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The effect of melody on the physiological responses of heel sticks pain in neonates

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Abstract

Background:

During health care in the neonatal intensive care unit (NICU), infants undergo extremely painful procedures, which may cause problems, if not controlled, such as changes in the pattern of respiratory rate, heart rate, and blood oxygen saturation. The present study aimed to find the effect of melody on the physiological responses of neonates' heel stick pain.

Materials and Methods:

This quasi-experimental study was conducted in Alzahra Hospital (Isfahan, Iran) for 5 months. Fifty infants were selected through convenient sampling method and were randomly assigned in equal numbers to two groups ($n = 25$). In the melody group (intervention), a selected melody was played for the infants at a distance of 1 m from them, with a sound intensity of 65 dB, from 3 minutes before, during, and after the heel stick procedure, respectively, and their physiological responses were observed with a monitoring system and recorded at the afore-mentioned time periods. Physiological responses were also recorded in the control group (no intervention) 3 min before, during, and after the heel stick procedure, respectively.

Results:

Means of respiratory and pulse rates in the melody and control groups showed a significant difference at different time points. But the mean blood oxygen saturation in the melody group showed no significant difference at different time points, although the difference was significant in the control group.

Conclusions:

The results showed that melody could maintain more balance in some physiological responses of infants, such as the respiratory rate and pulse rate during the Guthrie test. Therefore, melody is recommended to be

used to prevent the destructive effects of pain in infants during painful procedures.

Keywords: Intensive care units, Iran, neonate, nursing

Introduction

The two main and comprehensive goals of health provision are promotion of quality of a healthy life and prolonging it, and deletion of health disturbing factors.[1] Pain is one among the health disturbing factors.[2] In the past, it was believed that neonates and infants either could not feel pain or felt it less than adults due to incomplete development of their nervous system. Meanwhile, it has been found that the pain-conducting fibers are formed in the fetal period, and term neonates are sensitive to pain and experience it like infants and children.[3] On an average, the neonates admitted in the neonatal intensive care unit (NICU) experience 115 painful procedures during their 16-day stay in this ward, of which 79.2% are administered no dedicational and non-dedicational sedative methods. In about 2.1% of these procedures, the neonates receive sedative medications, in 18.2% of the procedures, they receive non-dedicational sedation, and in 20.8% of the cases, they receive both dedicational and non-dedicational interventions.[4] The procedure conducted most frequently among neonates in the NICU is heel stick (56%).[5] Pain in neonates, if not treated, leads to immediate and long-term complications. The immediate complications include intraventricular hemorrhages and high mortality in the NICU, long-term response to pain, and poor responses to stimulants. Long-term complications include learning problems, reduction of concentration, lack of adaption with new situations, and mood changes in neonates and children.[1] If not managed, pain and tension in neonates can disturb their sleep condition, growth and development, nutrition tolerance, and even vital signs such as respiration, heart rate (HR), BP, and O_2 saturation.[6] Reduction of stress imposed on the neonates can notably prevent further damages. Further education and better detection of pain signs are essential for the health care personnel due to the short- and long-term complications of the uncontrolled pain among neonates. Prevention of these destructive effects may also help in reduction of hospitalization period and costs.[7] Neonates can be relieved of pain through non-dedicational methods such as intake of oral sucrose, non-nutritive sucking, breast feeding, mother–infant skin touch, and music[8] during the procedures.[9] Among the effective methods of pain relief in neonates is playing a melody which can act as a tool for distracting the neonates and enhancing the secretion of endorphins.[10] Playing a melody on a piano and recorded lullaby voice results in rapid return of the HR and behavioral and facial reactions due to pain to the baseline values.[11] Studies on the effect of music on neonatal physiological responses concluded that music is effective on HR increase and changes of respiratory rate.[12,13] Karimi *et al*. reported a significant difference in neonates' HR during removal of a needle as well as in the first 5 min after heel stick.[14] Other studies reported controversial results concerning the effect of music on neonatal physiological responses. A study in the NICU showed no notable changes in neonates' HR after playing music compared to before it.[15] Johnson also reported a decrease in neonates' O_2 saturation after they listened to music.[16] Taking into consideration the destructive and numerous effects of pain on neonates' various physiological systems, as well as the existence of controversial results regarding the sedative effects of music therapy, and the importance of pain management and prevention of numerous and irreversible complications in neonates, the researcher investigated the effect of melody on the physiological responses of heel stick pain in neonates which is among the most frequent painful procedures done on them.

Materials and Methods

This is a quasi-experimental study conducted for 5 months in the NICU of Alzahra hospital in Isfahan, Iran. Sampling was by consecutive convenient sampling, and the subjects comprised 50 neonates meeting

the inclusion criteria, who were assigned to study and control groups through random allocation. The neonates in the group of melody (study) and the neonates in the control group were selected on the first and second days of the study, respectively. Inclusion criteria were gestational age of ≥ 34 weeks, being hospitalized in the ward (inpatient hospitalization), not receiving O_2 before and during the study, intact hearing ability (through startle test), proper neonatal consciousness, and administration of no other painful procedures before conducting the intervention. Exclusion criteria were parents not willing to continue participating in the study or a need for oxygen therapy in the neonates due to any reason during the intervention and no success in the first heel stick trial. Researcher conducted the intervention after obtaining consent form the neonates' parents and explaining the study goals and method. The tool adopted in this study was a questionnaire to record the personal characteristics and a form of physiological signs record including HR, respiratory rate/min, and atrial O_2 saturation percentage in the neonates. Neonates' HR and atrial O_2 saturation were monitored by a Saadat monitoring device connected to the neonates, which was calibrated monthly by medical equipments engineers of the hospital. Neonates' respiratory rate was counted per minute through observation of their chest. Neonates' demographic information were extracted and recorded from their medical files. The melody adopted was the piece "golden dreams" played on piano with no lyrics. In the intervention group, the melody was played on an MP3 player laid at a distance of 1 m from neonates' cot[15] with a sound intensity of 65 dB. It was played 3 min before the heel stick was administered until 3 min after the end of the procedure by an experienced nurse[9] (voice intensity was measured by a dB meter device). Then, the neonates' heels were disinfected by alcohol disinfection cotton and the lancet was inserted from the lateral side of the heel, and the researcher measured and recorded the neonatal physiological responses (pulse, atrial O_2 saturation, and respiratory rate) by Saadat monitoring device 3 min before, during, and after the heel stick, respectively.[9] In the control group, the neonates underwent no palliative intervention except routine treatments and care. All variables (physiological responses) were evaluated and recorded in time points similar to the study group. The obtained data from both groups were entered into a computer and analyzed by Chi-square, repeated measure analysis of variance (ANOVA), and independent *t*-test using SPSS 15.

Ethical considerations

Informed consent was obtained from participants and the study has confirmation of Ethics Committee of Isfahan University of Medical Sciences (No 391316).

Results

Results showed that most of the subjects were males (58%), and the Chi-square test showed no significant difference between the two groups ($P > 0.05$). Independent *t*-test showed no significant difference in some demographic characteristics (gestational age, birth weight, current weight, and neonates' age) of the subjects in the two groups ($P > 0.05$). Repeated measure ANOVA showed a significant difference in HR in the melody and control groups at different time points ($P < 0.05$) [Table 1]. Least significant difference (LSD) *post hoc* showed a significant difference in the means of HR during and before intervention, and during and after intervention in the melody group ($P < 0.05$). It also showed a significant difference in the means of HR during intervention and before intervention ($P < 0.05$), but not at other time points ($P > 0.05$). Independent *t*-test showed no significant difference in the means of HR in the melody and control groups before intervention ($P = 0.69$), during intervention ($P = 0.87$), and after intervention ($P = 0.42$). Repeated measure ANOVA also showed no significant difference in atrial O_2 saturation at various time points in the melody group ($P > 0.05$), but the difference was significant in the control group ($P < 0.05$) [Table 2]. LSD *post-hoc* test showed that the difference before and after intervention had a significance

level of 0.05. Independent *t*-test showed no significant difference in the means of atrial O_2 saturation between the melody and control groups before intervention ($P = 0.12$), during intervention ($P = 0.37$), and after intervention ($P = 0.63$). Repeated measure ANOVA showed a significant difference in respiratory rate at various time points in the melody and control groups ($P < 0.05$) [Table 3]. LSD *post-hoc test* showed a significant difference in the means of respiratory rate before and during intervention, and during and after intervention in the melody group ($P < 0.05$). It also showed a significant difference in the means of respiratory rate before and during intervention, and before and after intervention in the control group ($P < 0.05$). Independent *t*-test showed no significant difference in the means of respiratory rate in the melody and control groups before ($P = 0.96$), during ($P = 0.69$), and after ($P = 0.87$) intervention ($P > 0.05$).

Discussion

Results showed that the means of HR and respiratory rate were higher during intervention compared to before and after intervention in the melody group. The increase in mean pulse during administration of the procedure was higher in the control group compared to the melody group. Means of respiratory rate showed an increase both in the study and control groups, although the increase remained longer after ending the procedure in the control group compared to the study group. Keith *et al*. also reported that music positively affected HR and respiratory rate and could balances these values,[17] which is in line with the findings of the present study. Our obtained results showed no significant difference in the means of atrial O_2 saturation at various time points in the melody group, possibly due to the type of selected melody, music, or length of the played music. For instance, Standly applied a piece of music containing lullaby sang by a woman, and in the study of Karimi *et al*., the music was played from 5 min before administration of the procedure. Several other studies, like the study of Collabra on the effect of music on premature neonatal physiological responses, showed that music had no effect on the neonates' atrial O_2 saturation, respiratory rate, and HR.[18] Karimi *et al*. also showed no effect of music on HR and atrial O_2 saturation,[14] which is consistent with the findings of the present study. In addition, obtaining no significant difference in neonatal physiological responses before, during, and after intervention in the study and control groups ($P > 0.05$) may be due to the type of selected melody or the low number of the subjects, as the difference may become significant with a higher sample size.

Conclusion

In general, the findings of the present study showed that playing a melody causes a balance in the neonatal physiological responses including respiratory rate and HR during heel stick. Therefore, a melody is recommended to be played for neonates during administration of painful procedures, to prevent the destructive effects of pain. Our obtained results showed that playing music is an efficient intervention to maintain balance in neonates' respiratory rate and HR during administration of painful procedures. These findings reveal the importance of the application of music in the caring of neonates. Music therapy decreases the negative effects of treatment procedures and playing musical melodies is a cost-effective and convenient independent nursing intervention which does not need a physician's visit and extra staff, and is not so time consuming. We hope our obtained results can improve the quality of neonatal care administration.

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Footnotes

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Figures and Tables

Table 1

Time / Group	Before		During		After		Repeated measure ANOVA	
	Mean	SD	Mean	SD	Mean	SD	*F*	*P* value
Melody	132.04	28.03	139.7	26.3	131.04	26.7	5.2	0.014
Control	129.6	8.13	141.7	21.4	136.4	20.8	4.99	0.016

SD: Standard deviation, ANOVA: Analysis of variance

Comparison of means of neonates' heart rate in the two groups at various time points

Table 2

Time / Group	Before		During		After		Repeated measure ANOVA	
	Mean	SD	Mean	SD	Mean	SD	*F*	*P* value
Melody	90.7	5.3	89.8	5.4	90.2	6.2	0.54	0.59
Control	92.6	3.2	91	3.8	89.4	7.1	4.75	0.02

SD: Standard deviation, ANOVA: Analysis of variance

Comparison of means of neonates' O_2 saturation in the two groups at various time points

Table 3

Time / Group	Before		During		After		Repeated measure ANOVA	
	Mean	SD	Mean	SD	Mean	SD	*F*	*P* value
Melody	51.4	12.9	54.6	12.6	50.7	13.3	13.4	<0.000
Control	5.51	12.6	56	11.5	56.6	12.8	4.99	0.02

SD: Standard deviation, ANOVA: Analysis of variance

Comparison of means of neonates' respiration rate in the two groups at various time points