Differences in DPOAE and AABR in Noise Exposed Infants in the Neonatal Intensive Care Unit

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Abstract

Background: Hearing loss rates in neonatal intensive care units (NICU) run at 2-15%, compared to 0.3% in full-term births. The etiology of this increase remains unknown. In this study, we focus on a preventable cause: sound exposure levels. Design: Prospective outcomes study. Methods: First 20 out of 150 NICU infants, <37 weeks gestational age, enrolled in an IRB-approved study. A noise dosimeter measures each infant’s cumulative sound pressure level exposure. Automated auditory brainstem response (AABR) and distortion product otoacoustic emissions (DPOAE) testing is done at discharge. Results: The average sound pressure level per individual admission ranged from 57.4 to 67.8 dBA. DPOAE demonstrated a greater rate of abnormalities in the high frequency range (40-45%) compared to low frequencies (10-15%). AABR generated only a 5% rate of referrals, however, 50% of DPOAEs obtained showed abnormal results in at least 2/3 of the high frequencies tested. Conclusions: All infants received sound exposures that substantially exceeded American Academy of Pediatrics (AAP) guidelines. More abnormalities were found on DPOAE than AABR, with a significantly higher rate in the high frequencies compared to low frequencies, consistent with possible noise-induced cochlear dysfunction. NICUs should consider adding DPOAE to their hearing screen protocols so that infants at risk for noise-induced hearing loss are not missed.

Methods and Materials

A target population of 150 infants, <37 weeks gestational age, and admitted to the NICU are being enrolled in the first 3 days of life. Exclusion criteria include diagnosis of a pre-existing syndrome associated with hearing loss or other diagnosis of a known cause of hearing loss. This study looks at data from the first 20 subjects.

Each subject has a noise dosimeter (ER-200D, Etymotic Research Inc., Elk Grove Village, IL) fixed to the head of the bed after enrollment. The dosimeters continuously record sound pressure levels until the time of the subject’s discharge from the NICU.

Each subject receives a clinical newborn hearing screen via AABR with a pass/fail result, regardless of study enrollment. In addition, each study participant has a research diagnostic DPOAE. The F2 frequencies tested are 2063, 2531, 2953, 3563, 4172, 4969, 5953, 7031, 8391, 10031 Hz, with an L1/L2 of 65/55 and an F2/F1 = 1.22. These values can be categorized as “low frequency” (F2 values <4000 Hz) and “high frequency” (F2 values >4000 Hz). A normal value is defined as a distortion product (DP) >0 with a difference between DP and noise floor (NF) >6. A reduced value is defined as a DP <0 with a DP-NF <6. An absent value is defined as a DP-NF <6. Both reduced and absent OAEs for any given frequency are defined as “abnormal.” We define an “abnormal” overall test result as having more than 50% of the OAE responses return as abnormal. For comparison purposes with the AABR, we also convert our diagnostic DPOAE into a screening test for high frequency hearing loss, with more stringent passing criteria as requiring a normal OAE response to at least 1/3 of the high frequency F2s.

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Figure 1. Normal DPOAE
Figure 2. High frequency abnormalities on DPOAE

References