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Clinical Cases in ENT



Geetha Chary

Clinical Cases in **ENT**

Geetha Chary MBBS MS DLO
Formerly Professor and Head
Department of ENT
St John's National Academy of Health Sciences
Bengaluru, Karnataka, India

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Chapter
5

Hard of Hearing

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What are the investigations for a patient presenting with hearing loss?

1. Pure tone audiometry (described in chapter 1)
2. Tympanometry.

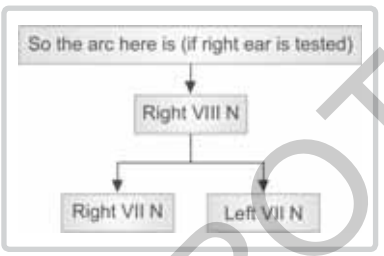
In a mechanical system the ease with which energy will flow through the system is admittance and the resistance it offers is impedance. Together it is called immittance. In the ear it is tested by a probe tone of 226 HZ delivered at 85 dBSPL. The sound pressure level is measured by an immittance meter and any change is noted as the change in energy flowing through the system.

Three measurements are made:

1. Tympanometry
2. Static immittance
3. Acoustic threshold limits
    1. In *tympanomety*, the pressure in the external auditory canal is varied and the acoustic immittance studied. In normal ears maximum transmission occurs at atmospheric pressure.
        - Type A tympanogram has its maximum peak at Organization of Department and Program Advisors (ODaPA)
        - If there is fluid in the middle ear it is flat and called type B
        - In Eustachian tube dysfunction there is retracted drum due to loss of middle ear pressure. So the peak of the tympanogram is in the negative. This means maximum transmission of sound occurs when external canal pressure is negative and this is "C" type tympanogram
        - If ossicular chain is fixed than a shallow. As type tympanogram is seen where *s* stands for stiffness
        - If ossicular chain is unduly mobile as in thin tympanic membrane or ossicular chain discontinuity then energy flow is enhanced and it is called Ad. 'd' denotes discontinuity
        - In children 1000 Hz probe tone demonstrated fluid in the middle ear which may be normal with 226 Hz probe.

2. Static immittance measures only middle ear contribution; it compares the peak at ODaPA with immittance when the air pressure is +200 daPa: Values below 0.3 cc or above 1.6 cc are evidence of middle ear disorder. Because range is so wide, some mild middle ear disorders can be missed. If immittance is 0.2 cc than there is stiffness of middle ear mechanism.
3. Avoustic reflex threshold: If sound is presented to the ear stapedius muscle of both ears contract to increase impedance. If sound is applied to right ear. Ipsilateral right/uncrossed and contralateral left/crossed occurs. If sound is applied to left ear; contralateral right/crossed & ipsilateral left/uncrossed occurs.

Sound is presented at 85 dB at 500 to 4000 Hz frequency



So sound traveling along right VIII N causes an ipsilateral/uncrossed VII N response and a contralateral/crossed VII N response.

SPAR: is based on difference between acoustic reflex threshold for pure tone and broadband noise. Threshold to broadband noise is lower than pure tones signals. But in sensorineural loss threshold to broadband noise is higher than for pure tone.

Threshold measurement can also be used to distinguish between cochlear and retrocochlear loss. Reflex threshold occurs at reduced sensation level in cochlear loss and they are elevated or absent in retrocochlear lesion.

If tympanic membrane is perforated increase pressure is external canal until there is a sudden fall due to opening of eustachian tube. In healthy ears slight positive pressure remains. This test can also be done when patient is swallowing.

What are the Eustachian tube functions?

Tests for eustachain tube functions:

1. Tests that measure passage of air.
2. Tests that measures opening of tube.
   a. Valsalva: pinch nose and exhale with mouth cross.
   b. Toynbee: swallow with mouth closed.
   c. Step inflation/deflation tympanometry test: In cases of intact or perforated tympanic membrane, tympanometry can be done for testing function of eustachian tube. A negative and positive pressure –200 or +200 mm of water is created while patient is asked to swallow 5 times in 20 seconds. The ability to equilibrate the pressure suggests normal Eustachian tube function.

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d. Sonometry: It measures sound of opening of eustachain tube. Sound is applied in the nose and a microphone in the ear picks up the sound. SPL of 5 dB or more in the external canal indicates tubal opening.

What are the functions of Eustachain tube?

1. Pressure equalization.
2. Mucociliary clearance and drainage.
3. Middle ear protection.
4. Sound protection.

Describe the anatomy of Eustachain tube

It has bony 1/3 and cartilaginous 2/3. The opening in mesotympanum is oval to triangular and not dependent.

The bony part is related to temperomandibular joint laterally and inferiorly and middle cranial fossa superiorly, internal carotid artery is medial. In pneumatised mastoid 33% have peritubal cells.

The cartilaginous part has a large medial lamina and smaller lateral lamina. It is fixed in a groove in the greater wing of sphenoid. Nasopharyngeal end lies opposite posterior end of inferior turbinate.

Dilator of eustachain tube is tensor veli palatini muscle.

The fossa of Rosenmüller is related to petrous apex.

3. Otoacoustic emission is a test of outer hair cell functions
   - Spontaneous otoacoustic emissions occur without any sound stimulus. It is absent in ears with sensorineural loss above 30 dB. It is absent in 50% of normal ears. A microphone in the external canal measures this sound as it is absent in 50% of normal ears it cannot be used as a test
   - Evoked otoacoustic emissions have to be used. It is of two types, transient evoked otoacoustic emissions and distortion product otoacoustic emission
   - Transient evoke otoacoustic emission occur as a response to click signal at 80-85 dB. The responses are analyzed on a graph depicting amplitude versus frequency. If magnitude of emissions exceeds magnitude of signal and if reproducibility of emission exceeds predetermined level then emission is present and it is normal
   - In distortion product otoacoustic emission two tones are presented designated f1 and f2 and so distortion occurs. The best distortion is seen in the frequency 2 f1–f2. Tones are used from 1,000–6,000 HZ .This is plotted on a graph with frequency on x axis and amplitude in dB on y-axis. Emission should exceed normal background noise to be considered normal and it means outer hair cells are functioning well for f2 frequency
   - Otoacoustic emission is a good screening test for detecting hearing loss in children. It is used as a screening test in all countries for their universal hearing screening program.

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4. Auditory evoke potential
   - In response to sound, portions of the auditory system generates a waveform called auditory evoke potential
   - The waveform which occurs within 5 milliseconds of presentation of sound is electrocochleogram. This tests cochlea and proximal VIII nerve. Electrocochleogram has 3 responses: Summation potential, action potential and cochlear microphonics
   - Cochlear microphonics mimics stimulus
   - Action potential is response by nerve fibers
   - Summation potential precedes action potential
   - The important measurements are action potential latency, amplitude between SP and action potential
   - This is not an ideal test, as the probe has to be close to the promontory
   - The response which occurs within 10 milliseconds is auditory brainstem evoke response (ABR). This is the response from distal VIII N to mid brain
   - 50 millseconds MLR (middle latency reflex). This is the response from auditory cortex
   - 250 milliseconds the response is LLR or (late latency reflex). This is the response from primary auditory cortex and associated areas of cerebral cortex
   - These are all evoked by a single stimulus and have a transient nature
   - ASSR is auditory steady state potential and is recorded by modulating change in stimulus. Response to slower rate comes from central part of the system, while response to faster rate comes from peripheral system
   - Auditory brain stem evoke response (ABR) has 5 positive peaks.

   Wave I: distal end of VIII N 2 milliseconds
   Wave II: proximal portion of nerve near brain stem
   Wave III: proximal portion of nerve near brain stem and cochlear nucleus. 4 milliseconds.
   Wave IV and V: cochlear nucleus, superior olivary body, and lateral lemniscus. The inter peak latency from Wave I to Wave V is about 4 milliseconds.

   ABR:
   1. Can be recorded by surface electrodes.
   2. Response is not influenced by patient's condition such as sleep/sedation.
   3. Waves are uniformly produced and is constant across people.
   4. Interpeak intervals are prolonged in retrocochlear loss and so can be used to differentiate between cochlear and retrocochlear loss.
   5. To detect small tumors of VIII N, instead of using only high frequency range as is done normally, a broadband frequency is used and summated wave V results are used to detect small tumors. This is stacked ABR.
   6. Each laboratory has its own normative data.

MLR: It can be used to detect problems such as auditory processing disorder. It has two positive peaks.

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LLR: It has a negative and positive peak but it is not well developed in infancy and childhood, and is best seen only in the awake state. Abnormality or absence denotes auditory processing disorder.

What happens to ABR in conductive hearing loss?

A 30 db conductive hearing loss causes 90 db ABR waveform to resemble one elicited at 60 db in a normal ear. Absolute latencies are delayed but interwave latencies are not affected. Otoacoustic emission is absent in conductive hearing loss, if the loss prevents sound from reaching cochlea.

When is ABR considered abnormal?

ABR is abnormal if:
1. There is an interaural latency difference in I-V interpeak interval.
2. I-V interpeak interval.
3. Interaural difference in wave V frequency latency.
4. Absolute latency of wave V.
5. Interaural difference in V/I amplitude ratio.
6. Wave V/I amplitude ratio.
7. Selective loss of late waves.
8. Grossly degraded waveform morphology.
9. Cochlear hearing loss gives rise to acoustic reflex at reduced intensity. OAE is absent in cochlear hearing loss.

How is bone conduction perceived?

Sound travels by three routes to the cochlea
1. Skull bones to cochlea.
2. Skull bones → middle ear ossicles → cochlea.
3. Skull bones → external auditory canal → middle ear → cochlea

What is Carhart's notch?

In conductive hearing loss the 2 components of bone conduction hearing is missing, i.e. middle ear component and external auditory canal component. So there is a dip at 2 KHz in the audiogram in bone conduction. It was first seen in otosclerosis. It can occur in any conductive hearing loss.

What are the usual frequencies used to study air bone gap?

0.5, 1, 2 and sometimes 4 KHz. 10 dB gap is considered as loss. In otosclerosis, operate between 15-20 dB loss.

What is Carhart's effect?

The bone conduction curve improves by an average of 12 db over 0.5, 1 and 2 KHz after stapedectomy. This happens because, postoperative bone conduction curve appears to have improved in comparison to preoperative bone conduction curve, as external canal and middle ear factors have improved.

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What is overclosure?

When postoperative air conduction curve is tested with preoperative bone conduction curve, it appears to be better than bone conduction and is called overclosure. Overclosure is seen in otosclerosis surgery and not in other surgeries for conductive hearing loss because, other surgeries do not correct hearing impairment as well as stapedectomy does.

What are the contraindications for stapedectomy?

1. Associated Meneire's.
2. In unilateral otosclerosis, benefit is perceived only if hearing improves to match normal ear. The airbone gap has to close to 10 dB.
3. Refixed stapes.
4. Only hearing ear.

What are non-surgical methods of relieving deafness?

- Hearing aid: Its components are microphone, amplifier and receiver.
  Microphones may be directional—a microphone converts acoustic energy to electrical energy.
  Amplifier may be digital.
- Implantable aids:
  a. Implanted to ossicles
  b. Implanted to skull bone → bone anchored hearing aid.

What is Glasgow hearing aid benefit profile?

Glasgow hearing aid benefit profile is a preferred questionnaire to assess hearing aid benefit because, it measures all three parameters such as benefit, use, and satisfaction.

- It contains both standard and individualized measures to assess benefit
- It assesses direct benefit
- It also compares disability before and after rehabilitation.

Why are implant aids preferred over hearing aids?

i. Appearance
ii. Can be used in external canal occlusion
iii. Less distortion of sound
iv. Less feedback
v. Amplification is better
vi. Can be done in discharging ears.

- Cochlear implants
  a. Parts of implants:
     - Receiver/stimulator in bony recess; electrode array goes to cochlea. These form internal device
     - Microphone/microprocessor/transmitter coil form external device

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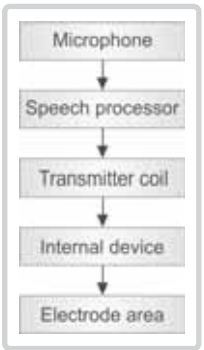
– Transmitter coil is magnetically coupled to the internal device (which has a magnet).



b. Types of cochlear implants generally used (name of device/country of origin):
   – Nucleus–Cochlear–Sydney Australia
   – MedEl–Innsbruck–Austria
   – Clarion–Advanced Bionic Device-California–USA
c. Conditions in which implant will work:
   – Normal cortical and central auditory system
   – Viable spiral ganglion cells and VIII N. The exact number of viable ganglion cells is not known, but at least 10% should be viable
   – Best if implanted before 2 years of age
   – Longer the duration of deafness worse the outcome in post lingual adults/children
   – Can be done even when some residual hearing is present
   – Loss of neural plasticity if deafness is of long duration. So implant may not work.
d. Investigations prior to surgical implantation:
   i. High resolution CT to look for ossified cochlea.
   ii. MRI–vestibular aqueduct
   Auditory nerve
   Internal acoustic meatus to rule out shwanomma
   Cochlear dysplasia
   Size of cochlear nerve gives an indication of number of spiral ganglion cells.
e. Surgical technique:
   – Standard postaural incision
   – Cortical mastoidectomy/posterior tympanotomy
   – Scala tympani entered via cochleostomy/use facial nerve monitor
   – Bony recess to fix receiver/stimulator
   If cochlea is ossified drill over modiolus and insert into scala vestibule.

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f. Complications:
   - Facial nerve palsy/stimulation of facial nerve
   - Device failure
   - Meningitis

How to do an MRI in an implantee?

1. Remove magnet surgically.
2. Scanner equipped with 1 tesla magnet allows MRI.

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Clinical Cases in ENT is an indispensable book for postgraduate students in otolaryngology. It is extremely useful in the early stages of their training, as the symptomatology has been discussed in detail and it also gives them an idea on how to proceed with examination of the patient. The investigations to be done and the method of treating the probable diagnosis will help them in managing the patients.

During the preparation for the postgraduate examination in otolaryngology, this book can be a ready reckoner.

The book can be a good source of reference for the practicing ENT surgeons as well as family practitioners.

This book can be useful to physicians, surgeons and pediatricians because some symptoms like vertigo, etc. can present in a number of departments.

Geetha Chary MBBS MS DLO has been teaching undergraduates and postgraduates for the past three decades. She graduated from Kilpauk Medical College, Chennai, Tamil Nadu, India, and completed her postgraduate training from the Institute of Otorhinolaryngology, Madras Medical College, Chennai. She is an undergraduate and postgraduate examiner in various universities.



She carries with her rich experience of working as Professor and Head of the Department of ENT and Head & Neck Surgery in various institutions such as MS Ramaiah Medical College, Bengaluru, Karanataka, India, and St John's National Academy of Health Sciences, Bengaluru.

During the inception of Rajiv Gandhi University of Health Sciences, Bengaluru, she was on the Board of Studies for postgraduate courses and has been responsible for the curriculum for postgraduate studies.

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