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VARIABILIDADE DA FREQUÊNCIA CARDÍACA EM RECÉM-NASCIDOS DE ALTO RISCO NA PRESENÇA DE RÚÍDO

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HEART RATE VARIABILITY IN HIGH-RISK NEWBORNS IN THE PRESENCE OF NOISE

Variabilidade da frequência cardíaca em recém-nascidos de alto risco na presença de ruído

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INTRODUCTION

Human hearing may be impaired due to prolonged exposure to high intensity noise. The noise does not have a mathematical expression defining the time and cannot be predicted in time, even after detection. The level of influence of a noise can be presented in several ways. One of the most important is the ratio between the desired signal power and the noise power, or simply, the signal-to-noise ratio (SNR)1.

The intense and continuous noise that hospitalized newborns are exposed to can lead to sensory and motor disorders, as well as physiological and behavioral changes. Besides, the interruption of rest and sleep, there is a concurrent disturbance of the circadian cycle of these infants. As a result, there is an increase in stress, fatigue and irritability. Consequently, these behavioral alterations may lead to an increase of the oxygen consumption and heart rate, thus resulting in increased calorice.

ABSTRACT

Purpose: to assess changes in heart rate of babies at risk in an intensive care unit in the presence of noise. Methods: the Research qual-quantitative. It examined the variation in heart rate in babies exposed to various sources generating noise. The measurements were separately in three areas known as 'boxes, observed in three intervals of five minutes each. The heart rates of babies were verified by reading of monitors coupled the apparatus to pulse oximetry. The measurement of noise was made at the back of each box during two periods/days, between eight and nine hours, with a distance of approximately 30 cm from the source boisterous, using decibelimeter digital IP-130, weighting “C”, frequency of 31.5Hz ~ 8Khz. the pits were equipped with oxygen outlet, infusion pump, a vacuum aspirator, compressed air, vacuum cleaners manuals, washbasin, stainless steel and the presence of at least two employees. Results: it was recorded, during the research, noise levels above the recommended by the American Academy of Pediatrics, Brazilian Association of Technical Standards and the World Health Organization. There was a significant variation in heart rate during the measurement: The babies in the Box a presented 11 beats per minute, in Box two four beats per minute and in Box three thirteen. Conclusion: we observed variations in peak in noise, as well as the heart rates of evaluated babies. Considering the harmful effects that noise can cause in neonates, the results show the importance of an intervention aimed at suggestions for improvement of the environment and awareness of the multidisciplinary team.

KEYWORDS: Intensive Care Units; Heart Rate; Noise

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Conflict of interest: non-existent
intake and retarded weight gain of these babies, prolonging the period of stay in Neonatal Intensive Care Unit (NICU).

Other physiological changes that may be present are: hypoxia, increased blood pressure and intracranial pressure. These are factors that predispose preterm newborns to intraventricular cranial hypertension, apnea, bradycardia and disturbances in the social interaction of these babies.

In 1980, the Pan American Health Organization and the World Health Organization recognized that noise can disturb rest and sleep, and these factors may also contribute to deficits in human communication, as well as cause psychological, physiological and even pathological reactions. The recommended noise level is 40dBA. The American Academy of Pediatrics suggests the intensity of 50 dBNPS as the limit of noise exposure to the newborns.

The Brazilian Technical Standards Association (Associação Brasileira de Normas Técnicas – ABNT) recommends the level of criteria for evaluating noise in environments by means of Brazilian Standard Rules no. 10151/87 – NBR 10151 in hospitals, and hospital (nursery), should be 50dB during the day and 45dBA at night. The Brazilian Standard Rule no. 1052/87 – NBR 10152/87 recommends that the noise level for acoustic comfort in environments such hospitals, should be 35dB during the day and 45dBA at night.\(^3,4\)

Therefore, the population of premature and low birth weight neonates is more susceptible to environmental stimuli since they are still in process of brain development and maturation. There are no existing inhibitory controls in the processing of sensorial information. The lower the gestational age, the greater the risk of abnormal brain development.\(^6,7\)

Thus, the management of the intensive care environment should be the minimization of noise and light, thus preventing an iatrogenic effect in this population. It is essential for the healthy growth of these babies. In order to promote their adequate growth and development, a change of professional attitude is necessary. There is a need to insure there are adjustments made toward less noisy behavior, as well as adequate acoustic baffling in rooms in a hospital environment.\(^3,8,9\)

The purpose of this research was to assess changes in heart rate of high-risk infants admitted in a NICU of a public state maternity in Maceió – AL, Brazil, in the presence of high noise levels.

## METHODS

This research was approved by the Ethics Committee in Research of the Universidade Estadual de Ciências da Saúde Alagoas – UNCISAL, protocol no.1735. All individuals responsible for the newborns in the study signed the Informed Consent Form indicating voluntary participation in this study.

This research was a cross-sectional and descriptive study of a qualitative and quantitative nature, performed in an Intensive Care Unit (ICU) of a public maternity hospital in the state of Alagoas, Brazil.

Eligibility criteria for the selection of patients were newborns with a gestational age between 27-30 weeks, with normal appearance and good general state of health referred in daily upgrades. Babies who had neurological disorders and diseases/congenital syndromes were excluded.

Study participants were 10 babies from the NICU. The study was conducted during daytime hours between 8 a.m. and 9 a.m. This time of day was chosen because of the rotation of employees on duty, visits from parents and other professionals, as well as the presence of the cleaning staff. Measurements took place in an area called a Box, a room that measured 3,20 x 4,20 meters, containing a maximum capacity of eight beds. Each of these was equipped with an oxygen outlet, infusion pump, vacuum aspirator, compressed air, manual aspirator, a stainless steel washbasin and the constant presence of at least two employees.

Noise was generated from a number of sources. These included: the handling of the incubator, ventilator, infusion pump, secretion aspirators, oxygen and compressed air outputs, the telephone, the opening and closing noise of the trash bin, running water in the sink, and the conversations of the professional staff members. All of these sources were included in the analysis.

It is noteworthy that during the research there was no interference from hospital officials. The investigation was performed in secret, and all communication was limited to the head nurse.

The times for each measurement ranged from five to ten minutes at an approximate distance of 30 cm from the source of the noise. Measurements were made with an IP-130 digital decibel meter, detachable microphone, condensed ½ inch, operating in the compensation circuit “C” and slow response circuit, with a slow time weighting 15sec, with the measuring level between 60 and 130dBA.

Concomitant to environmental noise measurement, the heart rate of the participating newborns was monitored. The babies admitted to the analysis unit are routinely kept under continuous monitoring by pulse oximetry. The analysis was done by reading the monitors connected to the pulse oximetry apparatus without involving any sort of extra handling of the newborns.
Noise induced Heart Rate variation in neonatals

RESULTS

Noise levels above the recommended by agencies/standards (AAP, ANBT– NBR 10151 and NBR 10152/1987 and WHO) were registered during the study, for verification of points of higher noise.

Variations of peak noise, of heart rate of the assessed infants were observed, occurring variations of heart rate in the babies together with the noise level that they were exposed to. Average of noise levels of apparatus/ equipment / people existing in the environment.

Front of the observation of heart rate (HR) during the period proposed, the Box 1 presented a minimum variation during the observation: 11 beats per minute (bpm). The variability of heart rate in the exposure of noise level of 80,1dB, 80,8dB and 73,6dB were respectively (Table 1): 153bpm, 144bpm and 155bpm. During the study, the record of higher HR (3º moment with HR = 155 bpm) was realized in the lowest peak noise (73.6 dB), but still in a high noise level, above to the recommended (Table 1).

Table 1 – Noise Level Average X Heart Rate Average : Box 1

<table>
<thead>
<tr>
<th>Risk Time</th>
<th>HEART RATE</th>
<th>NOISE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1º MOMENT</td>
<td>153bpm</td>
<td>80.1dB</td>
</tr>
<tr>
<td>2º MOMENT</td>
<td>144bpm</td>
<td>80.8dB</td>
</tr>
<tr>
<td>3º MOMENT</td>
<td>155bpm</td>
<td>73.6dB</td>
</tr>
</tbody>
</table>

Source: Direct Search

Three measurements of noise in three different moments were conducted. The noise measurement was performed at the same time as it was measured the heart rate of the babies.

In Box 2, three different moments of analysis were observed: heart rate of 169bpm in the noise level of 72,4dB; 173bpm in 61,6dB and 171bpm in 63,6Db.

In Box 3, heart rate of 173bpm in the noise level of 65,9dB, 178bpm in 73,1dB and 186bpm in 77,2dB were recorded. There was a greater variation, occurring, a progressive increasing of the heart rate, but not significant: 13 bpm. Heart rates beyond the normal range were recorded. The HR peak occurred in the third moment (HR= 186 bpm) in line with the higher peak noise level (77,2 dB – that is much higher than the recommended).
A study conducted by Topf (1996) and cited by Souza (2010), observed that during 24 hours the average noise level exceeds 45 dB, with peaks over 70 dB occurring every 9 minutes. This study also reported that the oxygen masks, ventilators and the suction devices produce, each one, between 50 dB and 70 dB. The alarms and equipment produce noise levels up to 80 dB.

In the same study, noise levels above those recommended by agencies were found. The major noise sources were found to be alarms (71.4 dB “M” and 72 dB “I”), infusion pumps (74.2 dB “M” and 72.1 dB “I”), conversations between four professionals (73 dB “M” and 66 dB “I”), opening and closing the trash receptacles (73 dB “M” and 72 dB “I”), the telephone (75.3 dB “M” and 74.1 dB “I”), and running water in the sink (74.5 dB “M” and 72.6 dB “I”).

Aurélio, 2009, found noise ranging from 43.3 to 114.9 dB, with a varying approximately from 60 to 65 dB on average. These are high levels according to Brazilian and international standards.

In another study, similar noise levels were found from 48.3 to 82.6 dB. Values above those considered acceptable by the agencies were found in all studies researched. Technological resources are needed to improve the growth and development of the newborns – (NB), however, the equipment in the rooms creates a high Sound Pressure Level (SPL), making the environment noisy, contributing

<table>
<thead>
<tr>
<th>Risk</th>
<th>Time</th>
<th>HEART RATE</th>
<th>NOISE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1º MOMENT</td>
<td>169bpm</td>
<td>72.4dB</td>
<td></td>
</tr>
<tr>
<td>2º MOMENT</td>
<td>173bpm</td>
<td>61.6 dB</td>
<td></td>
</tr>
<tr>
<td>3º MOMENT</td>
<td>171bpm</td>
<td>63.6 dB</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 – Noise Level Average X Heart Rate Average: Box 2

<table>
<thead>
<tr>
<th>Risk</th>
<th>Time</th>
<th>HEART RATE</th>
<th>NOISE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1º MOMENT</td>
<td>173bpm</td>
<td>65.9dB</td>
<td></td>
</tr>
<tr>
<td>2º MOMENT</td>
<td>178bpm</td>
<td>73.1 dB</td>
<td></td>
</tr>
<tr>
<td>3º MOMENT</td>
<td>186bpm</td>
<td>77.2 dB</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 – Noise Level Average X Heart Rate Average: Box 3
to the development of possible physiological and behavioral changes.\textsuperscript{15}

The observed results showed high noise levels along with variations in the heart rates of the assessed babies. The change in the heart rate occurred during all times of measurement, but it was not significant.

During the analyzes of Boxes 2 and 3, heart rates above the normal levels were observed throughout the study period. Overall, there was an increase in the observed average. In Box 1 variations of the cardiac levels occurred, however, they were minimal. Given the average obtained in this box, it was noticed that all measurements of heart rates were within the normal range.

It is worth mentioning that the observed heart rates were recorded during individual moments. However, without knowing the clinical status of the observed infants, it is not possible to know the long term effects of the noise on the heart rate.

In another research study, no significant relation between the exposure to the noise and the variation of heart rate was found. However, behavioral and relevant clinical changes on the everyday noise in the neonatal unit were observed.\textsuperscript{16,17}

Nevertheless, another similar study demonstrated that the sudden increase of noise of 70 dB at maximum frequency range over a few seconds generates a significant increase of the heart rate in premature infants as a defensive reaction to the unexpected stimulus.\textsuperscript{18}

Although there was no significant oscillation during the observation, those changes may be clinically important to the evaluated population because of the gestational immaturity of the infants combined with the associated stressing agents and the increased susceptibility to the environmental stimuli which they are exposed to.\textsuperscript{2,4,7,14,18,19}

Thus, it is important to prevent the noise as a fundamental strategy in neonatal care, and seek to minimize neurodevelopmental disorders in infants exposed to inappropriate levels of sound pressure. To this end, it is necessary, to increase the awareness of professionals involved in the direct care of these babies, through continuing in-service education programs, in addition to insuring adequate noise level protection to the assisted population in the hospital environment.

\section*{CONCLUSION}

It was noticed the presence of high noise levels, above those recommended; it was not found relation between the Sound Pressure Level and Heart Rate variations.

\section*{RESUMO}

\textbf{Objetivo:} verificar mudanças na frequência cardíaca dos bebês de risco em uma unidade de tratamento intensivo na presença de ruído. \textbf{Métodos:} pesquisa quali-quantitativa. Analisou-se a variação da frequência cardíaca nos bebês expostos a diversas fontes geradoras de ruído. As medições ocorreram, separadamente, em três áreas denominadas boxes, observadas em três intervalos de cinco minutos cada. As frequências cardíacas dos bebês foram verificadas pela leitura de monitores acoplados a aparelhos de oximetria de pulso. A medição do ruído foi feita ao lado posterior de cada box durante dois períodos/dias, entre oito e nove horas, com distância aproximada de 30cm da fonte ruidosa, utilizando-se decibelímetro digital IP-130, ponderação “C”, frequência de 31.5Hz –8Khz. Os boxes eram equipados com saída de oxigênio, bomba de infusão, aspirador a vácuo, ar comprimido, aspiradores manuais, lavatório de inox e presença de, pelo menos, dois funcionários. \textbf{Resultados:} registrou-se, durante a pesquisa, níveis de ruído acima do recomendado pela American Academy of Pediatrics, Associação Brasileira de Normas Técnicas e Organização Mundial de Saúde. Ocorreu variação nas frequências cardíacas durante a medição, havendo variação de frequência cardíaca em todas as exposições de nível elevado de ruído. Os bebês do Box um apresentaram onze batimentos por minuto, no Box dois quatro batimentos por minuto e no Box três treze \textbf{Conclusão:} observaram-se variações de pico das frequências cardíacas em níveis elevados de ruído, não sendo relacionado que quanto maior o ruído maior a variação de frequência cardíaca.

\textbf{DESCRITORES:} Unidades de Terapia Intensiva; Frequência Cardíaca; Ruído
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