Normative Reflectance 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 detect middle ear fluid in newborns and older infants, both at the time of newborn screening and when middle-ear fluid is suspected. Energy reflectance measurements provide a possible alternative to tympanometry; however, this option is an unreliable measure of middle-ear status for ages less than six months (Holte et al. 1991).

SPECIFIC GOAL OF THIS WORK

The specific goal of the work performed here is to characterize the energy reflectance of normal-hearing, healthy newborn babies. Kacik et al. (1993) demonstrated that the energy reflectance difference (ERD) at 1000 Hz was more than one standard deviation (SD) higher in newborns than older children. Other work focuses on energy reflectance in NICU babies (e.g. Shahnaz et al. 2008; Kacik et al. 2000), babies one month and older (Sanford and Feeney 2008; Kacik and Levi 1996; Kacik et al. 1993), and groups that include a range of newborns to more than one month (Hunter et al. 2008). Here, we present measurements of energy reflectance on normal-hearing, healthy newborn and one-month old infants.

RATIONALE FOR TEST OF MIDDLE EAR FUNCTION IN NEWBORNS

Due to the potential for otitis media of newborns, hearing screening and an infant’s auditory logical measurement, if correct, 95% of children by age two (Parental and Barkerd 1997) medical management of children who suffer from otitis media results in subacute otitis media. Thus, reflectance measurements may help diagnose and manage young infants with mild symptoms, which influence 91% of children by age two. (Parental and Barkerd 1997). Medical management of children on NICU babies is similar to Keefe et al. (1993) and groups that include a range of newborns to more than one month (Hunter et al. 2008). Here, we present measurements of energy reflectance on normal-hearing, healthy newborn and one-month old infants.

DESCRIPTION OF ENERGY REFLECTANCE

Energy reflectance is the ratio between the reflected pressure wave and the incident pressure wave, and its magnitude is in the energy absorbed and the intensity of the sound delivered, in the sound delivered system (Allen 1985).

EXPERIMENTAL METHODS

OVERVIEW

Reflectance was measured on newborns and one-month old infants using the FDA-approved Etymotic Research ER-10c probe system. To minimize ambient sounds, from the age, (180), Etymotic Research were used (Wade and Price 2005). Each ear was tested twice to allow for the normal variability with the same ears, at least 10 minutes apart to reflectance differences in newborns. Each ear was recorded by the same investigator, and the right ear order was randomized.

SUBJECTS

Eight newborns (age 3 to 9 days) and eleven one-month old babies (age 28 to 81 days) were recruited by their pediatrician at a newborn well-baby visit. Each subject underwent an otoscopic examination to ensure a clear ear canal. All parents consented for their baby’s ear to be examined. During their well-baby visit, each subject underwent an otoscopic examination to ensure a clear ear canal. Each ear was recorded twice to allow for the normal variability with the same examiner, at least 10 minutes apart to reflectance differences in newborns. Each ear was recorded by the same investigator, and the right ear order was randomized.

TESTING PROCEDURE

Measurements were taken on both ears of each newborn and one-month old infant. In each case, one ear was not measured due to examiner error, and those measurements were not taken into account. Each ear was measured twice to test for the normal variability of the instrument, and the right ear order was randomized. Each ear was recorded twice to allow for the normal variability with the same examiner, at least 10 minutes apart to reflectance differences in newborns. Each ear was recorded by the same investigator, and the right ear order was randomized.

DATA ANALYSIS

Measurements were made every 5 Hz and were smoothed using a 7-point moving average filter. The data was recorded with a computer, and an examiner performed the analysis with a computer. The data was analyzed with a computer, and an examiner performed the analysis with a computer. The data was analyzed with a computer, and an examiner performed the analysis with a computer. The data was analyzed with a computer, and an examiner performed the analysis with a computer. The data was analyzed with a computer, and an examiner performed the analysis with a computer.

RESULTS

Individual Energy Measurements

Energy reflectance measured on eight newborn and eleven one-month old infants.

Left vs. Right Ears

The mean energy reflectance from the left and right ear is not significantly different for newborns or one-month olds.

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.

COMPARISON TO OTHER DATA

Kacik et al. (1993) reported energy reflectance (ER) measurements from a population that included NICU babies, healthy newborns, and newborns at risk for hearing loss. Hunter et al. (2008) report ER measurements of newborns and infants at frequencies below 1000 Hz. Hunter et al. (2000) report ER measurements that are similar to Kacik et al. (1993) from 1000 Hz to 6000 Hz, but Hunter et al.’s ER measurements are larger in the 250 to 750 Hz range.

CONCLUSIONS

Energy reflectance measurements were made on 8 newborns (6 left and 8 right ears) and 11 one-month old (9 right and 2 left) healthy babies.

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

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

Mean energy reflectance measurements comparing newborn and one-month old ears show no significant differences at most frequencies. There is some evidence of differences near 2000 Hz, and more measurements are needed to determine the significance of this difference.

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