Diagnostic ABR in Infants: Costs, Benefits, and Outcomes Using Sedated and Non-Sedated Procedures

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Introduction

Newborn hearing screening, now performed in all 50 states, has created a need for efficient diagnostic procedures for infants who do not pass the initial screening. Diagnostic procedures, such as the auditory brainstem response (ABR), are used routinely to estimate hearing threshold levels based on physiologic recordings of evoked neurological activity in the auditory nerve and brainstem. The three methods for completing the test are:

- ❑ ABR performed in natural sleep
- ❑ ABR performed under conscious sedation
- ❑ABR performed under general anesthesia (in the operating room or MRI suite)

The ABR method of choice is influenced by several factors including the age of the child, the need for other clinical procedures that require sedation/anesthesia, and any comorbidities impacting the child's developmental status or general health. In turn, the choice of method has important implications for the cost and timeliness of the procedure.

Purpose & Methods

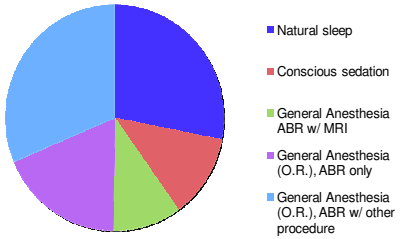
Purpose: To compare the costs, benefits, and outcomes of three methods of performing diagnostic ABR in infants referred to UNC Hospitals from newborn hearing screening. This presentation reports the first phase of the investigation.

Methods: This is an ongoing retrospective review of pediatric patients who received diagnostic ABR testing by audiologists at UNC Hospitals over a two year period. Data collection, when complete, will include:

- ❑ Patient variables (e.g. age, etiology of hearing loss, co-morbidities)
- ❑ Financial considerations (e.g. cost, reimbursement, timeframe)
- ❑ Logistical considerations (e.g. scheduling and coordination with other procedures)
- ❑ Impact of these variables on age of intervention

Results

Total ABRs in One Year (N = 217)




ABR performed in natural sleep


ABR performed under conscious sedation


ABR performed under general anesthesia in the operating room

Total ABRs Performed in One Year (N = 217)

Recording Environment	Number of Procedures	Average Age at Diagnostic ABR
Natural Sleep (NS)	61	2m, 28d*
Conscious Sedation (CS)	26	1y, 6m, 8d
General Anesthetic (GA)	130	2y, 9m, 14d

*Four ABRs performed on older children (>5 years of age) in natural sleep were excluded from the average to better represent the age of infants tested following referral from NBHS

ABRs Performed Under General Anesthetic (N = 130)

Recording Environment	Number of Procedures
GA--ABR Only	40
GA--MRI	22
GA---Tympanostomy Tubes or Other	68
Total	**130**

Group A* (N = 25)

Recording Environment	Number of Procedures	Average Age at Diagnostic ABR	Average Age at Hearing Aid Fitting
Natural Sleep (NS)	6	3m	4m, 3d
Conscious Sedation (CS)	10	9m	10m, 21d
General Anesthetic (GA)	9	8m, 12d	9m, 15d
Total	**25**	**6m, 28d**	**8m, 18d**

*Group A includes infants referred from newborn hearing screening from July 1, 2008 to July 1, 2009 who received a diagnostic ABR at UNC, were diagnosed with bilateral hearing loss, and fitted with hearing aids. Exclusion criteria: ABRs for infants diagnosed with normal hearing, ANSD or unilateral hearing loss. Also excluded were ABR performed on infants with extended hospitalization in NICU, ABRs performed prior to cochlear implantation or for purposes of retro cochlear testing.

Group A (N = 25)

Number of Sites	Number of Cases	Average Age at Diagnostic ABR
Diagnostic ABR at Multiple Sites	13	7m, 9d
Diagnostic ABR at Single Site	12	6m, 15d

Group A (N = 25)

Average Time Between ABR at UNC to HAF	31d
Minimum	15d
Maximum	70d

Discussion

Challenges:

- ❑Multiple screening attempts prior to referral for diagnostic assessment
- ❑ Lack of skilled pediatric audiologists (too few centers of expertise)
- ❑ Not enough centers willing to accept pediatric patients (lack of institutional support)
- ❑ Distance or travel time for families

Solutions:

- ❑ Work with statewide EHDI programs to:
  - ❑Eliminate repeat screenings
  - ❑ Identify specialty centers where accurate and complete diagnostic ABR can be obtained.
  - ❑Promote timely referral for diagnostic ABR no later than three months of age.

Conclusions:

In this sample, children identified with permanent bilateral hearing loss who received a complete diagnostic ABR under 3 months of age in natural sleep received hearing aids 5-6 months earlier than those who required either conscious sedation or general anesthesia. In addition to earlier hearing aid fitting, accurate ABRs completed in natural sleep resulted in substantial cost savings as compared to sedated procedures, with less risk to the infant. In order to meet national 1, 3, 6 goals, it is essential that infants be referred to specialty centers as soon as possible.

References

•Joint Committee on Infant Hearing. (2007). Year 2007 position statement: Principles and guidelines for early hearing detection and intervention programs. *Pediatrics, 120(4)*, 898-921.
•Roush, P. (2005). Hearing aid fitting in infants: Practical considerations and challenges. In R. Seewald & J. Bamford (Eds.), *A Sound Foundation Through Early Amplification* (pp. 105-113). Great Britain: Cambrian Printers Ltd.
•Stapells, D.R., Gravel, J.S., & Martin, B.A. (1995).
•Thresholds for auditory brain stem responses to tones in notched noise from infants and young children with normal hearing or sensorineural hearing loss. *Ear & Hearing, 16*, 361-371.

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