Pros and Cons:
Including High Frequency (1000 Hz) Ipsilateral Acoustic Stapedial Reflexes in UNHS

Samantha J. Kleindienst, M.S.
Wendy D. Hanks, Ph.D.

Gallaudet University
Collaborators

• Carmen Brewer, Ph.D.
  – National Institutes of Health (Bethesda, MD)
• Ken Henry, Ph.D.
  – Inova Fairfax Hospital for Children (Falls Church, VA)
• Spencer Brudno, M.D.
  – Inova Fairfax Hospital for Children (Falls Church, VA)
• Carol LaSasso, Ph.D.
  – Gallaudet University (Washington, DC)
Overview

• Acoustic Stapedial Reflexes
• Diagnostic Importance
• Previous Research
• Research Goals
• Methodology
• Results/Discussion
• Implications for UNHS
  – Pros
  – Cons
Acoustic Stapedial Reflexes

- Acoustic Stapedial Reflexes:
  - Contractions of the stapedius muscle to loud stimuli
  - Nature’s purpose: protection & perceptual theories
Diagnostic Importance

- Differential diagnostic test
- Diagnosis of conductive pathology hearing loss
- Confirmation of nonorganic hearing loss
- Objective measure for:
  - central pathology
  - cochlear pathology
  - loudness recruitment
  - neuronal pathology
Previous Research

- Indicated low frequency probe-tones are not valid in the neonatal population
- Confirmed that the presence of acoustic reflexes increased with increase in probe-tone frequency

- Hallmark Studies:
  - Weatherby & Bennett, 1980
  - McMillan, Bennett et al., 1985
  - Sprague et al., 1985
  - Swanepoel et al., 2007
Mature vs Neonatal Ears

- Mature ears
  - 226 Hz probe-tone
    - Stiffness-driven system
- Neonate ears
  - Higher frequency probe-tone (i.e. 1000 Hz)
    - Mass-driven system
      - Smaller ECV
      - More compliant
    - Debris/mesenchyme
Research Goal

- To establish normative data for 1000 Hz probe-tone ipsilateral acoustic stapedial reflexes for neonatal ears using elicitor tones 500, 1000, 2000 Hz and broadband noise (BBN)
  - Means
  - Standard Deviations
  - 90th percentile ranges
Methodology

• Demographic Criteria
  – 12-60 hours old
  – 2500+ grams
  – 5-minute Apgar of 7+
  – State of arousal ≤ 2 (Bench, 1976)

• Inclusion Criteria
  – Pass of the TEOAE screening
  – Normal (peaked) 1000 Hz Tympanometry

• 138 neonates were included in initial study
  – 266 ears

• Acoustic reflexes obtained on 102 neonates
  – 175 ears
Methodology

- **1000 Hz tympanometry**
  - $\geq 0.39$ from the positive tail (Kei et al., 2003)
  - $\geq 0.6$ mmho from the negative tail (Margolis et al., 2003)

- **1000 Hz ipsilateral acoustic stapedial reflexes**
  - Elicitor Stimuli:
    - 500 Hz; 1000 Hz; 2000 Hz; BBN
  - Minimal compliance change: 0.04 mmho
  - Randomized order of elicitor and ear
  - Started measurement at 50 dB HL; ascended in 10 dB steps; bracketing technique in 5 dB increments for threshold
Results: Descriptive Statistics

- 97% of the ears had present acoustic reflexes for at least one elicitor stimuli
  - Absent for 3% of the ears tested
- 87% of the ears had present reflexes for all elicitor stimuli
- 91-94% presence across elicitor stimuli
- Positive/Negative Deviations
  - Negative= 145 ears (83%)
  - Positive=14 ears (8%)
  - Both= 10 ears (6%)
# Results: Acoustic Reflex Thresholds*

<table>
<thead>
<tr>
<th>Elicitor Stimulus</th>
<th>500 Hz</th>
<th>1000 Hz</th>
<th>2000 Hz</th>
<th>BBN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N</strong></td>
<td>139</td>
<td>142</td>
<td>147</td>
<td>138</td>
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<tr>
<td><strong>Mean (dB HL)</strong></td>
<td>92.46</td>
<td>91.40</td>
<td>83.90</td>
<td>66.97</td>
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<tr>
<td><strong>SD</strong></td>
<td>5.96</td>
<td>7.04</td>
<td>9.40</td>
<td>10.37</td>
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<tr>
<td><strong>Min</strong></td>
<td>80</td>
<td>80</td>
<td>65</td>
<td>50</td>
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<tr>
<td><strong>Max</strong></td>
<td>105</td>
<td>110</td>
<td>110</td>
<td>90</td>
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<tr>
<td><strong>5th Percentile</strong></td>
<td>85</td>
<td>80</td>
<td>65</td>
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<tr>
<td><strong>50th Percentile</strong></td>
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<tr>
<td><strong>95th Percentile</strong></td>
<td>100</td>
<td>105</td>
<td>100</td>
<td>85</td>
</tr>
</tbody>
</table>

(*Negative deviation only)
Distribution of AR Thresholds Across Elicitor Stimuli*

(*Negative deviation only)
Positive/Negative Deviations

Deflection, Ipsi 1000 Hz

Deflection, Ipsi 2000 Hz
Results Summary

• Tonal Elicitors: mean thresholds 80-90 dB HL
• BBN Elicitor: mean threshold 65 dB HL
• Compared to 226 Hz probe-tone norms*:
  – 13.5 dB & 9.5 dB higher mean thresholds
  – 2.3 dB lower for 2000 Hz
• Other studies
  – Similar to Swanepoel et al. (2007)
  – Some differences with Mazlan et al. (2008)
• Positive/negative deviations

*Wiley, Oviatt, & Block, 1987
Results Summary

- Time of testing
  - 12-18 hours old higher TEOAE refer rate & flat tymps
    - Especially for Cesarean Section
  - Tympanometry:
    - 12-18 hours old: 35% passed
    - 19-24 hours old: 65% passed
    - 25-60 hours old: 90% passed
- Suggests immittance testing after 24 hours for more effective test results
Conclusions

• Based on the high prevalence of high frequency ipsilateral 1000 Hz acoustic reflexes in neonates 12-60 hours old, clinical use is recommended

• Careful interpretation of immittance results is needed for neonates less than 24 hours old

• The use of automated acoustic reflex measurements is not recommended at this time due to unknown significance of reflexes in the positive direction
Acoustic Reflexes in UNHS

• Pros
  – Specific and time-sensitive diagnoses
    • Auditory Neuropathy
    • OAE-based programs
  – Reduced parent anxiety
    • Informed parent counseling
  – Decreased percentage of false-positives
    • Misses for auditory neuropathy
  – Improved follow-up process
Acoustic Reflexes in UNHS

• Cons
  – Personnel resources
    • Time
  – Tester Error
    • Expertise/Training
  – Expense
Future Clinical Needs

• Assess clinical effectiveness of implementation
  – Trial by error
• Further Research:
  – positive vs. negative deviations
    • Screening protocols
  – high frequency acoustic reflexes in NICU and premature neonates
  – Obtain normative data on contralateral high frequency acoustic reflexes
Take Home Message

- Ipsilateral high frequency acoustic stapedial reflexes in neonates at least 12 hours old
  - Reliable & accurate
  - Auditory Neuropathy: ↓ miss/late ID
  - Improved parent counseling
  - Effective management
References

References

Thank you!!

Questions or comments

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