What is The Best Tympanometric Protocols for Testing Newborns?

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Why Tympanograms are Different in Newborns

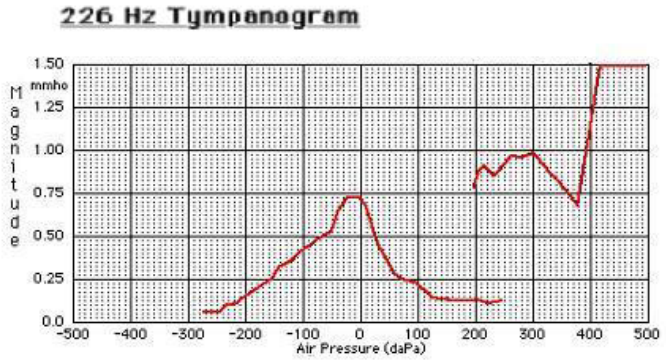
- The external ear and middle-ear in infants will undergo some structural changes that can affect the mechano-acoustical properties of conductive mechanism. (Keefe et al, 1993; Keefe and Levi, 1996).
  - The external auditory canal will increase in size and becomes less compliant (due the formation of the bone) post-natally until about one year of age (Anson & Donaldson (1981). This can potentially reduce the resonance gain and shift the resonant frequency of the canal to the higher value in younger infants;
  - growth of middle-ear cavity from the tympanic membrane to the stapes footplate in the first 6 months after birth Eby & Nadol (1986) and an increase in pneumatization of mastoid air cells which will contribute to the enlargement of volume in the middle-ear cavity . The volume of air is important in determining the tympanic membrane compliance and controlling the conduction of low frequencies;
  - a decrease in the overall mass of the middle-ear due to presence amniotic fluid and mesenchyme in the middle-ear cavity which may last for up to 5 months after birth Paparella et al. (1980); a decreases in the density of stapes due to internal bone erosion which could lead to a reduction in mass for this structure,
  - tightening of the osssicle joints and stapes footplate attachment to the oval window which may decrease the resistive component

What Would be the Effect of These Changes on the Tympanogram?

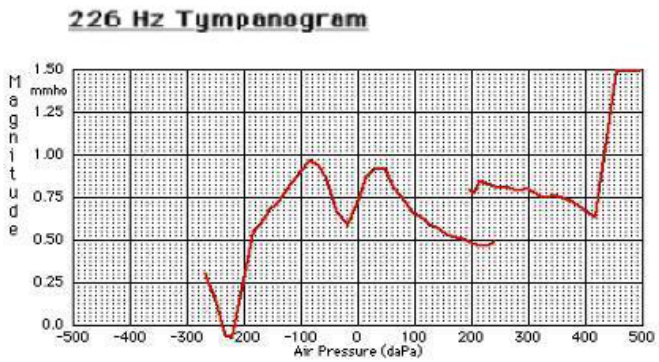
- The overall maturation of the external and middle-ear may result in an increase in mass at birth which will gradually decrease as infants become older. This prediction has been confirmed by multi-frequency tympanometry (Holte et al., 1993; Shahnaz, 2002)

Typical Tympanograms Seen in Normal Newborns

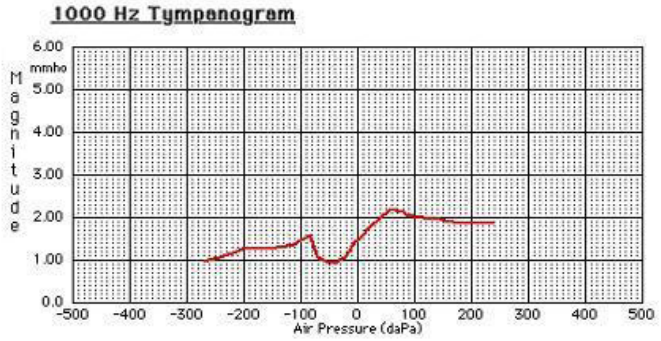
Adult



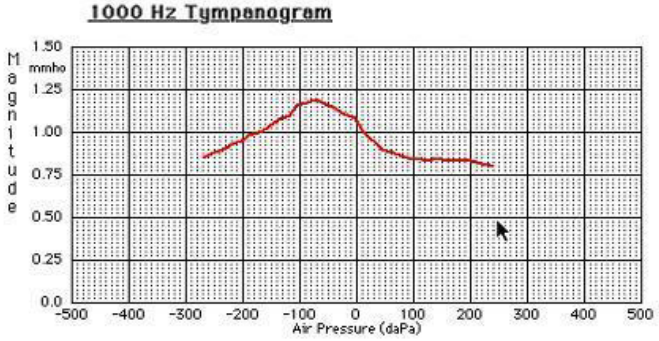
Newborn



Adult

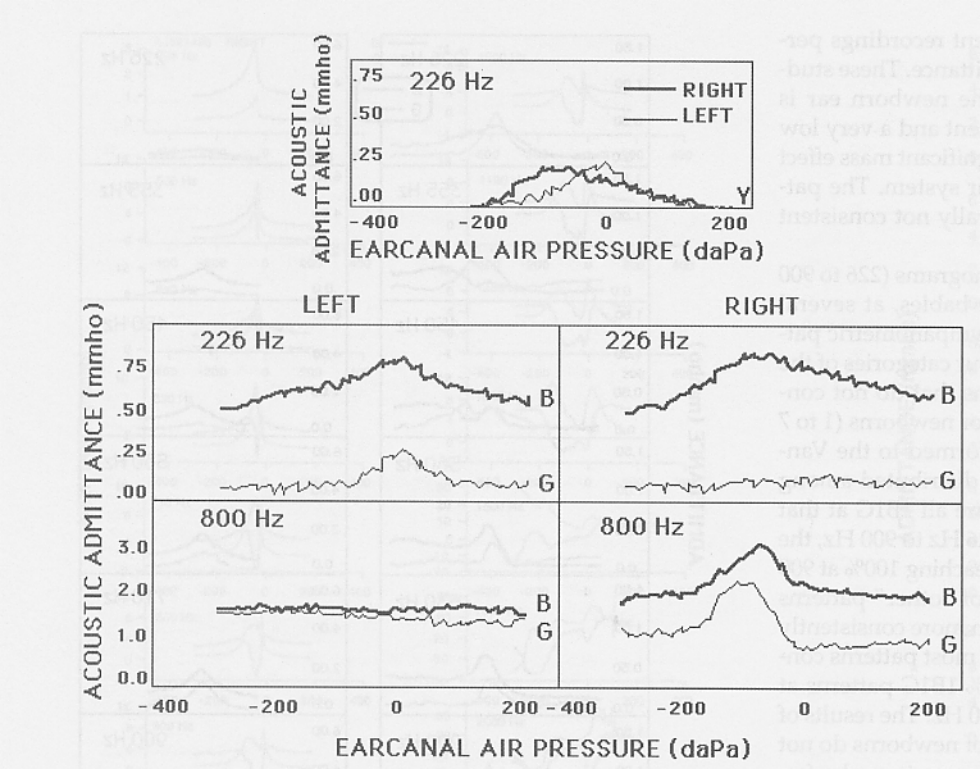


Newborn



Shahnaz, 2002;

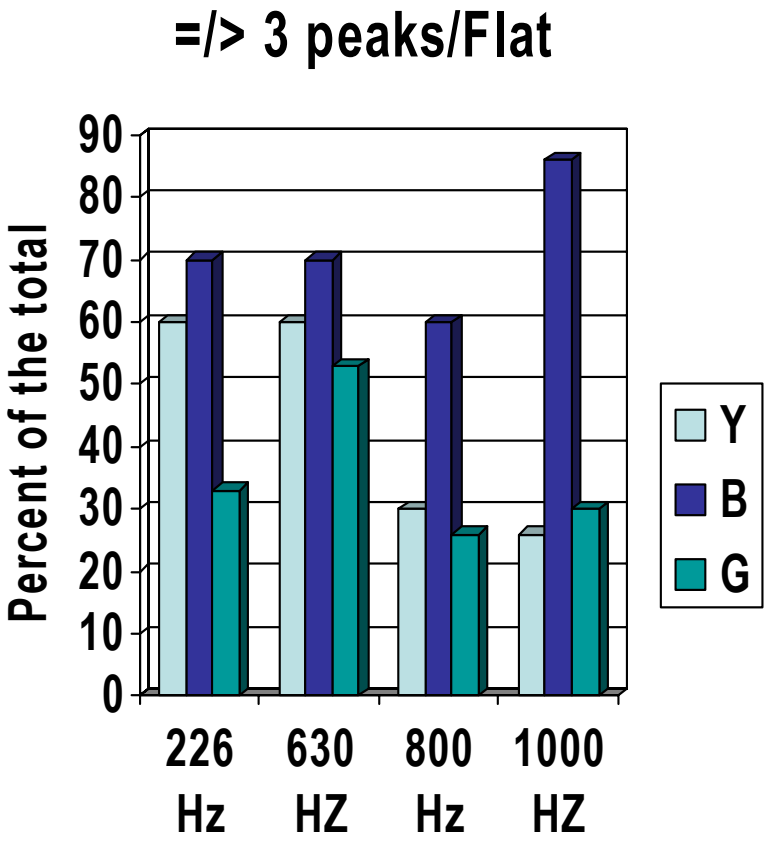
Typical Tympanogram Seen in an Abnormal Newborn



Margolis & Hunter, 1999

Results (Shahnaz, 2002)

- While eighteen ears had multiple peak or irregular patterns on Y tympanogram at standard low probe tone frequency (226 Hz), 22 ears had a single peak and essentially normal shape tympanogram on G component at 800 Hz and Y @ either 800 or 1000 Hz.
- One infant who failed Algo-II protocol in both ears at the time of birth and at 3-weeks of age, had an irregular Y tympanogram at 226 Hz and single peak G tympanogram at 800 Hz. This infant was later diagnosed to have a moderate to severe bilateral sensorineural



Results (Polka, Shahnaz, Zeitoni, 2002)

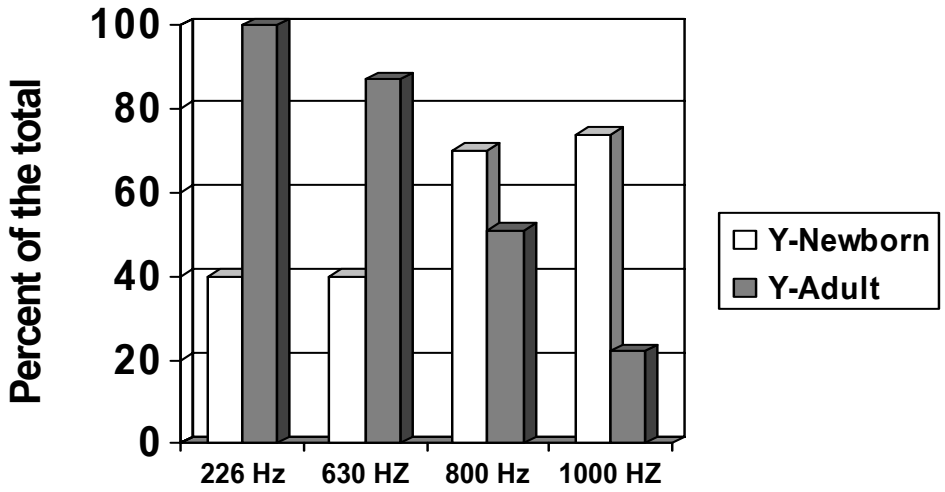
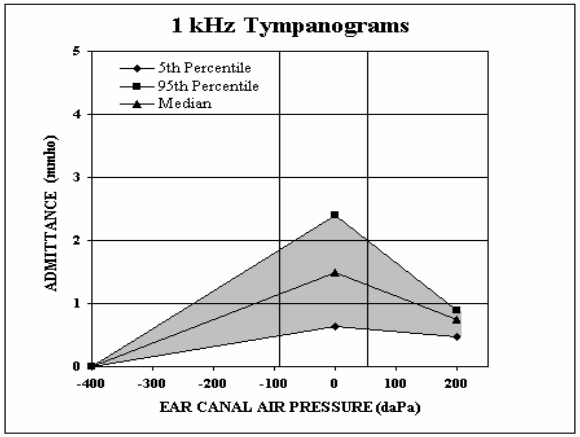


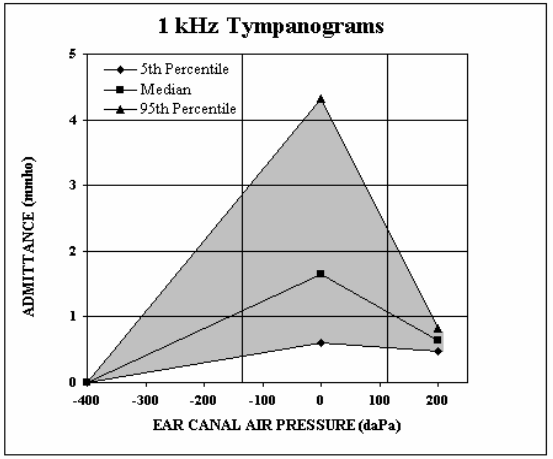
Figure 2: Proportion of single peak admittance (Y) tympanogram in newborn infants and young adults across four different probe tone frequency.

Results – Margolis et al, 2003

- Normative data presented for NICU graduates tested at a mean age of 3.7 weeks and full-term infants tested at 2-4 weeks who passed an otoacoustic emissions (OAE) screen
- The 5th percentile for static admittance for NICU and full-term babies was identical, allowing a single pass-fail criterion (Static Y)



NICU



Full term

Margolis et al., 2003

	TPP (daPa)	Y +200	Y -400	Y Peak	Comp Y (+200)	Comp Y (-400)
Mean	-10	1.4	0.8	2.7	1.3	1.9
S.D.	68	0.4	0.4	1.2	1.0	1.3
Max	200	2.3	1.7	7.0	5.0	6.0
Min	-200	0.7	0.0	0.8	0.0	0.1
5th %ile	-133	0.8	0.3	1.2	0.1	0.6
95th %ile	113	2.2	1.4	4.8	3.5	4.3
50th %ile	0	1.4	0.8	2.5	1.0	1.7

Normative tympanometric values from 1-kHz tympanograms from 46 ears of 30 full-term babies tested at 2-4 weeks chronological age.

Summary

- Recommend the use of 1000Hz probe tone tymapanometry to test babies under 6 months using Y-tympanogram
- Adapt Margolis et al, 2003 norms until more data become available
- Tympanometry using 220 Hz should not be used.
- Equipment improvements are needed to meet audiologists' needs for simplicity and ease of use.
- More data are need on interpretation of traces and validation of results.

Thank You