

Effect of noise intensity on vital parameters of newborns in a tertiary care hospital

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Abstract

Objective: To find effect of noise intensity on heart rate, respiratory rate and oxygen saturation in late preterm and term newborns in a tertiary care hospital.

Method: A controlled prospective study was carried out on 100 preterm and term newborns in the Surat Municipal Institute of Medical Education and Research during a 3 month period. Newborns were exposed to white noise of different intensities for 5 seconds and vital parameters were recorded. A statistical analysis was performed with SPSS 16.0.

Results: Out of the 100 newborns, 65 were term and 35 were late preterm (34-36 weeks). Male to female ratio was 51:49. Heart rate increased significantly ($p < 0.01$) to all levels of noise exposure i.e. from 60-70 dB and 80-90 dB in both groups. Oxygen saturation decreased as the noise intensity increased in both groups but only significantly ($p < 0.05$) in high noise intensity of 80-90 dB whereas, there was no effect on the respiratory rate and by gender.

Conclusions: A 5 second white noise has a variable effect on the vital parameters of newborns; it accelerates heart rate and decreases oxygen saturation but has no effect on respiratory rate and gender.

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(Keywords: Noise, newborns, term, late preterm)

Introduction

Noise is defined as an unwanted sound. Acoustic signals producing a pleasant sensation are referred to as “sound” whereas the unpleasant sounds are

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referred to as “noise”¹. The neonatal intensive care unit (NICU) is often characterized by loud, unpredictable noise from extraneous sources such as alarms, ventilators, phones and staff conversation to which newborn infants are especially vulnerable². Many studies have concluded that the average sound levels in NICU range from 50-75 dB^{3,4,5}, 45- 85 dB^{6,7} and 61-80 dB^{8,9,10}, whereas, the American Academy of Paediatrics (AAP) recommends a maximum safe noise level of 45 dB in an NICU¹¹. There is growing concern that such noise puts newborns at high risk for adverse health effects. Loud transient noise has a negative short-term effect on the cardiovascular and respiratory systems of newborn infants¹².

Method

A prospective controlled study was conducted by the Department of Paediatrics in Surat Municipal Institute of Medical Education & Research Hospital with the help of an audiologist from August to October 2015. The study was approved by the hospital ethical committee. A total of 100 healthy and haemodynamically stable newborns constituted the study population. The newborns were exposed to white noise of different intensities (60dB, 70dB, 80dB and 90dB) for 5 seconds. The test was painless and performed on the newborn without any contraindications, when they were in a state of natural sleep, A headset connected to a computer was applied to the newborn’s ear. The device emitted a white noise with intensities of sound level (60dB, 70dB, 80dB and 90dB) for 5 seconds and the results produced by the newborn’s ear were recorded. Simultaneously vital parameters (heart rate, respiratory rate and oxygen saturation) were observed on a portable cardio-respiratory monitor and recorded after a minute of sound intensity stimulus. After 5 minutes, another sound intensity stimulus was given and its effect on vital parameters was also recorded. A statistical analysis was performed with SPSS 16.0.

Results

Out of the 100 newborns 65 were term (gestational age 37-42 weeks) and 35 were late preterm (gestational age 34-36 weeks). There were 51 males and 49 females. There was a significant increase in heart rate (HR) with increase of sound intensity as depicted in Table 1.

Table 1: Effect of sound intensity on heart rate with gestational age

Sound level	Gestational age	Mean heart rate	SD	Mean difference	P value	95% CI
Basal	Late preterm	147.66	7.094	7.90	P<0.01	4.22-11.58
	Term	139.75	9.630			4.53-11.26
60 -70 dB	Late preterm	152.93	8.330	8.83	P<0.01	6.24-11.43
	Term	144.09	9.150			6.30-11.36
80 - 90 dB	Late preterm	158.11	9.520	8.91	P<0.01	6.26-11.55
	Term	149.20	8.780			6.19-11.63

HR increased with increase in the sound intensity in both late preterm and term infants which is statistically significant at all levels of white noise but

the values did not cross the maximum normal limit in newborns i.e. 160/minute.

Table 2: Effect of intensity of sound on heart rate, respiratory rate and oxygen saturation by gender

Sound level	Gender	Mean heart rate	SD	P value	Mean respiratory rate	SD	P value	Mean oxygen saturation	SD	P value
Basal	Male	142.59	9.7	0.942	46.68	6.9	0.116	94.78	1.7	0.282
	Female	142.45	9.5		48.87	6.8		94.42	1.5	
60-70 dB	Male	146.49	10.1	0.308	46.35	7.7	0.690	93.64	3.5	0.527
	Female	147.91	9.4		45.91	7.7		92.55	3.6	
80-90 dB	Male	151.86	9.9	0.510	42.86	8.7	0.863	91.63	4.4	0.604
	Female	152.82	10.1		43.06	7.5		89.62	3.8	

There was no statistically significant difference found by gender when the effects of sound intensity on HR,

respiratory rate (RR) and oxygen saturation were compared (Table 2).

Table 3: Effect of sound intensity on respiratory rate with gestational age

Sound level	Gestational age	Mean respiratory rate	SD	Mean difference	P value	95% CI
Basal	Late Preterm	48.94	6.5	1.81	P<0.845	-1.06976
	Term	47.12	7.1			-1.00418
60 -70 dB	Late Preterm	45.33	8.0	-1.23	P<0.161	-3.48386
	Term	46.57	7.4			-3.54121
80 - 90 dB	Late Preterm	42.40	7.7	-0.86	P<0.684	-3.25324
	Term	43.26	8.3			-3.20559

The respiratory rate decreased with an increase in intensity of sound in both late preterm and term

newborn but it was not statistically significant (Table 3).

Table 4: Effect of sound intensity on oxygen saturation with gestational age

Sound Level	Gestational age	Mean oxygen saturation	SD	Mean difference	P value	95% C.I.
Basal	Late Preterm	94.34	1.8	-0.41	P<0.399	-1.11419
	Term	94.74	1.6			-1.14703
60 -70 dB	Late Preterm	91.73	3.4	-2.12	P<0.194	-3.14395
	Term	93.85	3.5			-3.14317
80 - 90 dB	Late Preterm	89.42	3.8	-2.03	P<0.017	-3.23509
	Term	91.46	4.2			-3.20024

Both late preterms and term newborns showed a decrease in oxygen saturation, but late preterms had significant decrease in oxygen saturation at a higher sound intensity of 80-90 dB (Table 4).

Discussion

Studies on the effect of sound intensity on different parameters such as HR, RR, blood pressure and oxygen saturation on newborns have varying results. Wharrad and Davis *et al*¹³ compared the HR response

of 22 full-term and 20 preterm newborns (mean gestational age 32 weeks) to a 5 second white noise stimulus of 80, 90 and 100 dB. This resulted in a rise of HR in the both preterm and full-term newborns which was proportional to the intensity of the stimulation but this was only significant in the preterm newborns with the exposure to 90 and 100 dB stimuli ($p < 0.01$). In our study HR was significantly increased ($p < 0.01$) at 60 dB level and above. However, never did the HR exceed the maximum limit of 160/minute for it to be labelled a tachycardia. On the contrary, the study by Vranekovic¹⁴ conducted on 30 full term and 15 preterm (<1750g) babies exposed to a 5 second warbled tone (100 dB) led to a heart acceleration but with a milder response in preterms. There was a decreased RR in all newborns to increasing sound intensity with stimulus in study by Wharrad and Davis *et al*¹³ with conditions as above, but it was statistically significant only with 100dB level. In our study also there was decrease in RR with increase in sound intensity but it was not statistically significant. On the contrary, there was increase of RR and a decrease in oxygen saturation as the intensity of sound increased, in the study by Zahar & Balyan¹⁵ and Long *et al*¹⁶; however the measurement was observed at the postnatal age of 2- 21 days in preterm newborns. A decrease in the level of oxygen saturation in preterms with increase in noise ($p = 0.000$) was observed in study of Cardoso SM¹⁷ and Hisham *et al*.¹⁸ In our study there was a decrease in oxygen saturation with the increase in the levels of noise but it was statistically significant only when newborns were exposed to a high level of noise (80-90 dB). Extremely premature newborns were not included in our study due to the unstable vital parameters and requirement of continuous monitoring. This is a limitation of the study.

Conclusions

A 5 second white noise has a variable effect on vital parameters of newborns; it accelerates HR and decreases oxygen saturation but has no effect on RR and these effects do not differ by gender.

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