Overview

- Review ear anatomy
- Evaluation of hearing
- Types of hearing loss
- Specific causes of hearing loss

Normal Ear Anatomy

Evaluation of Hearing

- Bedside Testing
  - Whisper test
  - Tuning forks (512 Hz): Weber and Rinne
- Audiometry
- Electrical Tests
  - ABR: Auditory Brainstem Response
  - Otoacoustic emissions
- Tympanometry
Types of Hearing Loss

- Conductive
  - Loss at level of external ear or middle ear
- Sensorineural
  - Loss at level of inner ear, auditory nerve, or brain
- Mixed
  - Combination of conductive and sensorineural loss

Weber Test

- Tuning fork (512 Hz)
- Forehead bone conduction
- Patient will hear:
  - ON side of conductive loss
  - AWAY from side of sensorineural loss

Rinne Test

- Tuning fork (512 Hz)
- Compare bone conduction (mastoid) with air conduction
- Patient will hear:
  - Louder BONE if conductive hearing loss
  - Louder AIR if normal or sensorineural loss

Normal Audiogram

Discrimination:
R: 96%
L: 100%
Sensorineural Hearing Loss

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Sound Pressure Level (dB SPL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1000</td>
<td>10</td>
</tr>
<tr>
<td>10000</td>
<td>0</td>
</tr>
</tbody>
</table>

Discrimination R: 40%

Conductive Hearing Loss

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Sound Pressure Level (dB SPL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1000</td>
<td>10</td>
</tr>
<tr>
<td>10000</td>
<td>0</td>
</tr>
</tbody>
</table>

Discrimination R: 96% L: 100%

Causes of Conductive Hearing Loss: External Ear

Cerumen Impaction or Foreign Body
Infectious Disease

- Otitis Externa
- Cellulitis
- Herpes Zoster
  (Ramsay-Hunt Syndrome)

Congenital Malformation of External Ear

Microtia/Atresia

Ear Canal Exostoses

Carcinoma of the Ear Canal
Causes of Conductive Hearing Loss: Middle Ear

Etiology of Acute Otitis Media

- S. pneumoniae 25%
- H. influenzae 20-25%
- M. catarrhalis 10-20%
- S. pyogenes (gr. A) 2%
- S. aureus 1%
- No growth up to 35%

Beta-lactam resistance is growing in all isolates

Otitis Media with Effusion

Beta-lactam resistance is growing in all isolates
### Medical Treatment of OME

- Observation
- Antibiotics
  - Beneficial short-term resolution of OME
  - Unclear long-term impact
- Audiogram at 3 months with persistent effusion
- Follow-up every 6 weeks

### Complications of Otitis Media

- When to refer to Oto-HNS?
  - 3 bouts AOM in 6 months
  - 4 bouts AOM in 12 months
  - Chronic OME >3mos, hearing loss, speech delay
  - Complication
  - Earlier if anatomic or immune problem

---

**Otitis Media**

- When to refer to Oto-HNS?
  - 3 bouts AOM in 6 months
  - 4 bouts AOM in 12 months
  - Chronic OME >3mos, hearing loss, speech delay
  - Complication
  - Earlier if anatomic or immune problem

**Hemotympanum**
<table>
<thead>
<tr>
<th>TM Perforation</th>
<th>Cholesteatoma</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="https://commons.wikimedia.org/wiki/File:TM_Perp.png" alt="Image" /></td>
<td><img src="https://commons.wikimedia.org/wiki/File:Cholesteatoma.png" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Otosclerosis</th>
<th>Causes of Sensorineural Hearing Loss: Inner Ear or Auditory Nerve</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="https://commons.wikimedia.org/wiki/File:Otosclerosis.png" alt="Image" /></td>
<td><strong>Causes of Sensorineural Hearing Loss:</strong> Inner Ear or Auditory Nerve</td>
</tr>
</tbody>
</table>
Presbycusis

Sudden Sensorineural Hearing Loss

Viral? ... Vascular? ... Autoimmune?
Rule of Thirds
   1/3 full recovery
   1/3 partial recovery
   1/3 permanent hearing loss (15% progressive)
   WITHOUT INTERVENTION
   EARLY STEROID THERAPY

Noise Induced Hearing Loss

- Related to intensity, duration, and frequency of noise exposure
- May affect the ears asymmetrically
- Sustained work day (8-hour) exposures >85 dB require the hearing protection and annual audiograms
- Initially affects the 3000-4000 Hz frequency range
### Noise Induced Loss

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Sound Pressure Level (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>1000</td>
<td>20</td>
</tr>
<tr>
<td>10000</td>
<td>10</td>
</tr>
</tbody>
</table>

**Discrimination:**
- Early: 96%
- Later: 72%

### Vestibular Neuronitis/Labyrinthitis
- Put simply, “an inner ear infection”
- Usually viral. Treated symptomatically. Steroids may help. Antibiotics not usually required. May takes weeks to resolve.
- Labyrinthitis causes hearing loss and vertigo. Hearing loss can be permanent.

### Meniere’s Disease
- Episodic vertigo, tinnitus, aural fullness & hearing loss
- Treatment: low salt diet, thiazide diuretics and PRN vestibular suppressants.
- Other interventions: transtympanic gentamicin/steroid injection, endolymphatic shunt surgery, labyrinthectomy, or vestibular nerve section
- Up to 30% bilateral

### Acoustic Neuroma/Vestibular Schwannoma
- 8th cranial nerve
- Hearing loss, tinnitus, & disequilibrium early
- Facial numbness, facial weakness, hydrocephalus late
- 5% are associated with Type II Neurofibromatosis
- Tx: Surgery, gamma knife, observation
**Summary**

- Review ear anatomy
- Evaluation of hearing
- Types of hearing loss
- Specific causes of hearing loss

---

**Hearing Loss for Primary Care Physicians**

Laura Feeney, Au.D.
Audiologist
Department of Otolaryngology
The Ohio State University Wexner Medical Center
Medical Clearance

- Medical Clearance is required prior to a patient being fit with hearing aids.
- Medical Clearance may be obtained 3 ways
  - Evaluation by an ENT/Otologist
  - Evaluation by PCP, provided results do not warrant referral to an ENT
  - Patient Medical Waiver

What to look for when giving medical clearance for amplification

- Asymmetrical air conduction thresholds
- Conductive component of hearing loss – ‘air-bone gap’
- Asymmetrical speech discrimination
- Chronic middle ear disease

Hearing Aids : Factors to consider

- Age of patient
- Dexterity
- Severity/configuration of hearing loss
- Cosmetics
- Battery life
- Anatomy of the patient’s ear
**Styles of Hearing Aids**

- Completely-In-The Canal (CIC)
- In-The-Canal (ITC)
- In-The-Ear (ITE)
- Behind-The-Ear (BTE)

*Photos courtesy of Phonak*

**‘Open Fitting’ Hearing Aids**

- Appropriate for hearing loss that is normal/mild in the low frequencies.
- Inappropriate if much gain is needed at 250-500Hz
  - Can be coupled to an earmold, however to give low frequency gain
- Designed to eliminate the occlusion effect and improve cosmetics

*Photos courtesy of Phonak*

**Newer Features in Hearing Aids**

- In some advanced level products the following features are now available:
  - Wireless connectivity between ears
  - Automatic program changes
  - Better feedback control
  - Adaptive directionality
  - Wireless connectivity to bluetooth devices

**Bluetooth compatibility**

- Some hearing aids now have capability to connect with bluetooth devices
- Phone compatibility
- TV compatibility

*Photos courtesy of Phonak*
CROS/BICROS amplification

- For use when one ear is not aidable
- Transmitter on the poorer hearing ear
- Receiver and hearing aid on the better hearing ear
- Wireless communication

Photos courtesy of Phonak

FM System

- Transmitter
- Receiver
- Options for CI/BAHA

Photos courtesy of Phonak and Cochlear Americas

When hearing aids are not enough

- Cochlear implants and bone anchored hearing solutions are options for patients who cannot benefit from traditional amplification

• What are bone anchored hearing solutions?
  – Bone anchored hearing solutions are surgically implanted devices that transmit sound via bone conduction bypassing the middle ear to a normally hearing cochlea (either ipsi or contralaterally).
  – Often referred to as BAHA
  – Implications for single sided deafness and conductive/mixed hearing losses that cannot be conventionally amplified.
**BAHA Candidacy**

- Single Sided Deafness
  - Poorer ear - Profound SNHL
  - Good Ear - PTA AC threshold ≤20dB @ 500, 1000, 2000, and 3000Hz
- Mixed/Conductive
  - PTA BC threshold ≤65dBSHL @500, 1000, 2000, 3000Hz.

---

**BAHA**

Photos courtesy of Cochlear Americas

---

**Cochlear Implant**

- Consists of an external speech processor and a surgically implanted device
- Electrode implanted in the cochlea to electrically stimulate the nerve

Photos courtesy of Cochlear Americas

---

**Cochlear Implant Candidacy- Children**

- Profound sensorineural hearing loss bilaterally
  - Age 12-24 months
- Severe to profound sensorineural hearing loss
  - Age 2-17 years
- Limited benefit from binaural amplification trial
### Cochlear Implant Candidacy - Adults

- Moderate to profound sensorineural hearing loss bilaterally
- Limited benefit from amplification defined by preoperative sentence recognition scores

### Watch out for:

- Cochlear Implant Patients
  - Redness at magnet site
- Hearing Aid Patients
  - Otitis Externa caused by earmold closing off ear canal
- BAHA
  - Skin overgrowth at abutment site
- Patients who have hearing concerns