

TYMPANOMETRY AND REFLEXES

Amal Abu Kteish
aabukteish@birzeit.edu

TYMPANOMETRY

- Is a test of middle-ear function by measuring the middle-ear pressure (the mobility of the tympanic membrane)
- One of the audiological test battery procedures

TYMPANOMETER COMPONENTS

- Three main tubes in the probe (probe tube)
 - 1- loudspeaker: generates the tone and is transmitted through the speaker (low pitch constant sound into the ear canal, 226 Hz for adults and 1k Hz for children less than 6 months years old).
 - 2- microphone: picks up the sound in the external ear canal
 - 3- manometer: pressure pump (ranges from – 400 to + 200)
- Probe tip according to ear canal size

What does it measure?

- Impedance (mobility) of the TM & Ossicles when exposed to pressure.
- Ear canal volume.
- Pressure in the ME.

Physics of the Tympanogram

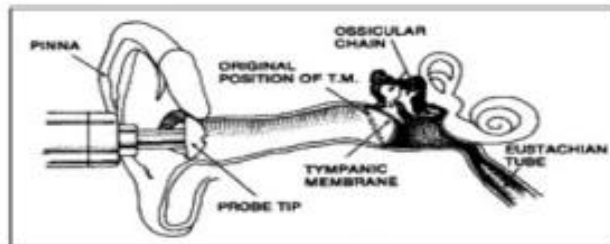
- The tympanometer measures the "admittance" or "compliance" of the tympanic membrane while different pressures are being applied to the external ear canal.
- The compliance of the TM is measured in cubic centimeters, and the pressure in the ear canal is measured in decapascals (daPa).
- The probe has different size "plugs" that provide a seal at the entrance to the external ear canal. The tip of the probe has a pressure transducer that changes the pressure in the external ear canal from negative, through atmospheric pressure, to positive pressure (-400 to +200). While the pressure is changing, a sound transmitter sends a sound wave to the tympanic membrane. The wave that is reflected from the TM is then picked up by a microphone in the probe. The tympanometer measures the energy of the reflected sound.



Physics of the Tympanogram

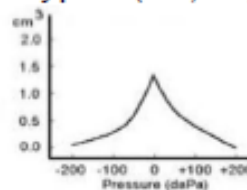
- A normal ear drum absorbs most of the sound so the least amount of sound is reflected toward the microphone.
- A tympanic membrane that is bulging or retracted it ends up stiff which results in less sounds absorbed and more sound reflected back to the chamber.





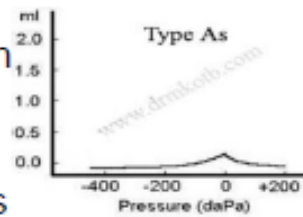
Results

- According to the shape of the graph , tympanogram is divided into 3 basic types (A,B,C) and 2 subtypes (As,Ad).
- Type A
 - ECV for children 0.3-0.9, and for adults 0.9-2.0
 - Admittance/compliance 0.3 to 1.7
 - Pressure -50 to +50



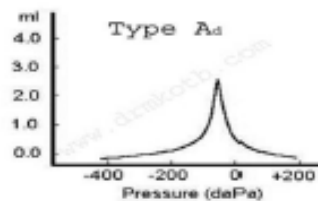
Results

- Type As
 - Normal ECV and normal pressure, but the peak compliance is shallower ≤ 0.2
 - It is often associated with tympanic membrane scarring and ossicular fixation and may result in fairly flat hearing loss with normal Eustachian tube function



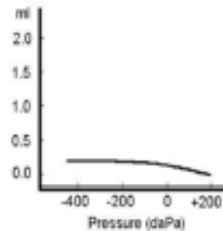
Results

- Type Ad
 - Normal ECV and normal pressure, but the peak compliance is very high /off chart
 - it is associated with ossicular disarticulation and may result in fluctuating, flat hearing loss with normal Eustachian tube function



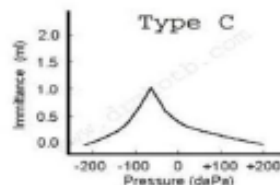
Results

- Type B (Flat)
 - Normal ECV, but the pressure is below -50 (dapa)
 - It indicates the presence of middle ear Effusion (fluid) behind the tympanic membrane.



Results

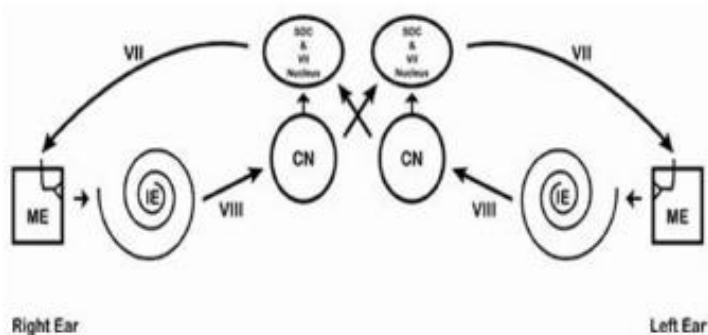
- Type C
 - Normal ECV and normal compliance, but peak pressure is below -50(dapa).
 - The peak falls on the negative middle ear side of the chart indicating negative middle ear pressure, usually consistent with Eustachian tube dysfunction, allergy, or the end stages of ear infection or cold.



ACOUSTIC REFLEXES

- What is an acoustic reflex?
- The reflexive contraction of the stapedius muscle in response to a loud sound. This causes the tympanic membrane to stiffen.
- Acoustic reflex threshold is the softest sound that can cause a reflex of the stapedius muscle.
- The reflex is presented as a deflection (curve) on the immittance monitor.
- Stimulus levels may be measured SPL, SL, or HL

Acoustic Reflex Pathway

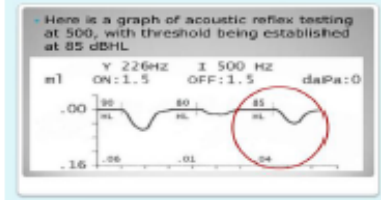


Acoustic Reflex Measurement

- Stimulation of one ear leads to reflex contractions in both ears.
- Two types ipsilateral and contralateral.
- The ear with the probe in (being tested) = probe ear.
- The ear receiving stimulus sound= stimulus ear.
 - For ipsilateral, a probe with a built in receiver is used.
 - For contralateral, a probe is in the probe ear, and an ear phone/insert receiver is placed in the stimulus ear.
- Contralateral testing: sending the sound through one ear and across the auditory pathway and monitoring the reflex of the opposite ear.
- Ipsilateral Testing: sending the sound through one ear and across the auditory pathway and monitoring the reflex of the same ear.
- Terminology: identify by stimulus and configuration.
 Left contralateral: stimulus is in the left ear and the probe is in the right ear
 Right ipsilateral: stimulus and probe are in the right ear.

Procedure

- The signal used is called "reflex-activating stimulus (RAS)", it can be a pure tone or BBN.
- tested frequencies: 500, 1000, 2000 Hz and 4000Hz.

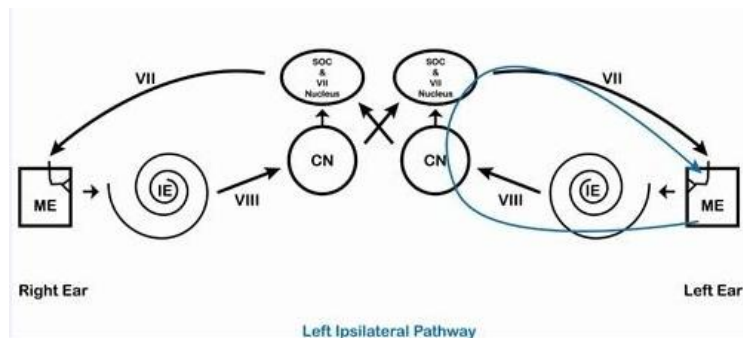


- A response is when a change in compliance is observed. It is seen as "dips" by a minimum size of 0.02 mmho.
- The louder the tone, the larger reflex.

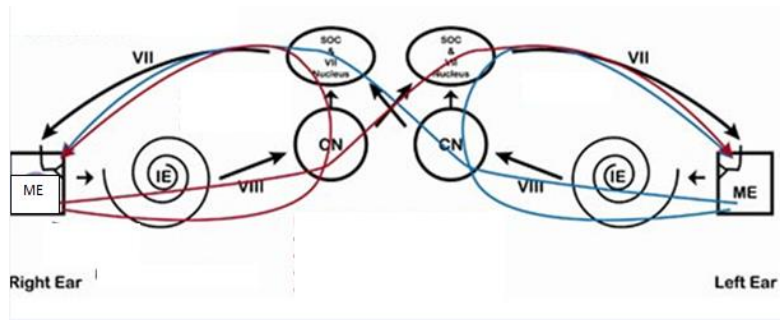
Results

- Normal ART ranges from 85-100 dB SPL in pure tone stimuli.
- BBN thresholds are usually 20 dB less than pure tone.
- In HL, the responses range from 80-90 for pure tone stimuli and about 20 dB less for BBN.

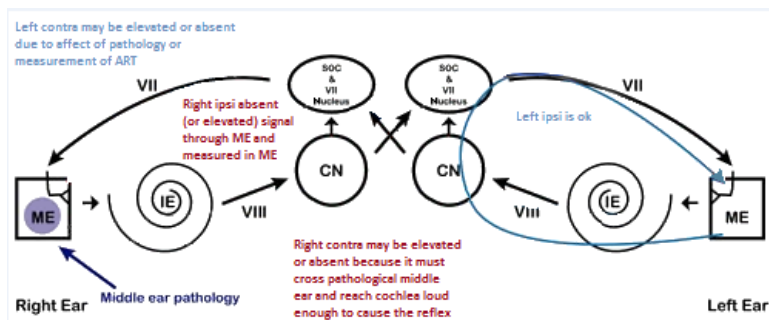
LEFT IPSILATERAL PATHWAY



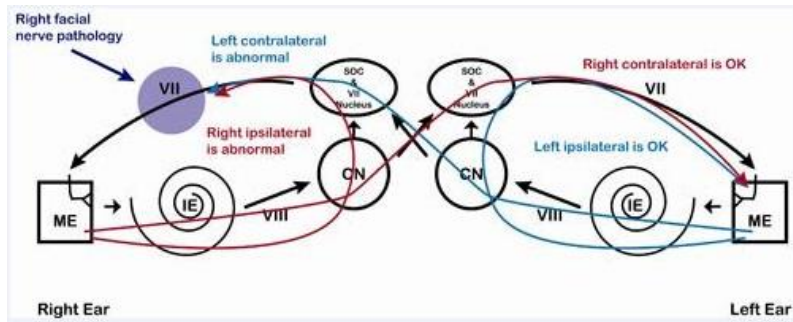
IPSI AND CONTRALATERAL PATHWAYS



RIGHT MIDDLE EAR PATHOLOGY



RIGHT FACIAL NERVE PATHOLOGY



TUMOR

