Tympanometric results from neonates and infants under four months

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Abstract

Advantages of objective studying the middle ear of infants and neonates are presented. High frequency timpanometry is proposed and used because of anatomical differences between children and adults. This method is used widely in diagnosing , because he is noninvasive, quick and easy to perform.

Introduction

The process of hearing begins with a simple interaction between the mechanical energy of the sound wave and the hearing analyzer. Clinical audiology uses different methods of testing and techniques for the accurate diagnosis of the hearing function. Acoustic impedancemetry gives us information about the functional capacity of the hearing analyzer and abnormalities in hearing.

In 1990, ASHA (American Speech-lanquage Hearing Association) recommends immittance testing to screen middle- ear diseases. Silverman and Arick (1992) create an immittance protocol for the early detection of otitis media with effusion in children. Katz (1994) defines this method as a routine, objective and sensitive for determining pathologies in the middle ear.

Significant hearing loss is one of the most common major abnormalities present at bird and, if undetected, will impede speech, language and cognitive development.

The hearing screening should detect all infants with significant bilateral hearing impairment, i.e. those with hearing loss $\geq$ 35 decibel in the better ear.

Conductive hearing impairment are interruption of sound transmission due to absence, malformation or dysfunction of the outer ear, ear canal, ear drum or ossicles of the middle ear.

Methods

How are tympanograms recorded?

The tympanometer is comprised of three small plastic tubes, which are attached to a metal probe. The three plastic tubes are connected to:

- a miniature loudspeaker, which emits a pure tone
- a tiny microphone, which picks up the sound of the ear canal
- air pump, which can create either positive or negative pressure within the ear canal.

Results from the tympanometer are placed on a tympanogram which plots the compliance (mobility) of the eardrum on the Y axis versus the ear pressure of the ear which is measured in daPa (dekapaskals) on the X axis.

New and advanced middle-ear analysis techniques are developed for testing mechano-acoustic properties of the normal and diseased middle ear in newborns and children. The Interacoustics AT 235 h is an automatic impedance audiometer well suited for clinics doing screening, as well diagnostic work.

Pediatric audiological assessment protocol emphasize a battery approach to confirmation of hearing impairment in infants. The best protocol for testing newborn include: ABR + OAE + Middle Ear Tests.

The typical algorithm includes physical diagnostic measures:

- Auditory Brainstem Response testing to establish a minimal response level to click
- Acoustic immittance measures to assess middle ear mobility and status
- Otoacoustic Emissions testing to evaluate outher cell function.

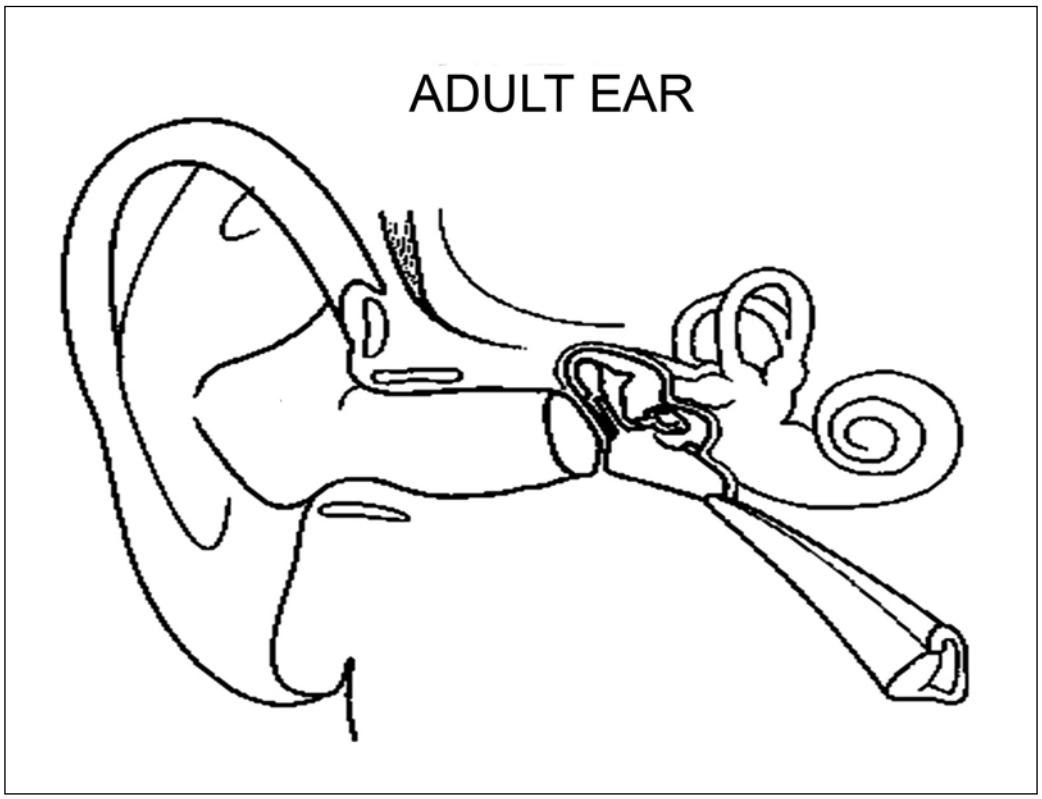
Huggard and Lutman (1990) describe the advantages of tympanometry as :

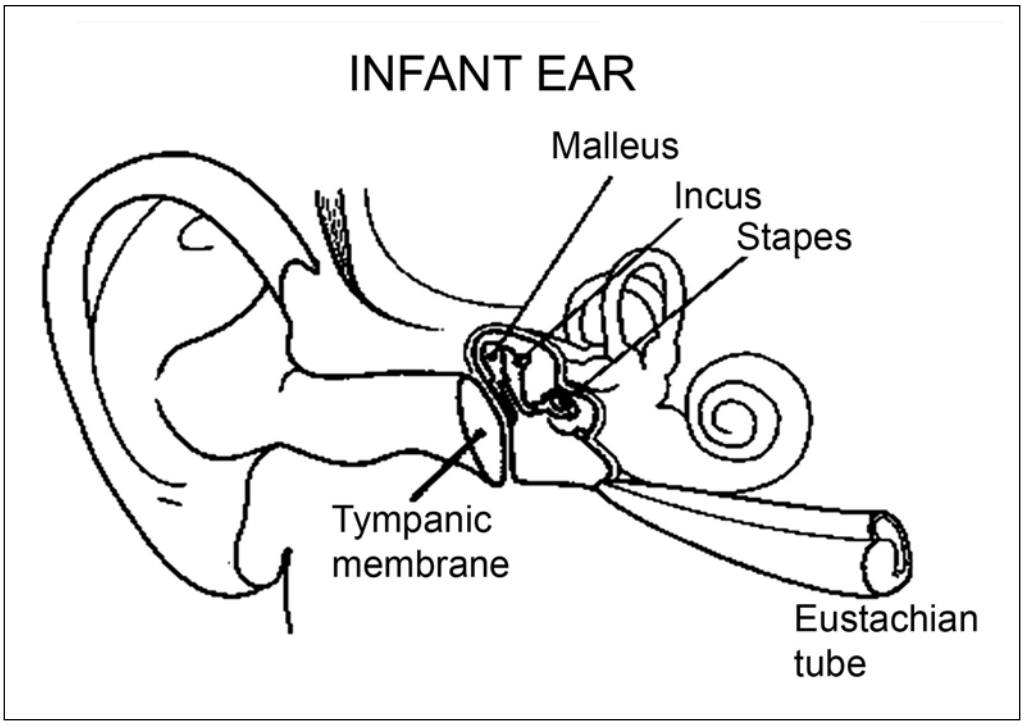
- An easy procedure;
- Comparable data from the different laboratories;
- The measure of immittance has certain advantages, especially combined with other methods;
- The documented results prove objectively the occurrence of change in the middle ear.
- The methodology is noninvasive, quick and easy to perform.

Recommended test protocol for Tympanometry

- Oto-admittance testing (tympanometry) in the first few mounths of live
- Evidence suggests that tympanometry can be used to help identify middle ear effusion (MEE) at this age, provided a higher frequency probe tone is used.

Using HFT measurements we do middle ear assessment in infants. Tympanograms collected from infants ears are different from those from adults ears.





External and middle ear changes after birth that could account for the acoustic alteration includes :

- size increased of the external ear, middle ear cavity and masyoid
- change in orientation of the tympanic membrane
- fussion of the tympanic ring
- decrease in the overall mass of the middle ear (due to changes in the bone density, loss of mesenhyme)
- ightening of the ossicular joints
- closer coupling of the stapes to the ligamentum anulare
- the formation the bony ear canal wall.

The infants middle ear is a mass-dominated system with a lower resonant frequency.

Disscussion

Tympanograms in pediatric audiology are most commonly used to identify the presence of middle ear fluid i.e. effusion.

It is clearly required immittance measurements use in diagnostic testing when neonatal screening ABR and OAE are abnormal.

Best chaice of a tympanometric probe frequency for neonates and infant is 1000 Hz. It is recommended that high-frequency immittance measurements be included in a battery of test to identify any abnormality in an infant's hearing, but they are most effective when they are incorporated along with ABR and OAE results.

Key points from literature:

- Normal 220 Hz tympanograms may be found in ears with confirmed MEE;
- Abnormal 220 Hz tympanograms may be found in presumed normal ears;
- Good agreement between higher probe tone frequency tympanometry and MEE presence;
- Good agreement between 1000 Hz tympanometry and ABR results.

Neonatal screening programs well particularly appreciate the presence of high probe tone tympanometry, allowing more reliable tympanometric results in neonates.

Using HFT measurements we do middle ear assessment in infants.

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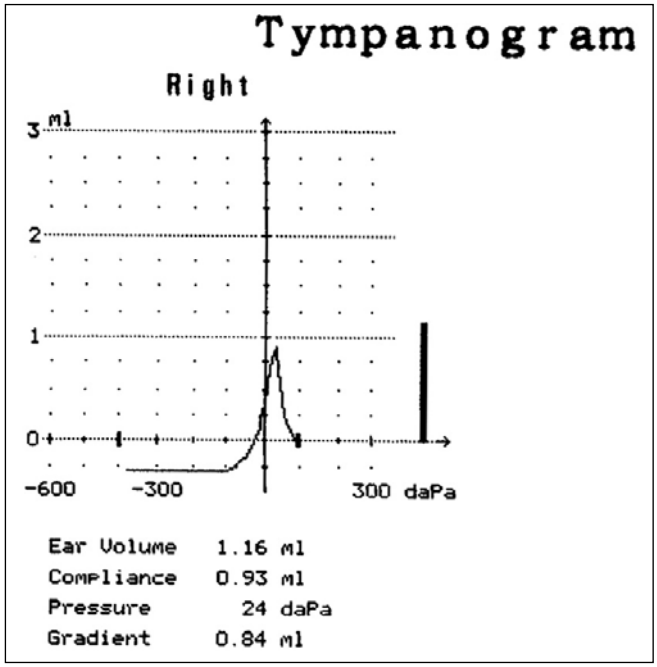
Advantages

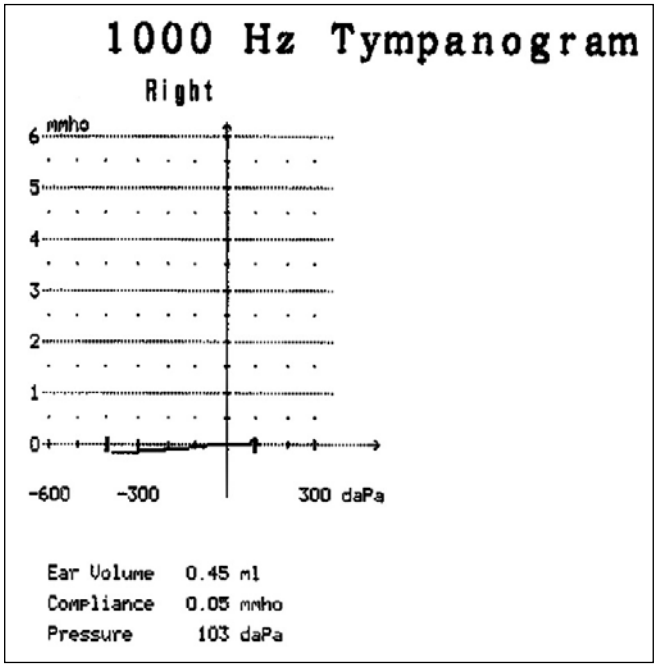
- Bellow 4 months of age, a high frequency probe tone must be used because of the different resonance characteristics of the middle ear. Any effects of ear canal wall movement are else minimized by using higher probe tones.

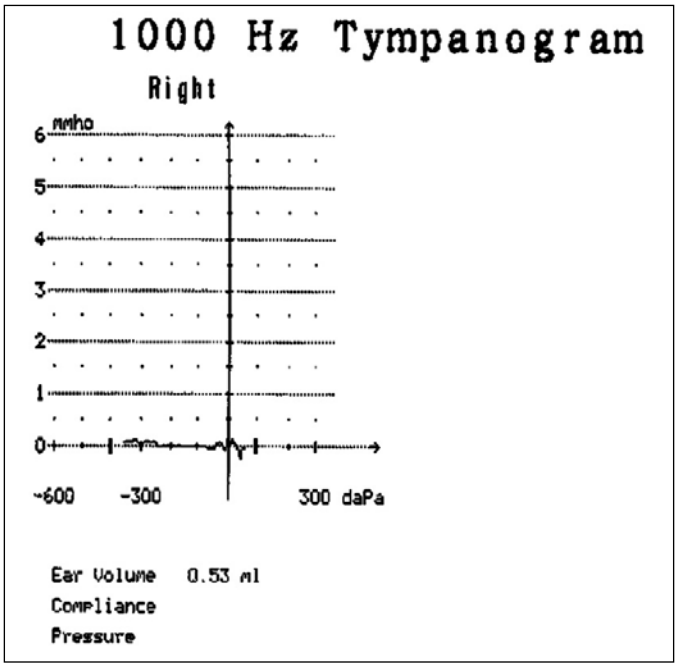
High frequency tympanometry appear to be valid (i.e. reasonably sensitive and specific) in detecting MEE below 4 months.

Current literature recommendation include the following:

- Bellow 4-7 months of age 1000 Hz probe tone should be used for detecting middle ear effusion.
- The following 1000Hz tympanograms are consider normal single or double-peaked curves.
- If normal data are not available for the specific age group, is considered indicative of effusion.
- It is recommended that high-frequency immittance measurements be included in a battery of tests to identify any abnormality in an infants hearing.
- There have been reports of infants with normal 226 HZ tymps despite confirmed middle ear effusion.





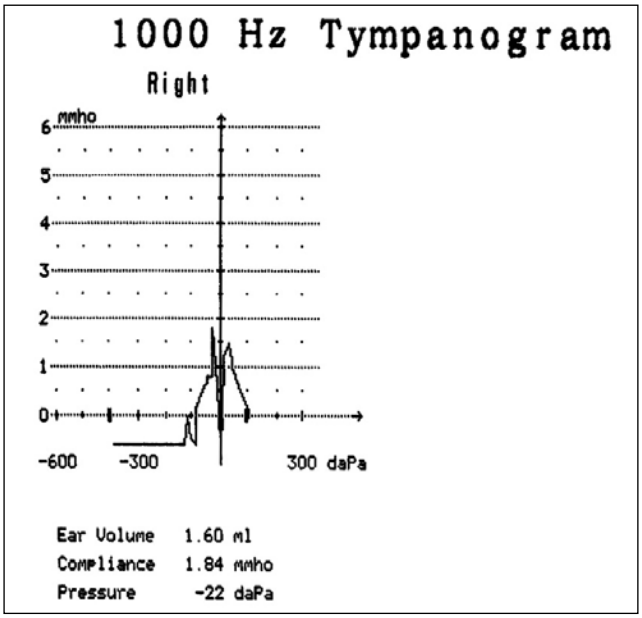


Interpretation

- Normal pressure from + 200 to – 400 daPa
- Identify the mean peak
- Measure pressure at peak (middle ear pressure MEP)

Normal if Y ≥ O and MEP ≥ – 200 daPa
Abnormal if Y ≤ O or MEP ≤ – 200 daPa

Positive MEP is more common in this group, with no clinical significance. Multipeaked tympanograms should considered to be normal.



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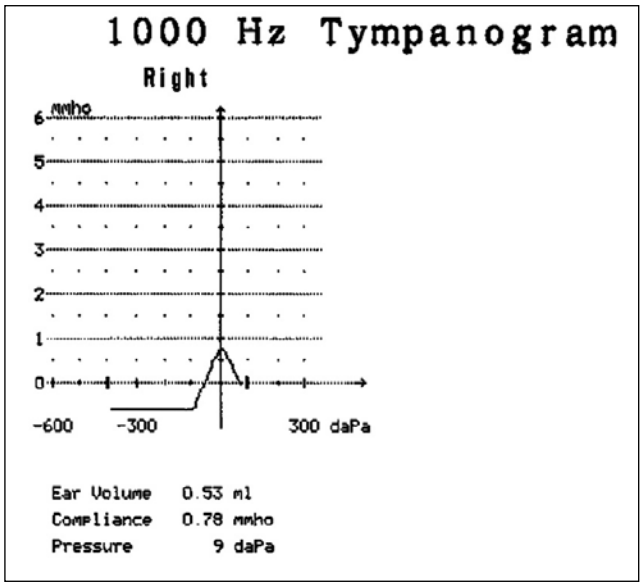

Conclusion

Tympanometry can assist in diagnosis but should be considered in conjunction with any other results.
HFT is more useful than conventional tympanometry in detecting MEE in neonates.
We recommended the use of 1000 Hz probe tone tympanometry to test babies under 4 months .

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