Behavioural Audiometry for Infants and Young Children

Whose hearing loss has been detected in infancy

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Diagnosis and Management of Hearing Loss in Children

• Quantify the type, degree and configuration of hearing loss as accurately as possible
  • Understand the likely impact of hearing loss
  • Identify range of intervention options
    • Benefits and limitations
  • Behavioural thresholds are the gold standard for defining hearing when the child can be conditioned to respond reliably to sound

• Explain the results and options to parents/carers

• Parents and clinician agree on the management plan
Behavioural Assessment

Birth → 7 mth → 2.5 yrs

- Behavioural Observation
- Visual Reinforcement / Conditioned Orientation Response
- Play Audiometry

Best correlation with threshold
Behavioural Observation

• Observe subtle *unconditioned* changes in behaviour in response to sound
  • Eye turn, eye widen, sucking, alerting, stilling

• **Minimum Response Level (MRL) is not a threshold**
  • Dependent upon infant’s age and state during testing
  • Responses likely to be suprathreshold
  • Correlation with Pure Tone Thresholds is variable
Unconditioned responses vary with age

<table>
<thead>
<tr>
<th>Age</th>
<th>MRL (noisemakers)</th>
<th>MRL Warble tones</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6 weeks</td>
<td>50-70 dBSPL</td>
<td>75 dBHL</td>
</tr>
<tr>
<td>6 weeks – 4 mths</td>
<td>50-60 dBSPL</td>
<td>70 dBHL</td>
</tr>
<tr>
<td>4-7 mths</td>
<td>40-50 dBSPL</td>
<td>50 dBHL</td>
</tr>
<tr>
<td>7-9 mths</td>
<td>30-40 dBSPL</td>
<td>45dBHL</td>
</tr>
</tbody>
</table>

Reference: Northern and Downs 2002
Unconditioned responses

- Thompson & Bruce, 1974: 190 Normally hearing infants age 3-59 mths
  - 10% responded < 20dB SPL
  - 50% responded < 50dB SPL
  - 90% responded < 88dB SPL
  - Children who could be reliably tested with both BOA & play audiometry responded to softer sounds using play audiometry
Is BOA still relevant in 2014?

For children who have a cochlear hearing loss

- Evoked Potentials provide the most accurate threshold estimation
- BOA may be useful for parent education
  - Demonstrate subtlety of infant hearing responses
  - Demonstrate change in response levels when comparing aided & unaided conditions
- Lack of exposure to sound can impact upon unconditioned responses
  - May not be a useful demonstration at first fitting appointment
Is BOA still relevant in 2014?

For children who have Auditory Neuropathy Spectrum Disorder

- Evoked Potentials do not correlate with behavioural thresholds
- BOA forms part of the test battery
  - Combine with Cortical Auditory Evoked Potentials and functional hearing assessment (eg PEACH, Ching et al, 2007)
- Consider amplification if responses consistently poorer than age-appropriate responses
Case Study – child M
born 29 weeks gestation, surviving twin

<table>
<thead>
<tr>
<th>Corrected Age (weeks)</th>
<th>Best Minimum Response Level dB(A)</th>
<th>Age Ave. MRL for Normal Hearing dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>55-60 (light sleep)</td>
<td>50-70</td>
</tr>
<tr>
<td>11</td>
<td>70 (deep sleep)</td>
<td>50-60</td>
</tr>
<tr>
<td>16</td>
<td>60 (awake, calm)</td>
<td>40-50</td>
</tr>
<tr>
<td>19</td>
<td>55 (awake, calm)</td>
<td>40-50</td>
</tr>
</tbody>
</table>
Audiogram
Infants who have a mild hearing loss

• Evoked potentials are used to estimate behavioural hearing thresholds
  • Based upon statistical relationships

• When the evoked potential threshold suggests a mild hearing loss be aware that some infants may have normal behavioural thresholds
Evoked Potentials and Mild Hearing Loss

- ABR (dBnHL) = Estimated Behavioural threshold ± 1 SD

Behavioural threshold (dBHL) = ABR (dBnHL) + correction

Air Conduction

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>500</th>
<th>2000</th>
<th>4000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-10</td>
<td>0</td>
<td>+5</td>
</tr>
</tbody>
</table>

Add this figure to the ABR threshold in dBnHL

Standard Deviation (used for determining deterioration)

- 10dB
- 10dB
- 15dB

Van Der Werff et al 2009

Hear the sounds you love
Infants who have a mild hearing loss

- In this instance it is usually advisable to obtain further behavioural data before deciding whether or not to provide amplification
  - Visual Reinforcement Audiometry
  - Track progress with functional questionnaire such as PEACH – compare to age norms.

- Consequences of amplifying normal hearing likely to be more significant than consequences of delaying amplification for a mild hearing loss
Visual Reinforcement Orientation Audiometry

• **Conditioned response**
  • Reinforces the natural tendency to turn towards a sound
  • Typically rewarded by an illuminated puppet or a film clip.

• **Child must be in a calm, alert state, not scanning room**

• **May be performed by a single audiologist or by 2 clinicians (tester & observer).**

• **Risk of observer bias in deciding if response is genuine**
  • Can be reduced by presenting masking noise to observer or by automating the reward system.
Behavioural tests can also provide information about a child’s development.
Visual Reinforcement Orientation Audiometry

• “Traditionally” tests were performed via loud speaker in the sound field.
  • May still be best option for children who are restless or fearful
  • Does not differentiate between hearing in each ear

• Ear specific information can be obtained
  • Headphones (can be difficult to retain on head)
  • Insert earphones with foam tips or personal earmould

• Important to know about hearing in each ear to advise parents about options
For children whose hearing loss is detected in infancy

- Behavioural tests are the gold standard for defining hearing loss

- The role of behavioural hearing tests varies depending upon
  - The child’s age
  - The degree and configuration of hearing loss
  - The presence/absence of ANSD

- Behavioural tests also provide developmental information
References:


Thank you for listening

Contact

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