ABI in Children
Surgery and Complications

J. Thomas Roland, Jr., MD
Mendik Foundation Professor and Chair
Otolaryngology-Head and Neck Surgery
NYU School of Medicine
Disclosures

• Several members of the team have consulting agreements and research funding from Cochlear Implant Manufacturers
• IRB approved protocol #S14-01010
• FDA IDE approved 4/14 #G140001
• Off label use of approved device
• Several members of team have NIH research funding
ABI Project Team

Long History of CI, Skull Base Surgery (including pediatric) and ABI work (#60+/-)
Large NF2 Program, numerous drug trials

Neurosurgery
  John Golfinos MD, Chandra Sen MD, Jeffry Wisoff, MD

Neurotology
  J. Thomas Roland, Jr., MD, Sean McMenomey, MD, Daniel Jethanamest, MD

CI Audiology
  William Shapiro, AuD, Alison Singleton, AuD, Janet Green, AuD

Radiology
  Mari Hagiwara, MD

Anesthesia
  Wanda Chiu, MD
ABI Project Team

Research
Susan Waltzman, PhD, William Shapiro, AuD, Allsion Singleton, AuD, Mario Svirsky, PhD, Chin-Tuan Tan, PhD, Rob Froemke, PhD, Michael Long, PhD, Kristin Montella, MPA, Christina Wheelwright, NP
FDA IDE Approved Centers

- University of North Carolina
  - Dr. Craig Buchman
- LA Peds ABI Team
  - Dr. Eric Wilkinson
- Mass. Eye and Ear Infirmary
  - Dr. Daniel Lee
- New York University
  - Dr. J. Thomas Roland, Jr.
The Nucleus 24 ABI

- Receiver-stimulator
- Monopolar reference electrodes
- Micro-coiled electrode wires
- Electrode array (21 platinum disks 0.7mm diameter)
- Removable magnet
- Stabilisation PET mesh
- T-shaped PET mesh

FDA Approval, July 2000

APRIL 1999

NYU Langone MEDICAL CENTER
Commentary
Auditory Brainstem Implantation in Children and Non-Neurofibromatosis Type 2 Patients: A Consensus Statement


*Hacettepe University, Ankara, Turkey; †Verona University, Verona, Italy; ‡University of Navarra, Pamplona, Spain; §Freiburg University, Freiburg, Germany; ¶Central Manchester University, Manchester, U.K.; ¶¶St. Augustinus Hospital, University of Antwerp, Antwerp, Belgium; #Neurosurgery Department of Staatliche Klinikum Braunschweig, Braunschweig, Germany; **Royal National Throat, Nose & Ear Hospital and Royal Free Hospital, London, U.K.; and ††Uppsala University Hospital, Uppsala, Sweden
ABI in Children Inclusion Criteria

• Age 18 mo to 18 years
  • Younger the better – earliest age controversial
• Bilateral absent hearing documented on physiologic and behavioral assessment
• Imaging, MRI and CT
• No cochlea or cochlear nerve aplasia/hypoplasia
  • Inability to place a CI
  • Lack of benefit from a CI
    • Had benefit and lost benefit from CI
• No medical contraindications
• No diagnosed significant cognitive or developmental delays that could interfere**
• Strong family support
• English language competency in guardians
• Reasonable expectations of family
  • Understand that child may not develop oral language
Work Up

- Imaging - includes MRI Tracktography (Diffusion Tensor Imaging)
- Behavioral testing
- Physiologic testing
  - ABR, OAE
  - EABR (via promontory stimulation or intra-cochlear electrode)
    - Not widely available

- CI first if there is something to implant at 6 months to one year of age
- ABI on same or opposite ear if CI fails to provide meaningful benefit
Anesthesia

- Pediatric Neurosurgery Team
- Non paralytic technique with special considerations for monitoring
  - Some agents suppress ability to monitor
- Smooth emergence from anesthesia
- Communication imperative
- +/- Mannitol
Surgical Issues

- ABI after CI common
- Accommodating CI incision
Audiology team

- Monitor EABR to assist with placement
- Monitor 10, 7, SEP, MEP
Auditory Brainstem Implant

• Retrosigmoid approach

• Placed in lateral recess of 4\textsuperscript{th} ventricle abutting the cochlear nuclei

- Landmarks include:

  ▪ 8\textsuperscript{th} nerve, 9\textsuperscript{th} nerve

  ▪ CSF from foramen of Luschka

  ▪ Lower cranial nerves

  ▪ Choroid plexus

  ▪ Intra-op EABR – assists with placement
ABI in the Brainstem

CEREBELLUM

LM

ICP

OLIVE

PB

DCN VCN

ABI
POST OP

• 1 night PICU
• CT post op (several non compliant or refused)
• Usually home on post op day 2
• Compression bandage for three days
• Seen by MD on PO Day 7-10
• Initial Activation with Monitoring and anesthesia again 3 weeks
Imaging
Initial Activation

• In operating suite with appropriate monitoring under anesthesia

• Look for untoward stimulation (ie Vagal)
• Assists with further mapping/programming sessions
## Four US Centers Demographics

<table>
<thead>
<tr>
<th></th>
<th>HEI</th>
<th>MEE</th>
<th>NYU</th>
<th>UNC</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number</strong></td>
<td>4</td>
<td>4 (5)</td>
<td>9</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td><strong>Previous CI</strong></td>
<td>3 (1 bilat)</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td><strong>Age at ABI</strong></td>
<td>27-58</td>
<td>11-16</td>
<td>21m-17 yrs</td>
<td>26-66</td>
<td>39 ± 26*</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>2M &amp; 2F</td>
<td>1M &amp; 3 F</td>
<td>2M &amp; 7 F</td>
<td>2M &amp; 3 F</td>
<td>7M &amp; 15 F</td>
</tr>
<tr>
<td><strong>Side</strong></td>
<td>3 R ,1 L</td>
<td>3R, 1L</td>
<td>5 R, 1L</td>
<td>3R, 2 L</td>
<td>14 R &amp; 5 L</td>
</tr>
<tr>
<td><strong>Etiology</strong></td>
<td>3 CND</td>
<td>3 CND</td>
<td>4 CND</td>
<td>5 CND</td>
<td>15 of 19 CND</td>
</tr>
<tr>
<td></td>
<td>1 Michel</td>
<td>1 Michel</td>
<td>2Michel</td>
<td>2 CHARGE</td>
<td>2 CND alone</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11/3/15
## Operative Outcomes

<table>
<thead>
<tr>
<th></th>
<th>HEI</th>
<th>MEE</th>
<th>NYU</th>
<th>UNC</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>eABR +</strong></td>
<td>4 of 4</td>
<td>4 of 4</td>
<td>9 of 9</td>
<td>4 of 5</td>
<td>22</td>
</tr>
<tr>
<td><strong>Other CN Stim</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Complications</strong></td>
<td>1 CSF Leak</td>
<td>2 Device Failure</td>
<td>1 CSF Leak</td>
<td>1 CSF Leak Aseptic Meningitis</td>
<td>3 CSF Leaks 1 Meningitis 2 Device Failure</td>
</tr>
<tr>
<td><strong>Sequelaee</strong></td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td><strong>OR Repeat Stim</strong></td>
<td>4</td>
<td>4</td>
<td>9</td>
<td>5</td>
<td>21-22</td>
</tr>
<tr>
<td><strong>Aversive Behavioral Stimulation</strong></td>
<td>1 of 4 Unsteady-resolved</td>
<td>0 of 4</td>
<td>4 of 9 Leg Leg,,Throat Chest Facial twitch</td>
<td>4 of 5 2 vestibular 1 cough 1 swallow</td>
<td>9 of 22 all demapped</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>Resolved</td>
<td>Resolved</td>
<td>Resolved</td>
<td>Resolved</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

11/3/15
Summary

• 3 CSF fistulae resolved without consequence
• Devices can fail
  • ? Eventually all will
• Placement is an important issue and use EABR to assist
  • ? is there a correlation between intraop EABR results and final outcomes
• New imaging concepts are emerging
• Surgery is safe with the right team
• NAS can be programmed out, revisit