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Original Article

Effect of the Sound of the Holy Quran on the Physiological Responses and Pain Caused by Blood Sampling from the Heels of Hospitalized Neonates at the Neonatal Intensive Care Unit

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ABSTRACT

Background: Invasive procedures could change the physiological responses of neonates. The present study aimed to evaluate the effect of the sound of the Holy Quran on the physiological responses and pain caused by heel stick blood sampling in neonates.

Methods: This three-stage, two-group, clinical trial was conducted on 72 hospitalized term neonates at the neonatal intensive care unit (NICU) of Al-Zahra Hospital in Isfahan, Iran during 2013-2014. Subjects were selected via simple random sampling and allocated to two groups of intervention and control. Data were collected using a questionnaire consisting of the demographic characteristics, physiological responses, and pain of the neonates. Data analysis was performed in SPSS version 18.

Results: Post-hoc LSD test indicated that the mean respiratory and heart rates were significantly higher in the intervention group (sound of the Holy Quran) during blood sampling compared to before and three minutes after the procedure (P<0.001). In addition, the results of post-hoc LSD test showed that oxygen saturation was significantly lower during blood sampling compared to before (P=0.001) and three minutes after the procedure (P=0.002) in the intervention group. However, the difference was not statistically significant (P=0.54).

Conclusion: According to the results, playing the sound of the Holy Quran during painful procedures could positively influence the stabilization of the physiological responses in the hospitalized neonates, thereby reducing their exposure to the risk of decreased oxygen saturation and the associated complications.

Keywords: Holy quran, Intensive care unit, Neonate, Physiological responses

Introduction

Neonates hospitalized at neonatal intensive care units (NICUs) undergo various invasive procedures on a daily basis. Some studies have shown that neonates hospitalized at the NICU experience about 10-16 painful procedures every day (1), while most of these procedures could be performed during the first week of birth (2).

Previous studies have denoted that due to the incomplete development of the nervous system,

neonates cannot sense pain. However, during a 20-year period, American and European researchers proved that neurochemical, anatomical, and physiological pain transmitters are well developed in neonates (3). Considering the development of pain receptors since birth, performing painful procedures without applying pain relief methods could affect the physiological and behavioral responses of hospitalized

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neonates (1, 4).

Physiological responses lead to changes in the response to pain. Moreover, painful provocations and stress may increase the catecholamine level, heart rate, blood pressure, and intraocular pressure. Decreased blood oxygen and heart rate, acidosis, increased blood glucose, irregular breathing, and pneumothorax are among the other pathologic conditions caused by pain responses in neonates (5). Medicinal and non-medicinal methods could be used for pain relief in the neonatal period (4, 6).

Today, there has been growing interest in non-medicinal pain relief methods. One of these approaches is using pleasant audio stimuli, which is known as music therapy (7). Music could be a stimulant causing physiological and psychological responses in the listener (8, 9). According to the literature, music is part of complementary care and a natural, noninvasive stimulant, which could be used to achieve therapeutic and evolutionary goals in the neonates hospitalized at the NICU. Furthermore, music therapy is a proper alternative to ambient noises (10). However, such methods are not commonly applied for pain relief due to the lack of nursing personnel and heavy workload of nurses during working shifts, as well as the increased rate of NICU admissions in hospitals.

Reciting the verses of the Holy Quran has a beautiful sound and is considered to be one of the most magnificent miracles of the Holy Quran with its unique order (11). To date, various studies have denoted the positive effects of the sound of the Holy Quran on improving vital signs during invasive procedures in preterm neonates, breathing in the patients with mechanical ventilation, and decreasing anxiety and the duration of endotracheal intubation following major surgeries (12, 13).

Despite the harmful effects of painful procedures without applying pain relief methods on neonates, most procedures in NICUs could be performed without effective measures to relieve pain (14). In this regard, Ricardo et al. (2008) claimed that the pain caused by 2.79% of the procedures was relieved without medicinal and non-medicinal methods, while 2.1% was relieved by analgesics, 18.2% was relieved through non-medicinal, palliative interventions, and 20.8% was relieved through medicinal and non-medicinal palliative interventions (15).

No prior studies have been focused on the effect of music therapy on the physiological responses of neonates during painful procedures.

Pain management is an important part of neonatal care. Currently, due to the lack of nursing personnel and heavy workload of nurses, pain management is frequently neglected in neonates, especially through complementary medicine. Since uncontrolled pain adversely affects the physiological responses of neonates, the present study aimed to evaluate the effect of the sound of the Holy Quran on the physiological responses caused by blood sampling from the heels of hospitalized neonates at the NICU.

Methods

This three-stage, two-group clinical trial aimed to evaluate the effect of the sound of the Holy Quran on the physiological responses and pain caused by blood sampling from the heels of hospitalized neonates at the NICU of Al-Zahra Hospital in Isfahan, Iran during 2013-2014. This specialized hospital was selected considering the highest number of neonatal admissions in Isfahan.

The number of the subjects in each group was 36 (total: 72), which was estimated using the following formula:

In the pre-intervention phase, the required permit was obtained from the Vice Chancellery for Research at Isfahan University of Medical Sciences, and a letter of recommendation was provided to the managers of Al-Zahra hospital and the NICU. Following that, the researcher referred to the NICUs and initiated the research.

The names of the neonates were written on two small sheets labeled with even and odd numbers, which were placed in a box, and one paper was randomly picked from the box. The first paper (odd number) was allocated to the intervention group, and the second one (even number) was allocated to the control group. During 5 December 2013-5 May 2014, the researcher referred to the NICU every morning at 7-12 o'clock. The neonates who were admitted to the NICU on odd days were allocated to the intervention group, and those admitted to the department on even days were allocated to the control group.

The researcher selected the eligible neonates based on the inclusion and exclusion criteria. The inclusion criteria were as follows: 1) gestational age of ≥36 weeks; 2) admission to the NICU; 3) not receiving oxygen before and during the study; 4) healthy hearing using the startle test; 5) full consciousness; 6) not undergoing painful procedures before the study and 7) not being nil per os. The exclusion criteria were as follows: 1) unwillingness of the parents to continue the study;

2) need for oxygen therapy during the study for any reason; 3) unsuccessful first attempt in collecting blood from the neonate's heel and 4) changes in the general condition of the neonate during the study.

After explaining the study objectives and procedures to the parents of the neonates and obtaining informed consent, the researcher started the intervention. Before the intervention, the hearing of the neonates was evaluated using the startle test, and the infants with healthy hearing were enrolled in the study. In the pre-intervention phase, the researcher evaluated the physiological responses and pain in the neonates of the intervention and control groups.

A checklist was used for data collection in the present study. The checklist contained seven items, and the first four items included the demographic characteristics of the neonates. To answer these questions, data were recorded from the medical files of the subjects. The other three items in the questionnaire were about the physiological responses (heart rate, respiratory rate, oxygen saturation percentage) of the infants. The physiological responses of the neonates were measured using Saadat monitoring device, and the condition of the device was approved by the manufacturer and engineer in charge. It is notable that the device was used three times in a row for one neonate, so that its reliability would be confirmed. The researcher observed Saadat monitoring device, which was attached to the neonate, and recorded the physiological responses in a checklist.

Pain evaluation in the neonates was performed by the neonatal infant pain scale (NIPS), which is a pain measurement test for preterm and term infants. The overall score of NIPS is calculated within the range of 0-7. This item has six items, including facial condition, crying, respiratory pattern, hand mobility, leg mobility, and state of consciousness. The minimum and maximum scores of NIPS are zero and seven, respectively. Scores 0-3 indicate the absence of pain, scores 3-5 represent moderate pain, and scores 5-7 show severe pain. Pain assessment was carried out by a qualified NICU nurse during and after the intervention. Recording of the physiological responses in the checklist was performed by the researcher through the observation of Saadat monitoring device, which was attached to the neonates.

The validity and reliability of NIP were confirmed based on the studies by Diley (2008) and Khodaei (2010) (r=98). The face validity of the checklist of physiological responses was verified by a pediatric professor, and since the checklist was only completed by the researcher, there was no need to measure its reliability.

During the intervention, the neonates in the intervention and control groups were laid on their back in order to prevent further excitation (16) and fed by breast milk half an hour before the intervention (15). During blood sampling from the heels of the neonates in the intervention group, the sound of the Holy Quran (recitation of Al-Rahman Surah with the sound of Abd-Al-Baset, the famous master of Quran recitation, selected based on the opinions of three clergy professors at the Seminary) was played using an MP3 player device at a one-meter distance from the neonates' beds (17), with the sound intensity of 65 dB since three minutes before the procedure (18).

Before starting the intervention, sound intensity was measured using a standard sound meter, and the sound of the Holy Quran was played for the neonates (sound meter model: Lutron SL 4001, made in Italy). The sound of Quran was played throughout the blood sampling procedure until three minutes afterwards. At this stage, the co-researchers disinfected the heels of the neonates using cotton soaked in alcohol and put the lancet into the side of the heel. The researcher measured and recorded the physiological responses (oxygen saturation, heart rate, and respiratory rate) and pain of the infants three minute before, during, and three minutes after the intervention. It is notable that if a neonate was sleeping or crying, blood sampling was delayed until after waking up or being calmed down. In the control group, the co-researchers collected the blood samples from the heels of the neonates without performing palliative interventions. The physiological responses of the neonates and pain were measured and recorded by the researcher three minutes before, during, and after the intervention. Additionally, all the neonates received routine care during their hospitalization.

Data analysis was performed in SPSS version 18 using descriptive statistics (frequency distribution, mean, and standard deviation) and inferential statistics (independent t-test, Chi-square, ANOVA, and post-hoc LSD).

Results
The present study aimed to evaluate the effect of the sound of the Holy Quran on the physiological responses caused by blood

sampling from the heels of hospitalized neonates. In total, 72 neonates were randomly selected and allocated to two groups of intervention (n=36) and control (n=36). In the Holy Quran group, 52% of the neonates were male, and 48% were female. In the control group, 68% and 32% were male and female, respectively. The results of Chi-square showed no significant difference in the frequency distribution of gender between the study groups (P=0.25). Moreover, the results of independent t-test showed no significant difference between the groups regarding the mean age, gestational age, birth weight, and current weight (P>0.05) (Table 1).

According to the results of repeated measures ANOVA, the mean heart rate of the neonates had a significant difference in the intervention and control groups at the three measurements intervals (P<0.05). Furthermore, the results of post-hoc LSD indicated that in the Holy Quran group, the mean heart rate was significantly higher during blood sampling compared to before (P<0.001) and three minutes after sampling (P=0.001). However, no significant difference was observed in the mean heart rate before and three minutes after blood sampling (P=0.68). In the control group, the mean heart rate significantly increased during blood sampling compared to before sampling (P=0.008), However, there was no significant difference in the mean heart rate of the neonates three minutes after blood sampling compared to before (P=0.08) and during the procedure (P=0.32).

According to the results of repeated measures ANOVA, the mean respiratory rate had a significant difference in the intervention and control groups at the three measurement intervals (P<0.05). In this regard, the results of post-hoc LSD test indicated that in the Holy Quran group, the mean respiratory rate was significantly higher during blood sampling compared to before and three minutes after sampling (P<0.001). However, no significant difference was observed in the mean respiratory rate before and three minutes after blood sampling (P=0.13). In the control group, the mean respiratory rate significantly increased during blood sampling compared to before sampling (P=0.001). However, the difference in the heart rate was not considered significant three minutes after sampling compared to before (P=0.14) and during sampling (P=0.49).

According to the results of repeated measures ANOVA, the mean oxygen saturation had a significant difference in the intervention and control groups at the three measurement intervals (P<0.05). Furthermore, the results of post-hoc LSD test showed that in the Holy Quran group, the mean oxygen saturation was significantly higher during blood sampling compared to before (P=0.001) and three minutes after sampling (P=0.002). However, no significant difference was observed in the mean oxygen saturation before and three minutes after blood sampling (P=0.54). In the control group, the mean oxygen saturation was significantly higher before blood sampling compared to during (P<0.001) and three minutes after sampling (P=0.03). However, the difference in the mean oxygen saturation during and three minutes after blood sampling was not statistically significant (P=0.43) (Table 2).

Table 1. Mean Age, Gestational Age, Birth Weight, and Current Weight of Neonates in Intervention and Control Groups

No	Variables	Intervention	Control	P-value
1	Age (day)	4.8±1.3	4.9±2.2	0.81
2	Gestational Age (week)	37.8±1.02	38.1±1.9	0.48
3	Birth Weight (g)	3161.4±567.9	3161±248.9	0.70
4	Current Weight (g)	3085.2±531.6	3176.8±278.2	0.45

Table 2. Mean Physiological Parameters at Different Intervals in Intervention and Control Groups

No	Variables		Intervention	Control	P-value
1	Heart Rate	Before Blood Sampling	130.04±22.9	129.6±13.8	0.93
		During Blood Sampling	142.3±19.7	141.7±21.4	0.92
		Three Minutes after Blood Sampling	129.04±18.9	136.4±20.9	0.20
		P-value	<0.001	0.02	
2	Respiratory Rate	Before Blood Sampling	51.4±6.4	51.6±12.6	0.97
		During Blood Sampling	54.6±7.5	57.2±12.5	0.38
		Three Minutes after Blood Sampling	51.04±6.5	55.6±12.8	0.12
		P-value	<0.001	0.005	
3	Blood Oxygen Saturation	Before Blood Sampling	93±2.9	92.6±3.2	0.68
		During Blood Sampling	88.1±6.9	88±3.8	0.96
		Three Minutes after Blood Sampling	92.7±2.6	89.4±7.1	0.04
		P-value	0.004	<0.001	

Table 3. Mean of Pain Intensity Based on Neonatal Infant Pain Scale (NIPS) Scale in Intervention and Control Groups

No	Variables	Intervention	Control	P-value
1	Before Blood Sampling	0.3±0.1	0.3±0.09	0.34
2	During Blood Sampling	4.2±1.1	4.9±1.9	0.09
3	Three Minutes after Blood Sampling	0.8±0.1	2.2±0.5	0.01
4	P-value	<0.001	<0.001	

Candidate newborns underwent heel stick blood sampling procedures in the emergency department of the infants at Al-Zahra Hospital in Isfahan, Iran. They were selected via simple random sampling and randomly allocated to the intervention and control groups. The names of the infants are written on small sheets and removed one by one from the box without insertion in order to allocate the subjects to the intervention (odd numbers) and control groups (even numbers).

According to the results of independent t-test and based on the NIPS standard, the mean pain intensity had no significant difference between the intervention and control groups before and during blood sampling (P>0.05). However, the mean pain intensity was significantly lower in the Holy Quran group compared to the control group three minutes after blood sampling (P<0.05). In this regard, the results of repeated measures ANOVA based on the NIPS standard indicated that the mean pain intensity had a significant difference between the intervention and control groups at the three measurement intervals (P<0.001).

The results of post-hoc LSD test indicated that the mean pain intensity in the intervention and control groups was significantly higher during blood sampling compared to before sampling (P<0.001). In addition, the mean pain intensity significantly decreased in the intervention and control groups three minutes after blood sampling compared to during blood sampling (P<0.001); however, the reduction was considered more significant in the Holy Quran group (Table 3).

Discussion

According to the results of the present study, the majority of the neonates in the intervention and control groups were male, and no significant difference was observed between the groups in terms of age, gestational age, birth weight, and current weight. Furthermore, the results showed that the mean heart rate was significantly higher in the intervention group during blood sampling compared to before and three minutes after sampling. In the control group, the mean heart rate significantly increased during blood sampling compared to before sampling; however, three minutes after blood sampling, no significant difference was observed in this variable compared to before and during blood sampling.

In the current research, the mean respiratory rate in the intervention group was significantly higher during blood sampling compared to before and three minutes after sampling. In the control group, the mean respiratory rate significantly increased during blood sampling compared to before and three minutes after sampling; however, three minutes after blood sampling, the difference with before and during sampling was not statistically significant. The results of a study regarding the effect of melodies on the physiological responses of neonates demonstrated that playing melodies could increase heart rate and decrease blood oxygen saturation during blood sampling from the heels of the neonates admitted to the NICU (19).

According to the results of the present study, heart rate and respiratory rate decreased in the intervention group compared to the control group after the intervention. In this regard, Majidi (2004) investigated the effect of the sound of the Holy Quran on the anxiety of patients before undergoing the angiography of coronary arteries, reporting that the patients who listened to the Holy Quran had lower vital signs and anxiety compared to the control group (20). Moreover, Mirbagher and Ranjbar (2010) have stated that listening to the sound of the Holy Quran could decrease the anxiety of mothers before undergoing caesarean section, which is in line with the results of the present study (21).

In the current research, the mean oxygen saturation was significantly higher during blood sampling in the intervention group compared to before and three minutes after blood sampling. However, in the control group, the mean oxygen saturation was significantly higher before blood sampling compared to during and three minutes after sampling. A study by Keshavarz et al. (2010) was conducted to evaluate the effects of the sound of the Holy Quran on the physiological responses of preterm neonates admitted to the NICUs in Tehran (Iran). According to the findings, the mean heart rate and respiratory rate significantly decreased, while the mean oxygen saturation significantly increased compared to the baseline values after the intervention in the neonates exposed to the sound of the Holy Quran. It is notable that these changes were stable for 10 minutes after the intervention. In other words, the

effect of the sound of the Holy Quran on the improvement of the physiological responses in the neonates (increased blood oxygen saturation and decreased heart rate and respiratory rate) persisted for 10 minutes after the intervention (22). Undeniably, using the other verses of the Holy Quran could lay the groundwork for performing further investigation regarding the positive effects of this heavenly voice.

According to the results of the present study, the sound of the Holy Quran had significant, sustainable effects on blood oxygen saturation, heart rate, and respiratory rate. Furthermore, our findings demonstrated that the mean pain intensity in the intervention and control groups was significantly higher during blood sampling compared to before sampling. On the other hand, the mean pain intensity significantly decreased three minutes after blood sampling compared to during blood sampling; however, the reduction was higher in the intervention group.

The results of the present study revealed that playing the sound of the Holy Quran could significantly decrease pain intensity during invasive procedures in neonates. The findings of a study regarding the effect of music therapy on physiological parameters demonstrated a significant difference in the systolic blood pressure before and after the intervention. However, no significant difference was observed in the heart rate and respiratory rate of the subjects. Although these differences were not statistically significant, since they were within the normal range, Allred et al. (2010) believed that the reduction of blood pressure was due to muscle relaxation, reduced vascular resistance, and reduced activity of the sympathetic nervous system in the patients (23).

Chlan believed that by creating a sense of comfort and relaxation, music therapy could decrease blood adrenaline level, heart rate, respiratory rate, and blood pressure (24). Moreover, Nicholson (2008) has claimed that music therapy could decrease blood pressure, pulse rate, and respiratory rate (5). On the other hand, Razavian et al. (2012) observed changes in blood pressure, heart rate, and respiratory rate in their study (25). It seems that the difference between the physiological parameters may be due to the type of the music, patients, and various environmental, social, and cultural factors.

Study Limitations
Despite the attempts of the researchers to perform the intervention during the quiet hours of the day, the existing noises in the ward were not controllable occasionally.

Conclusion
According to the results, the audible effect of the pleasant sound of the Holy Quran is a complementary medicine approach to reduce the physiological responses and pain intensity in the hospitalized neonates undergoing invasive procedures. Furthermore, listening to the rhythm of the Holy Quran is a systematic intervention, which could be helpful in decreasing physiological responses and anxiety in various patients. The advantages of music therapy and the sound of the Holy Quran include time-efficiency, accessibility, cost-efficiency, noninvasiveness, and lack of risks compared to other medicinal methods. Therefore, it is recommended that this approach be incorporated into care procedures in order to improve patient recovery and welfare.

Acknowledgments

Conflicts of interests
None.

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