Research Article

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Effect of Educational Intervention among NICU Team and Parents in Reducing Sound Level in Neonatal ICU

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Abstract

Objective: Baseline sound level in a tertiary level NICU were measured and compared before and after educational intervention to evaluate the impact of a noise awareness educational program in decreasing the sound level in nursery.

Methods: The study was conducted in a tertiary level NICU. Participants were NICU doctors, staff and parents of babies admitted in NICU. Participants were educated regarding hazards of increased sound level in NICU and measures to reduce the sound level. Sound level in NICU was monitored using a sound meter at seven different time periods every day for 2 weeks. After 1 week of educational intervention period of NICU doctors, staff and parents, post intervention readings in similar format were checked again for 2 weeks.

Results: There was a significant reduction in sound levels (61.9+7.37 dBA to 56.2+5.12 dBA, $p=0.002$) at pre-intervention and post intervention period respectively. There was a significant difference in sound levels ($p<0.01$) within the groups at different time periods.

Conclusion: Noise in the NICU is more than the recommended sound levels of 45 dBA. Activity of people on floor is a significant contributor. Educational interventions of doctors, staff and parents can reduce sound levels significantly, and should be promoted in every NICU.

Keywords: Sound level; Newborn; Neonatal intensive care unit

Introduction

NICU admissions usually comprise of sick or premature newborns who require constant supervision and monitoring. To achieve this, neonatal doctors and staff work effortlessly and provide them the desired care. Management of sick new-born in the Neonatal Intensive Care Unit (NICU) is a tough and demanding task as during this period, new-borns are often exposed to raised sound levels.

Exposure to noise and other environmental factors in the NICU may even result in cochlear damage and disrupt the normal growth and development of premature infants [1]. The American Academy of Pediatrics (AAP) recommends the proposal of US Environmental Protection Agency that sound levels should be less than 45 dB in the NICU, and recommendations for hospitals include sound levels no louder than 35 dB during night shift [1]. We conducted a prospective analytical study to compare baseline sound level in a tertiary level Neonatal ICU before and after educational intervention to NICU team and parents and compared it with the recommended level of 45 dBA.

Methods

This study was done in tertiary level 12 bedded NICU in a corporate hospital in from August to September 2015.

Sound level was noted in different time period (morning: 3-5 am, sisters over: 8-9 am, doctors over: 9-10 am, Head of department round: 1-4 pm, doctors over: 5-6 pm, night: 11 pm-1 am and during resuscitation or sick baby admission. During a single time period, three sound level readings were noted randomly with gap of 15 min and the average was taken as final reading. Total such seven readings were then noted in 24 h period by assigned fixed members in NICU. To avoid any bias, staff and doctors were informed that this is done as a regular practice in NICU.

A digital sound level meter was used for sound measurement. It was calibrated and kept at height of 36 inches (the usual height at which babies are from ground level on warmer), and at the centre of the main

room in NICU. Sound levels were recorded daily for 2 weeks. Total number of people on the floor was also noted. The average occupancy of babies during study period was almost similar to the average occupancy throughout the year (8-10 babies).

A one week educational intervention was then provided to the resident doctors and staff in the department. The parents of admitted babies were educated separately. They were made aware of the hazards of high sound levels in nursery and were explained the requirement of reducing sound level in short classes with the help of PowerPoint presentation, ensuring 100% coverage. Baseline interventions to reduce sound levels was taught: a) reducing the alarm levels of all the monitors to a safe hearing level b) talking in a low volume just enough to be audible in the NICU c) no bedside hand over to be given by nurses and doctors. d) volume of music in NICU kept below 40 dB e) making habit of promptly attending rather than anticipating monitor alarms f) all were encouraged to download sound level app in their mobile for practical purpose of measuring sound levels for personal use g) parents of admitted babies were sensitized regarding sound levels guidelines in nursery, and explained not to talk/discuss while visiting baby bedside h) NICU phone ringer was reduced to minimal level which would be well audible i) posters depicting various sound levels during specific activities were put in the unit j) At time of cleaning, workers were explained to minimize unnecessary sound.

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After this interventional period, sound level was noted again in similar format for 2 weeks.

The study assessed the following outcomes: average sound level during different time period, peak sound levels, significance of no of people on floor and efficacy of educational intervention on sound levels in NICU. This study was approved by the institute ethics committee.

In the present study, Variables were reported as mean $\pm$ standard deviation (SD). Univariate analysis was done using independent sample t-tests, Mann-Whitney U test for continuous variables. For multiple data sets (>2 groups), one way ANOVA was used for continuous variables, robust test of significance was used in the case of homogeneity of data was significant. Post hoc analysis was done using Tukey HSD. SPSS version 22 (SPSS, Inc., Chicago, IL, USA) was used for data analysis. A two sided p-level of <0.05 was considered statistically significant.

Results

The mean $\pm$ SD of sound levels during pre- intervention and post-intervention period, along with range is shown in Table I. Analysis within the pre-intervention period of 2 weeks by one way ANOVA revealed significant difference in sound levels ($F(6,91)=6.430$, $p<0.01$) within the groups at different time periods. Post hoc analysis using

Tukey HSD showed that sound levels at time period when babies were resuscitated/sick baby admission (70.00 ± 7.74 dBA) differed significantly from sound levels at rest of the time periods as shown in Figure 1. Rest of the time periods did not differed significantly within the groups. Lowest sound level was seen during night 11 pm-1 am period, with mean 56.71 ± 7.09 SD, with second lowest seen in early morning period 57.57 ± 7.71 SD. The lowest sound level ever recorded was 48 dBA at night (Table 1).

Analysis within the post intervention group by one way ANOVA suggested that there was a significant difference in sound levels ($F(6,91)=9.38$, $p<0.01$) within the groups at different time periods. Post hoc analysis using Tukey HSD showed that sound levels at time period when babies were resuscitated/sick baby admission (62.93 ± 4.71 dBA) also differed significantly from sound levels at rest of the time periods, shown in Figure 1. Sound levels at morning (3-5 am), which was 52.93 ± 2.33 SD also differed significantly with the evening doctors over (5-6 pm) with mean 57.78 ± 5.22 SD, respectively. Rest of the time periods did not differed significantly within the groups (Figure 1).

There was a significant reduction in sound levels ($p=0.002$) at pre-intervention and post intervention period respectively. Pre-intervention average sound level was 61.9 ± 7.37 dBA, while post intervention average sound level was 56.2 ± 5.12 dBA.

Time periods	Sound levels Pre-intervention (Mean $\pm$ SD)	Sound levels Post-intervention (Range)	Sound levels Pre-intervention (Mean $\pm$ SD)	Sound levels Post-intervention (Range)	P value
Morning (3-5 am)	57.57 ± 7.71	48-80	52.93 ± 2.33	50-57	0.041
Sisters over (8-9 am)	62.07 ± 3.98	58-70	55.71 ± 2.27	52-60	<0.01
Doctors over (9-10 am)	62.50 ± 4.72	54-68	56.43 ± 2.68	49-61	<0.01
HOD round (1-4 pm)	62.71 ± 4.65	55-71	54.14 ± 5.07	45-62	<0.01
Doctors over (5-6 pm)	62.07 ± 7.46	53-81	57.78 ± 5.22	51-68	0.09
Night (11 pm-1:00 am)	56.71 ± 7.09	47-72	53.64 ± 5.30	49-65	0.206
Resuscitation/Sick baby admission	70.00 ± 7.74	52-84	62.93 ± 4.71	52-69	<0.001

Table 1: Subgroup analysis of pre and post intervention group.

Figure 1: Mean sound levels at different time period pre and post intervention.

A positive correlation between number of people present in the NICU and sound levels recorded in different time intervals before intervention ($r=0.285$, $p=0.004$) was present. No such significant correlation was seen post intervention.

Discussion

Sound level in neonatal ICU was high in pre-intervention period, with average sound level being 61.9 ± 7.37 dBA. There is significant reduction in noise level to 56.2 ± 5.12 dBA after education intervention was done. Still, noise levels continued to be fairly high above the recommended of 45 dBA. This raised level can affect neonates significantly. By 24 weeks of gestation, the human cochlea and peripheral sensory end organs complete their development [2]. The hearing threshold at 27-29 weeks of gestation is 40 dB, which improves to 13.5 dB by 42 weeks of gestation, which indicate on going postnatal maturation of these pathways [3].

Hearing capabilities of preterm new-born may get disturbed by raised sound level in NICU which usually differ from the intrauterine environment. Prolonged exposure to NICU environment is increasingly implicated as a contributor to attention difficulties [4].

A mother's speech to her infant has similar frequencies as other sounds in the nursery- monitor alarms, telephone ringers and hence it can get masked and rendered less intelligible by these sounds [5].

Ramesh et al. measured the noise levels in a tertiary NICU and found that range of sound level in the NICU was more than the recommended levels, with mean sound level in ventilator room- 68.9 dB, in the preterm room- 56.6 dB and in the extreme preterm room was -54.3 dB [6]. After post intervention, as in our study, the levels reduced significantly to 59.3 dB, 54.2 and 52.2 dB, respectively.

Darcy et al. studied sound levels in several NICU of mid-Atlantic region, which revealed that hourly mean sound levels ranged from 53.9 dB to 60.6 dB, with no statistically significant difference between noise levels recorded on day shift versus night shift, and no statistically significant difference among sites [7]. Krueger et al. in his study has noted that morning timings were noisier than other times of day [8].

For healthy auditory development, sound levels in the NICU should be similar to intrauterine environment. However, this is not possible in practice as loud and undesirable noise from various sources such as alarms, ventilators, phones and staff talking are always present in NICU [9]. Even during normal conversation, peak intensity sound can go up to 60 dBA, while use of vacuum cleaner and telephone ringing can range in 70 dBA and 80 dBA, respectively [1]. In both pre intervention and post intervention reading, maximum average sounds levels of 70 dBA and 62.9 dBA, respectively were recorded during sick baby admission or resuscitation, implying that significant activity amongst neonatal doctors and staff along with the noise from monitors during that period contributed to raised sound. Physiological responses

of term newborns to hospital nursery sound ≥ 80 dBA include apnea, bradycardia, fluctuations in heart rate, blood pressure, perfusion and oxygen saturation [2]. Hence, reducing sound level in NICU is a requirement for effective management of sick neonates.

Regarding correlation of number of people on the floor with sound levels, a positive correlation between number of people in the NICU and sound levels recorded in different time intervals was present before intervention. However, no such correlation was seen in post intervention, which implies that when people were trained they managed well in maintaining sound levels.

Despite of intervention and behavioural modification, noise in the NICU during post intervention is still higher than the recommended level of 45 dBA. Also, night time values never reached the desired 35 dBA. Activity of people on floor is a significant contributor.

Our study has documented effectiveness of reducing this level by educating the NICU staff and doctors regarding measures leading to reduced sound level in NICU. This should be implemented strictly in NICU to reduce the noise level and for better neonatal outcome.

Author Contribution

LB was involved in concept and finalization of the draft. SB was involved in data collection and manuscript preparation.

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