Comparisons and Measurements on Healthy Newborn and One-Month Old Infants

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INTRODUCTION

LONG-TERM GOAL

The long-term goal of this research project is to determine if energy reflectance measurements can be used as an objective measure to determine middle ear function in newborns and one-month old infants. Other work focuses on energy reflectance in NICU babies (e.g., Shahnaz 2008; Karas et al. 2008), babies one month old and older (Hunter et al. 2008; Keefe and Levi 1993). Karas et al. (2008) assert that the middle ear is under development throughout the first year of life. The NICU environment can lead to differences in energy reflectance measurements. Therefore, we developed a study to examine these differences.

SPECIFIC GOAL OF THIS WORK

The specific goal of the work presented here is to characterize the energy reflectance measurements of normal-hearing newborns and one-month old infants. Lentz et al. (1985) showed that energy reflectance measurements may also help diagnose and manage young infants with otitis media. However, the long-term goal of this research project is to determine if energy reflectance measurements can be used as an objective measure to determine middle ear function in newborns and one-month old infants.

RATIONAL FOR TEST OF MIDDLE EAR FUNCTION IN NEWBORNS

Due to three factors or abnormalities of newborn middle ear function and the infant’s developmental stage, newborns are under study for middle ear function. One factor is the immaturity of the sound delivery system (Allen 1985). Reflectance is the ratio between the reflected pressure wave and the incident pressure wave, and its development in infants can contribute to the development of middle ear function. The second factor is the development of a screening program for middle ear function at the time of newborn screening. In order to provide more complete audiological information starting at birth, a recent study funded jointly by the Centers for Disease Prevention and Control and the Association of Teachers of Preventive Medicine recommends the development of a screening tool for middle ear function at the time of newborn screening (Gravel et al. 2000). The third factor is the increase in the number of newborns and young infants with hearing loss (Sanford and Feeney 2008; Keefe and Levi 1993). Keefe et al. (2000) reported energy reflectance (ER) measurements from a small number of healthy newborns and one-month old babies. These studies encourage us to continue our research in the current study, with the goal of understanding differences in energy reflectance between newborns and one-month old babies.

EXPERIMENTAL METHODS

OVERVIEW:

Reflected energy was measured on newborns and one-month old infants using the TDT-314S with an Etymotic ER-10c probe. This setup has been modified by the experiments team. To minimize acoustic leaks, foam tips (size 14B, Etymotic Research) were used. The reference frequency was 250 Hz, and the reference level was 75 dB SPL.

METHODS:

At each frequency, we tested the null hypothesis that there is no difference in energy reflectance between the newborn and one-month old groups. Subjects were full-term, healthy babies ranging from one-month to adult; they were from the Harvard Children’s Hospital, the Boston Medical Center, and the Framingham Maternal-Infant Health Study. The measurements were approved by the Institutional Review Board.

SUBJECTS:

Eight newborns (ages 3 to 9 days) and eleven one-month old infants were recruited for the study. The newborns were recruited from the NICU, from a hospital, and from a community. All newborns and one-month old infants were full-term, healthy babies. The newborns were recruited from the NICU, from a hospital, and from a community. The one-month old infants were recruited from the same sources. The sample size was determined using the Fisher z-transformation.

TESTING PROCEDURE:

Measurements were taken on both ears at 720 Hz and 2500 Hz. These measurements were taken on the right ear first. The left ear was calibrated first. The one-month old infants were calibrated first. The right ear was calibrated last. The calibration measurements were taken on both ears at 720 Hz and 2500 Hz. The calibration measurements were taken on both ears at 720 Hz and 2500 Hz.

DATA ANALYSIS:

Measurements were made every 5 Hz and were smoothed using a 7-point moving average filter. The data were analyzed with a statistical testing program.

RESULTS

INDIVIDUAL MEASUREMENTS

1. Individual Measurements:

Reflectance measurements on eight newborns and eleven one-month old babies were taken at 720 Hz and 2500 Hz. The measurements were taken on both ears at 720 Hz and 2500 Hz. The measurements were taken on both ears at 720 Hz and 2500 Hz. The measurements were taken on both ears at 720 Hz and 2500 Hz.

2. Left vs. Right Ears:

The mean energy reflectance from the left ear was not significantly different from the right ear. The mean energy reflectance from the left ear was not significantly different from the right ear. The mean energy reflectance from the left ear was not significantly different from the right ear. The mean energy reflectance from the left ear was not significantly different from the right ear.

3. Male vs. Female:

The mean energy reflectance from males and females is not significantly different for newborns or one-month olds. The mean energy reflectance from males and females is not significantly different for newborns or one-month olds. The mean energy reflectance from males and females is not significantly different for newborns or one-month olds. The mean energy reflectance from males and females is not significantly different for newborns or one-month olds.

4. Newborns vs. One-Month Olds:

The energy reflectance from newborns and one-month olds is generally not significantly different. However, near 2000 Hz it appears there could be differences.

REFERENCES


Karas, N. et al. 1999. "Energy reflectance measurements on newborns and one-month old babies are plotted in comparison to newborns and one-month old babies of 10-18 months old." Ear Hear. 29:780-786.


CONCLUSIONS

1. Energy reflectance measurements were made on 8 newborns (6 left and 7 right ears) and 11 one-month old (11 right and 8 left) ears.

2. Mean energy reflectance measurements comparing the left and right ears from both newborns and one-month old babies show no significant differences.

3. Mean energy reflectance measurements comparing male and female ears from both newborns and one-month old babies show no significant differences.

4. Mean energy reflectance measurements comparing newborns and one-month old ears do not show significant differences at most frequencies. There is some evidence of differences near 2000 Hz, but no measurements are needed to determine the significance of this difference.

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