - Surgical removal

OTHER INTERVENTIONS

- External ear
  - Cerumenolytics/irrigation/manual removal
  - *Repeat infections/↑ size:* EAC occlusion
- Middle ear
  - Hearing aids

COMMON CAUSES OF CONDUCTIVE HEARING LOSS

	ETIOLOGY	SYMPTOMS[1]	OTOSCOPY	INTERVENTION
EXTERNAL EAR	Cerumen impaction	Earache, ear fullness, pruritus, reflex cough, dizziness, tinnitus	Cerumen in EAC[2]	Cerumenolytics/ irrigation/manual removal
	Otitis externa	Ear pain, pruritus, discharge; severe → regional LAD[3]	Edematous, erythematous EAC, mobile TM[4]	Mild: topical acidifying agent, glucocorticoid Moderate/severe: topical/oral ABX[5]
	Bony outgrowth	None	Bulging, normal-appearing EAC +/- TM visualization	Repeat infections/ ↑ size: EAC occlusion, surgery
MIDDLE EAR	Ossicular malformation	None	Normal	Hearing aids, surgery
	Eustachian tube dysfunction	Ear fullness	Effusion behind TM	Surgery (including tympanostomy tubes)
	Otitis media	Fever, irritability	Discomfort with exam, effusion, erythema, immobile TM	Pain control (ibuprofen/ acetaminophen), antibiotics
	Otosclerosis	None	Normal	Hearing aids, surgery → stapedectomy/ prosthesis
	Tympanic membrane perforation	Associated trauma to surrounding bones/tissue	Hole in TM, visual of middle ear components	None → (severe) tissue graft
	Malignancy	Size-dependent	Mass	Surgical removal

1 - other than hearing loss itself, 2 - external auditory canal, 3 - lymphadenopathy, 4 - tympanic membrane, 5 - antibiotics

SENSORINEURAL HEARING LOSS

osms.it/sensorineural-hearing-loss

PATHOLOGY & CAUSES

- Disability of inner ear (cochlea/CN VIII) to transduce sound waves → viable neurologic input → brain

CAUSES

Central nervous system (CNS)

- Acoustic neuroma (CN VIII; AKA vestibular neuroma)
  - ↑ size → compress cerebellum → ataxia
- Meningitis
  - Infection (via cerebrospinal fluid) → cochlea → cochleitis → direct damage to inner hair cells
- Meningioma
- Acoustic nerve neuritis
  - Multiple sclerosis, syphilis

Congenital

- Spontaneous/genetic
- Acquired
  - Toxoplasmosis, other (syphilis, varicella-zoster, parvovirus B19), rubella, cytomegalovirus (CMV), herpes (TORCH) infections

Drug-induced

- Aminoglycoside antibiotics (most common); cisplatin
- Aspirin (high-dose 6–8g/day), quinidine, loop diuretics (e.g. furosemide, ethacrynic acid) → reversible hearing loss, tinnitus

Inner ear infection

- Labyrinthitis (inflammation, spinning, ringing)

Menière's disease

- Rare
- Unilateral, episodic loss concurrent with tinnitus, vertigo
  - *Pathogenesis:* unknown; possible infection, autoimmune, vascular constriction, congenital malformation → endolymphatic hydrops (e.g. overproduction of endolymph, distension of endolymphatic space)

Noise-induced

- *Cause:* chronic exposure to loud (> 85dB) auditory stimuli
- *Pathogenesis:* overstimulation of hair cells in organ of Corti → nitric oxide, free radical release → damage, death of hair cells
- ↓ Mg^{2+} → ↓ Ca^{2+} intracellular concentration → ↑ cell damage, death

Presbycusis

- Most common
- Gradual, symmetric hearing loss in elderly
- More significant loss with higher frequencies
- *Pathogenesis:* degeneration of hair cells at base of cochlea

Trauma

- Skull fracture → injury to CN VIII/cochlea

SIGNS & SYMPTOMS

- Decreased perception of sound (esp. high-pitched sounds, speech discrimination)

DIAGNOSIS

DIAGNOSTIC IMAGING

MRI

- Identifies causes such as acoustic neuroma, perilymphatic fistula

OTHER DIAGNOSTICS

- History, associated symptoms
- Otoscopy
  - Rules out causes of conductive hearing loss
- Special testing
  - *Weber:* lateralization of sound to unaffected ear
  - *Rinne:* air, bone conduction (AC > BC)
- Audiogram
  - Identifies deficit in high-pitched pure tone discrimination

TREATMENT

- Specific to underlying etiology

MEDICATIONS

- Antiemetics, vestibular suppressants (e.g. benzodiazepines), diuretics
  - Endolymph of labyrinthine systems
- Antibiotics
  - Meninges

SURGERY

- Surgical resection
  - Acoustic nerve

OTHER INTERVENTIONS

- Hearing aids
  - Hair cells of organ of Corti
- Dietary changes (↓ Na^+)
  - Endolymph of labyrinthine systems
- Radiotherapy
  - Acoustic nerve

COMMON CAUSES OF SENSORINEURAL HEARING LOSS

	DISEASE	ASSOCIATED SYMPTOMS[1]	INTERVENTION
HAIR CELLS OF ORGAN OF CORTI	Presbycusis	Tinnitus, difficulty perceiving spoken voice in crowded rooms	Hearing aids
	Noise-induced hearing loss	Hyperacusis, tinnitus	Hearing aids
ENDOLYMPH OF LABYRINTHINE SYSTEMS	Meniere disease	Episodic vertigo, tinnitus	Dietary change (↓ Na^+), antiemetics, vestibular suppressants (e.g. benzodiazepines), diuretics
ACOUSTIC NERVE (CN VIII)	Acoustic neuroma	Tinnitus, dizziness, HA[2], disequilibrium, ataxia	Surgical resection, radiotherapy
MENINGES	Meningitis	Ill-appearing, nuchal rigidity, fever	Antibiotics
	Meningioma	HA, seizure, motor abnormalities, sensory abnormalities	Surgical resection

1 - in addition to hearing loss, 2 - headache