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Current effect: Sound of Silence in NICU on infant hearing range

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Abstract

Background and Aim: Neonatal Intensive Care Unit (NICU) is a noisy environment in which infants can be exposed to high noise levels. The aim of the study is to evaluate the adverse effects of noise on hearing and, neurological outcomes of NICU graduates at six months of age.

Methods: Thirty-two infants that had been admitted to Gazi University Hospital NICU and 25 healthy controls, were included in the study. Noise levels were recorded continously during hospitalization period. TEOAE, DPOAE and ABR tests were used to assess hearing. Neurological outcome was assessed with Bayley II Infant Development Scale.

Results: One small, high-quality study assessing the effects of silicone earplugs versus no earplugs qualified for inclusion. The original inclusion criteria in our protocol stipulated an age of < 48 hours at the time of initiating sound reduction. We made a deviation from our protocol and included this study in which some infants would have been > 48 hours old.

Conclusion: Major noise source in NICU was found to be the incubators. Although hearing loss was not detected in any infants, hearing tests at sixth months of life were adversely affected.

Keywords: NICU, Sound, Hearing, DBHL, DPOAE.

Introduction

Advancements in neonatal intensive care now allow survival of infants born as early as 22 weeks' gestational age. Infants at this extremely low gestational age have immature central nervous systems, putting them at high risk of adverse outcomes due to excessive noise. Excessive noise can have negative effects on premature infants' sleep patterns, growth, and neurodevelopment. Maintaining a stable physiological state is important for the infant during this time of rapid central nervous system development. Evidence has shown that noise in the neonatal intensive care unit (NICU) can negatively affect the cardiovascular, respiratory, nervous, and

auditory systems of the preterm infant. When exposed to sudden and loud noise, premature infants may exhibit changes in heart rate (tachycardia, bradycardia), respiration (apnea), blood pressure (elevated), oxygen saturations, and interrupted sleep patterns. In addition, excessive noise puts infants at risk of slow weight gain, elevated cortisol levels, decreased immunity, as well as increased risk of hearing impairment. Preterm neonates, who spend weeks in the NICU, are especially sensitive to noise and elevated sound levels because their auditory system is at a critical period of neurodevelopment. Research in the field of neonatal "developmentally supportive care" highlights that an environment free of excessive noise decreased neonates' oxygen requirements, days on respiratory support, and length of hospital stay, thus improving developmental outcomes.

Around 50% of the infants who are born with hearing loss have no known risk factors. Average age of diagnosing hearing disability in India is 18 months. Infants who are not identified for hearing impairment before 6 months of age have delayed speech and language development. The critical period for rehabilitation is in the first 6 months of life. Preterm infants depend on the Neonatal Intensive Care Unit (NICU) for continued existence and survival. The NICU is a sophisticated and technology-driven environment. Preterm infants experience enormous stress in an NICU environment. Even though NICU is required by preterm infants for their continued well-being, it may end up being an inappropriate milieu. The presence of an overwhelming stimuli like the continuous presence of ambient noise, may have various effects on preterm infants.

The sound environment in the NICU is louder than most home or office environments. The noise in NICUs' includes disturbing noises of short duration at irregular intervals. There are competing sound signals that frequently challenge preterm infants, staff, and the parents. The sound levels in NICUs range from 7 dBHL to 120 dBHL, that exceeds the maximum acceptable level of 45 dBHL, recommended by the American Academy of Paediatrics. The levels should not exceed 45 dBHL in infants' areas and that transient sounds should not exceed 65 dBHL. As per studies, these noise levels exceed more than 70% of the time for all levels of care.

Material and Methods

Study was done in three local NICUs' and four private nursing homes, obstetrics service. The study population included all babies born at the three local NICUs' and four private nursing homes. Noise levels and questionnaire Sound level meter was used to determine the sound level.

Implementation

Clinical interventions must be strongly guided by evidence that supports patient benefit as well as the practicality of its implementation. Abdeyazdan, Ghassemi, & Marofi (2014) measured NICU nurses' attitude about the use of earmuffs in premature infants to lower the stress imposed by noise. The majority of nurses surveyed (72%) perceived the noise in the NICU to be too loud, believed earmuffs were beneficial to the infants (64%), and all of the staff agreed that earmuffs only interfered with routine care sometimes and posed no hazard to the infants.

Results

Sound pressure level (SPL)

Noise levels resulted due to activities of the caregivers and doctors:

- Grand rounds 60-73 dB
- Using incubator tops as a writing surface 58-66 dB

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- Banging incubator to stimulator to stimulate apnoeic neonates 130-140 dB
- Staff (paramedical) giving over conversation 59-64 dB
- Placing bottle of formula on the top of the incubator 88-107 dB
- Closing cupboard door 70-95 dB
- Closing incubator potholes 82-105 dB
- Monitors IV pump alarm 63-79 dB
- Apnoea alarm 58-89 dB
- Bubbling in ventilator tubing up to 80 dB
- Ventilator 64-83dB
- Suction pump 61-84 dB
- Nebuliser 70-90 dB
- Miscellaneous telephone ringing up to 80 dB
- Food trolley 71-90 Db

Discussion

Covering the incubator of the infant significantly reduced the level of noise within an incubator. In an addition to this, instructing the nursing and other staff to modify their speaking behaviour like use of different communication strategies resulted in a lowering of baseline noise levels. A survey of hospital employees indicated their perception that noise levels were high enough to interfere with their work and with the comfort and recovery of adult patients suggested that silicone earplugs play an effective role in hearing protection of low--birth weight infants. The study showed that more infants passed the auditory brainstem response test during hospital stay who were made to wear silicone earplugs.

Paediatrician are encouraged to monitor and control the ambient noise in the NICU and within the incubators. A noise level >45 dB is of concern according to American Academy of Paediatrics. Ideally, as proposed by the US Environmental Protection Agency, a noise level exceeding 45 dB is best avoided. NICU personnel should devise simple strategies to reduce noise in the nursery (no tapping or writing on the tops of incubators and hoods, careful closing of incubator doors, soft shoes). If these basic modified strategies fail to reduce monitored noise levels, more technical strategies need to be considered (incubator covers, using the equipments that are less noisy). Long et al demonstrated that hypoxemia occurred in infants in conjunction with sudden loud noise (of approximately 80dB). A study has demonstrated that loud noises in the NICU significantly changes the behavioral and physiological responses of the infants. Chick hatchlings reared in an NICU-like environment with similar noise levels failed to demonstrate habituation in their peeping behaviour after a white noise stimulus. The equipment manufacturers should also be encouraged by paediatrician to reduce the noise generated by the equipment.

Conclusion

Exposure to excessive noise in NICU may result in high frequency hearing loss in association with other risk factors (co morbid conditions) and drugs (rampant use of not needed Neosporin powder) may result in cochlear damage. Paediatrician is encouraged to monitor sound in the NICU as proposed by US (EPA) noise level of more than 45db is of concern.

Simple strategy to reduce noise in nursery- soft shoes, no tapping or writing on the top of incubators, careful closing of incubator doors and earmuffs or more complicated technical strategies sound protector and porous material as incubator cover and flashy lights instead of alarm. Hearing loss is significant in survivors of NICU affecting quality of life. It is evident from literature that, despite acknowledging that excessive noise in the NICU is an on-going problem, there is still a

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paucity of data on effects of noise on preterm infants, though many studies have documented the effects on full term infants.

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