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Original Research Article

Effect of ambient noise in NICU on infant hearing

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ABSTRACT

It is known that high noise levels can be harmful to preterm infants, causing physiological and psychological disorders. The ambience of NICU should have sound or noise levels within safe limits for the healthy development of preterm infants. The aim of present study was to create awareness about the effect of ambient noise in NICU on infant hearing. 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. 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.

1. Introduction

Universal Neonatal hearing screening program is one of the important services that are offered in the hospitals by most of the neonatologist. The rate of hearing impairment in neonates admitted to neonatal intensive care units (NICU) is found to be at 2–15%, as compared to the 0.5% in full-term births. The neonatal intensive care unit is an environment filled with dedicated care givers, state of the art monitors and lifesaving drugs which collectively works to provide the best care for the critical neonates. A so far underappreciated result of having these resources mingled together is an elevated level of environmental noise which may cause hearing impairment.[1]

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.[2] 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 overwhelming stimuli like the continuous presence of ambient noise, may have various effects on preterm infants.[3]

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

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sounds should not exceed 65 dBHL. As per studies, these noise levels exceed more than 70% of the time for all levels of care.[4] This exposure to the constant background noise generated by contemporary life-support equipment in the NICU can also lead to hearing loss. The first effect of noise is outer hair cell damage which is seen in the results of otoacoustic emission (OAE) and automated auditory brain stem response (AABR). Particularly dangerous for newborns are hazardous sound levels during transport. For example, in an ambulance the noise level can reach 90–110 dBHL. Regardless of the recommendations and directives given by various committees, different researchers have found that the noise levels in the NICUs have exceeded the recommended limits.[1,5]

Several Studies have reported the evidence of the existence of noise in the NICU and its hazardous effects on infant hearing. AAP Committee on Environmental Hazards (1974), in their review on the neonatal aspects of noise pollution stated that the excessive noise exposure results in hearing impairment by damaging the organ of Corti. In a cohort of 273 infants, weighing 1500g or less and who were exposed to noise of 65 dB, 10 had sensory neural hearing loss, out of which eight had bilateral sensorineural hearing loss in speech frequency spectrum (250- 8000 Hz) among the 129 surviving infants.[3] This study also found that four of the eight infants who had bilateral hearing loss were severely handicapped by their degree of hearing loss and required special education. Even though, four were able to compensate for the loss with hearing aids and remedial help, other two children had unilateral loss.[3] The purpose of present study was to assess the noise levels in NICUs' (NICU-Neonatal intensive care unit)

2. 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.

3. Results

Table 1 show the sources of noise and decibel level.

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

1. Grand rounds 60-73 dB
2. Using incubator tops as a writing surface 58-66 dB
3. Banging incubator to stimulator to stimulate apnoeic neonates 130-140 dB
4. Staff (paramedical) giving over conversation 59-64 dB
5. Placing bottle of formula on the top of the incubator 88-107 dB
6. Closing cupboard door 70-95 dB
7. Closing incubator potholes 82-105 dB
8. Monitors IV pump alarm 63-79 dB
9. Apnoea alarm 58-89 dB
10. Bubbling in ventilator tubing up to 80 dB
11. Ventilator 64-83dB
12. Suction pump 61-84 dB
13. Nebuliser 70-90 dB
14. Miscellaneous telephone ringing up to 80 dB
15. Food trolley 71-90 dB

Table 1: Sources of noise and decibel level

S.No.	Location	spl dB	Peak db	Max peak db
1	Knocking the door	89	93	96
2	O2 Hood	68	81.9	93.8
3	Phone via operator	74	93	98
4	Nebuliser	75	88.7	91.4
5	Mobile	79	91.3	91.3
6	Infusion Pump syringe	70.4	84.6	97
7	Nurse taking over	77	87.9	93
8	Baby crying	82.4	91	94
9	Ventilator on	68	83	86.1
10	Ventilator alarm	64	91	96.5
11	Fan on/off	64.6	89.2	90.2

Sound pressure level (SPL)

4. Discussion

Covering the incubator of the infant significantlyreduced the level of noise within an incubator. In an addition to this, instructing thenursing and other staff to modify their speaking behaviours like use of different communication strategies resulted in a lowering of baselinenoise levels. A survey of hospital employees indicated theirperception that noise levels were high enough to interfere withtheir work and with the comfort and recovery of adult patients.[6] Al Madhoob and Ohlsson (2022) 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.[7]

Paediatricians 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 noiselevel exceeding 45 dB is best avoided. NICU personnel should devisesimple strategies to reduce noise in the nursery (no tapping orwriting on the tops of incubators and hoods, careful closing ofincubator doors, soft shoes). If these basic modified strategiesfail to reduce monitored noise levels, more technical strategiesneed to be considered (incubator covers, using the equipments that are less noisy).[4]

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 significantlychanges the behavioural and physiological responses of the infants.Chick hatchlings reared in an NICU-like environment with similarnoise levels failed to demonstrate habituation in their peepingbehaviour after a white noise stimulus. The equipment manufacturers should also be encouraged by paediatricians to reduce the noise generated by the equipment. [8]

Investigators globally have repeatedly monitored the background noise in the ambience of the NICU. Regardless of the recommendations by various committees and researchers in collaboration, investigators have found that the noise levels in NICUs have exceeded the recommendations. The authors reported that the ambience of NICU has potential to cause hearing loss, difficulty in processing auditory inputs, disrupts sleep and the physiological systems in infants [3,4]. Subtle developmental problems occur in infants following significant exposure to the NICU's physical and care-giving environment.

5. 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 ear muffs 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, in spite of acknowledging that excessive noise in the NICU is an on-going problem, there is still a paucity of data on effects of noise on preterm infants, though many studies have documented the effects on full term infants.

6. Conflicts of Interest

None.

7. Source of Funding

None.

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