Cochlear Implantation in the Very Young Child: Audiological Management

American Cochlear Implant Alliance
2013

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- Laurel Okulski, AuD
- Patricia Roush, AuD
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### Speech-Language Pathologists:
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### Otolaryngologists:
- Craig Buchman, MD
- Oliver Adunka, MD
- Carlton Zdanski, MD
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Evaluation of Candidacy
- Early Identification
- Team effort to identify needs and resources

Device Programming
- Expert management
- Optimizing technology

Continuum of Care
- Monitoring performance
- Meeting individual needs
Evaluation of Candidacy

- Early Identification
- Team effort to identify needs and resources
Pediatric Team Approach to Cochlear Implantation

- Educators
- Surgeon
- Child
- Other Professionals
- Audiologist
- LSLS/SLP/HI Therapists
- Parents & family
Age at Implantation: Earlier is Better

- Speech Perception outcomes better for children <5 (Fryauf-Bertschy, et al, 1997)
- Language growth rates greater <12 months compared to 12-24 months (Dettman, et al 2007)
Reynell Developmental Language Scores

The Ideal Process

- NBHS
- ABR, Hearing Aid Fitting, Medical Evaluation, Early Intervention
- Behavioral Testing, Early Intervention, CI Evaluation
- Cochlear Implantation, Early Intervention

Birth  2-4 months  6-9 months  10-14 months
Factors that Delay Early Implantation

**Auditory**
- Delay in diagnosis
- Significant or fluctuating residual hearing
- Unreliable or conflicting results
- Under fit amplification

**Medical**
- Anatomic uncertainty
- Multiple co-morbidities

**Parental**
- Parental education and understanding
- Poor compliance with amplification & follow up
- Socioeconomic barriers
Is “No response” on Diagnostic Auditory Brainstem Response Testing An Indication for Cochlear Implantation in Children?  
Hang, AX, Roush, PA, Teagle, HFB, Zdanski, C, Pillsbury, HC, Adunka, OF, Buchman, CA  
in press, 2013

Retrospective review of pediatric patients who underwent multi-frequency ABR testing in a 5 year span at UNC Hospitals

- 1143 pediatric patients underwent ABR testing during the study period.

- 105 (9.2%) were identified as bilateral no response (NR) based on absent responses to both click and tone burst stimuli.

- Behavioral audiograms obtained subsequent to ABR to determine amount of residual hearing.
Etiology of children with No Response ABR

- Unknown
- CMV Infection
- Connexin 26
- Inner Ear Malformations
- Waardenburg Syndrome
- CHARGE Syndrome
- Meningitis
- Cochleo-Vestibular dysplasia
- Enlarged Vestibular Aquaduct
- CND or Hypoplasia
- Other congenital syndrome
Medical Co-morbidities

- Prematurity
- Hyperbilirubinemia
- NICU stay
- Seizure disorder
- Developmental delay
- Cerebral Palsy
- Family History of loss
Residual hearing as confirmed by behavioral audiometry for patients with NR on ABR
Is “No response” on Diagnostic Auditory Brainstem Response Testing An Indication for Cochlear Implantation in Children?

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Results: Of the 105 children that met inclusion criteria, 94 had sufficient follow up to be included in this analysis. Ninety-one (96.8%) of 94 children with bilateral NR ABRs were ultimately recommended for and received a CI.

3 children who did not receive a CI had other significant co-morbidities.

For those that had diagnostic ABRs, the average time from ABR to CI was 10.78 months (SD 5.0, range 3-38).

Conclusions: CI should tentatively be recommended for children with a bilateral NR result on multi-frequency ABR.
Appropriate hearing aid fitting, counseling, and auditory-based intervention are essential to the process.

In presence of No Response ABR, questions of candidacy related to residual hearing should not delay cochlear implantation beyond time it takes to resolve other considerations.
Device Programming

- Expert management
- Optimizing technology
The Challenges

- To continuously update our working knowledge of cochlear implant hardware and programming software in era of rapid technological change
- To optimize the use objective measures (Telemetry, ECAP and ESRT) as a supplement to behavioral measures
- To recognize individual differences and needs in the pediatric population that has become more heterogeneous over time. How do we match choices in technology to fit individual needs?
How does ECAP measure up?

- Easy to run in all current versions of 3 manufacturer software systems (NRT, NRI, ART)
- Tells us about device integrity and something about neural response of cochlea
- Support programming efforts
- BUT, Correlations to behavioral electrical comfort levels vary for all 3 manufacturers and NONE are sufficient to stand alone when programming devices in children.

How about ESRT?

- Not present in the presence of middle ear issues
- Not present in many with cochlear malformations
- Not present in children with bilateral CI
- Clumsy, often difficult to obtain, not widely used

- BUT, correlations to behavioral electrical comfort levels are generally good.

Meeting the Challenges

- Rely on our training as behaviorists
- Use objective measures to guide but follow with behavioral measures - still the gold standard of patient management
- Resist one size fits all strategies
- Recognize that not all solutions are answered by technology
- Continuously counsel and educate and evaluate
Continuum of Care

• Monitoring performance
• Meeting individual needs
Frequent assessment of function and performance...

Through the use of standard materials and methods...

To identify red flags, support individual progress, and plan for the future.
Customizing technology to facilitate participation in all life experiences

Continued team work to achieve each child’s potential

Planning and visioning for the next phase
- For individual children
- For the next generation of candidates
Changes in Technology

- Smaller, lighter, more durable components
- Signal Processing
- Improved Telemetry (intra operative measures, fitting)
- Improved Flexibility & Interface
- Wireless programming
- Remote Internet programming
- Data Logging to determine typical environments and best input processing
- Electrode options and surgical techniques to preserve hearing

Changes in Practice

- Bimodal fittings
- Electro Acoustic fittings for children