BIAP Recommendation 12/8

Part 12/8.1.1 and 12/8.1.2 Otoscopy and Impedance Measurement

(as part of the assessment of middle ear ventilation problems and conductive hearing losses after newborn hearing screening)

General foreword

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Introduction

Middle ear ventilation problems and conductive hearing losses are a relevant obstacle in the hearing assessment of children after newborn hearing screening. In a good quality hearing screening program 10 -40 of a 1000 newborns (1-4%) will fail the screening and 1-2 infants will have a permanent bilateral hearing loss. Most of the other children will have failed the screening because of a middle ear ventilation problem. - Research shows that 50% of all the children having middle ear effusion as a neonate will have reoccurring and prolonged middle ear problems in the following months. Therefore in the hearing assessment of children after newborn hearing screening a high number of cases will be affected by middle ear problems.

Recommendation

The assessment of conductive hearing losses include the following procedures:

1. otoscopy, ear-microscopy
2. tympanometry
3. stapedius reflexes
4. OAE
5. bone conduction measurement with BOA or ABR.

Using these procedures with infants younger than 6 month, some considerations and adaptions are necessary:

1. Otoscopy and Ear-Microscopy:
   With babies the external ear canal can be very narrow and it might even collapse,

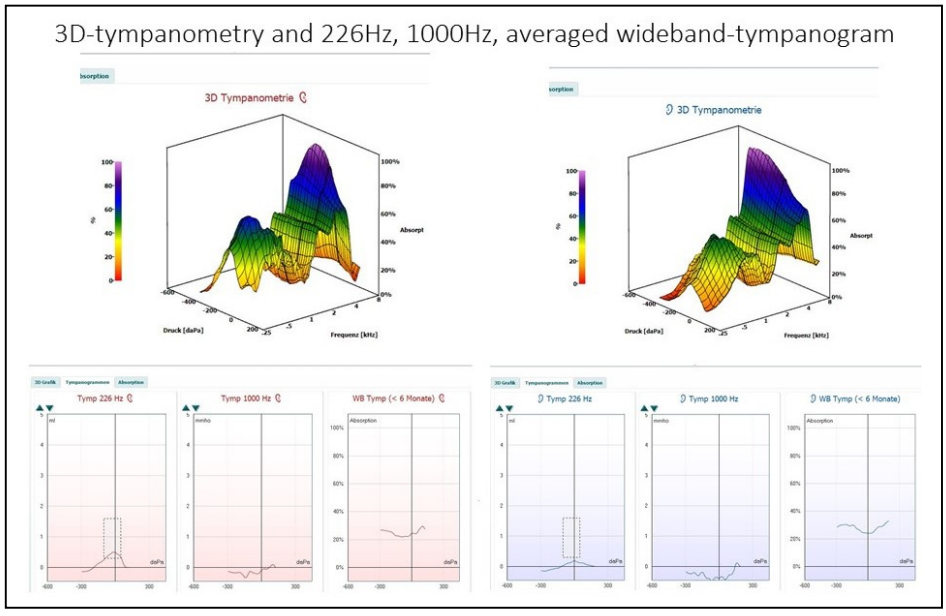
so that it can be very difficult or impossible to get a sufficient look at the eardrum (even with an ear microscope). A collapsing ear canal will also affect any measurement using an ear canal probe (like: tympanometry, OAE, insert earphone). Additionally the eardrum of a baby has a more flat angle, so that the top view on the tympanic membrane gets further limited. With these limitations in mind it is often not possible to assess the middle ear status of a baby reliable enough through ear microscopy (not to mention through an otoscope).

In case of an ear canal stenosis or partial atresia an observational judgment of the tympanic membrane is no longer possible. Even a differentiation between a stenosis and a partial atresia can be very difficult by inspection alone.

2. Tympanometry:

Due to a smaller ear canal volume (with a higher resonance frequency), a softer tissue of the walls of the ear canal and a different acoustic impedance of the tympanic membrane and the middle ear apparatus the standard tympanometry with a 226 Hz probe tone may lead to falsely normal tympanograms in babies with a middle ear effusion or to falsely pathological tympanograms in babies without effusion. With babies younger than 6 months it is therefore necessary to use a higher probe tone (mostly used are 1000 Hz) for getting more reliable results. But as the tympanogram is a complex function of the sound absorption and sound reflection of the ear canal walls and the tympanic membrane, the frequency of the probe tone and the pressure in the ear canal the ideal frequency to measure the tympanogram may differ from patient to patient.

a. Tympanometry with 1000 Hz probe tone: With babies less than 6 months a 1000 Hz -tympanogram helps to differentiate better and more reliable between ears with and without middle ear effusion. But a number of results, especially with a very small or a broadened maximum, will stay inconclusive or hard to interpret.



Example of a 3D WB-tympanogram (Interacoustics Titan):

5 month old child with a questionable 226Hz tympanogram and a flat 1000Hz and a flat averaged WB-tympanogram

b. Wideband Averaged Tympanogram: A wideband tympanometry takes the same amount of effort and time to perform as a standard tympanogram. But the clinical information which is acquired during this time is far greater than what can be achieved by of a single frequency testing of 226 Hz or 1000 Hz alone. Studies show that for babies averaging all of the tympanograms achieved in the frequency range between 800 Hz and 2000 Hz provides a more robust information about the middle ear status than single frequency testing. Additionally the graphs of the absorbance characteristics of the middle ear at peak tympanic pressure helps to distinguish between different middle ear pathologies.

3. Stapedius Reflexes: A proof of stapedius reflexes rules out a severe or profound hearing loss and the stapedius reflex threshold may give a hint about the existence of recruitment and the area of uncomfortable loudness. But stapedius reflexes do not rule out any mild or moderate hearing loss, especially they are no proof of normal hearing. For the measurement the babies have to be quiet (don't cry and don't move) for a significant amount of time, therefore in quite a number of cases it can be quite difficult or impossible to obtain reliable results.

4. OAEs are normally not considered an assessment tool for middle ear pathology. But the confirmation of OAEs will make any relevant conductive hearing loss (including middle ear effusion) very unlikely.

5. For bone conduction measurement you are referred to the part of the recommendation about bone conduction BOA and about bone conduction ABR. Please take into account that calibration issues for using a bone conductor (which is calibrated for an adult head) on the head of a baby are still unsolved. The volume of the head of a baby is much smaller, the bone is much softer and the sutures are still not closed. Therefore it can be expected that in many cases the sound pressure level that reaches the inner ear in the bone conduction measurement of babies is higher than in adults or older children. A difference of 10-20 dB is discussed especially in low frequencies.

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This recommendation was created and approved in a multidisciplinary cooperation between professionals of all audiophonologic disciplines, which are medicine, pedagogy, speech therapy, psychology and hearing instrument audiology.

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