Neural Response Telemetry in Pediatric Cochlear Implantation
Christine H. Heubi, MD1; Jonathan B. Ida, MD2; Michael Scott, AuD1; Jareen Meinzen-Derr, PhD3; John H. Greinwald, MD1

1Division of Pediatric Otolaryngology-Head and Neck Surgery, Cincinnati Children’s Hospital Medical Center, Cincinnati, OH
2Division of Pediatric Otolaryngology, Ann & Robert H. Lurie Children’s Hospital of Chicago, Chicago, IL
3Division of Biostatistics and Epidemiology, Cincinnati Children’s Hospital Medical Center, Cincinnati, OH

Abstract
Objectives
(1) Evaluate the Neural Response Telemetry (NRT) of patients with inner ear anomalies, namely enlarged vestibular aqueduct (EVA).

Methods
A retrospective chart review of pediatric patients who underwent cochlear implantation at a tertiary care pediatric referral center 2001-2010 was performed. Patients with inner ear anomalies were matched to controls without anomalies based on age at the time of implantation. Associations between abnormal NRT and perilymphatic gusher and correlations between NRT and audiometry were assessed.

Results
30 ears from 26 control subjects, and 30 ears from 23 case subjects with radiographic evidence of EVA were evaluated. Median age of implantation was 68 months for the control subjects, and 72.5 months for the case subjects. NRT at the time of implantation was normal in all of the control subjects; in the case subjects, 84.6% had normal NRT values. Intraoperative data revealed a perilymphatic gusher in 6 case ears (20.7%) of which 33% had abnormal NRT compared to 9% among patients without gusher (p=0.17). In both the control and case subjects, there seems to be a negative correlation between intraoperative NRT and postoperative SRT at the lower frequencies (p=0.09).

Conclusion
The presence of perilymphatic gusher at the time of cochlear implantation in patients with Enlarged Vestibular Aqueduct (EVA) may be related to abnormal NRT. Between the two groups, the mean NRT obtained intraoperatively is different; the case ears have higher NRT values than the controls (p=0.049). These values remain higher at follow-up, but not as great (p=0.078). In both patient populations, there may be a negative correlation between intraoperative NRT and postoperative SRT at the lower frequencies.

Introduction
Children with sensorineural hearing loss (SNHL) benefit from cochlear implantation.

Children with Enlarged vestibular aqueduct (EVA) comprise up to 12% of patients with SNHL; EVA is associated with Pendred syndrome, Waardenburg syndrome, and Branchio-oto-renal syndrome.

EVA is associated with perilymphatic gusher at the time of cochlear implantation, a process where fluid flows rapidly from the cochlea, making insertion of the electrode more technically difficult.

Neural response telemetry (NRT) is utilized in pediatric cochlear implantation for confirmation of appropriate electrode placement intra-operatively.

Intra-operative NRT readings have never been found to correlate with success of implantation, and a negative result in an otherwise uneventful CI procedure would not prompt immediate re-exploration.

Research to date has been unable to correlate intra-operative NRT with successful implantation and/or post-operative audiometric outcomes. In addition, no studies have looked at inner ear anomalies and NRT readings at the time of implantation.

Methods
•Retrospective chart review of pediatric patients who underwent cochlear implantation with Cochlear devices at a tertiary referral center 2001-present was performed. Subjects were selected from the Cincinnati Children’s Hospital Medical Center Cochlear Implant database.

•Children in the experimental group (30 ears from 26 subjects) were matched based on age of implantation to those of the experimental group (within 12 months); inclusion required no radiographic evidence of EVA. Children were excluded from the control group if they had any evidence of an inner ear anomaly.

•Post-operative audiometric data and NRT data was obtained during the first year after activation.

•Distributions of the data were described using means with standard deviations, medians with ranges, and frequencies with percentages.

•Differences in intra-operative and post-operative NRT values were correlated at 2 or 4kHz (rho = 0.09 & 0.03 respectively)

•There may be a negative correlation between intra-operative NRT and postoperative SRT at the lower frequencies.

•There is no difference in SRT of cases compared to controls.

Results
All ears in the control group (n=30) had normal NRT at the time of cochlear implantation while only 64.6% (n=22) of the case ears had normal NRT. This is not statistically significant (p=0.5).

There was no intra-operative gusher seen in the control population, while 20.7% of the case ears had a gusher.

Among those with a gusher, 33% had abnormal NRT values intraoperatively, compared to 9% without gusher. Although the proportion of abnormal NRT was higher in those patients with a gusher, it is not statistically significant.

Between the two groups, the mean NRT obtained intraoperatively is different. The case ears have higher NRT values than the controls (p=0.049). These values remain higher at follow-up, but not as great (p=0.078).

There seems to be a negative correlation between intraoperative NRT and postoperative SRT at the lower frequencies.

Conclusion
The presence of perilymphatic gusher at the time of cochlear implantation may be related to abnormal intra-operative NRT.

• The mean NRT obtained both intraoperatively, and at follow-up, is higher in the case ears.

• There may be a negative correlation between intra-operative NRT and postoperative SRT at the lower frequencies.

• A larger sample size is needed to determine if there is a correlation between intraoperative NRT and postoperative SRT at higher frequencies.

Introduction
Children with sensorineural hearing loss (SNHL) benefit from cochlear implantation.

Children with Enlarged vestibular aqueduct (EVA) comprise up to 12% of patients with SNHL; EVA is associated with Pendred syndrome, Waardenburg syndrome, and Branchio-oto-renal syndrome.

EVA is associated with perilymphatic gusher at the time of cochlear implantation, a process where fluid flows rapidly from the cochlea, making insertion of the electrode more technically difficult.

Neural response telemetry (NRT) is utilized in pediatric cochlear implantation for confirmation of appropriate electrode placement intra-operatively.

Intra-operative NRT readings have never been found to correlate with success of implantation, and a negative result in an otherwise uneventful CI procedure would not prompt immediate re-exploration.

Research to date has been unable to correlate intra-operative NRT with successful implantation and/or post-operative audiometric outcomes. In addition, no studies have looked at inner ear anomalies and NRT readings at the time of implantation.