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The Effect of Listening to White Noise and Heart Sound on Pain During Sternum Dressing in Newborn: A Randomized Control Trial Study

Yenidoğanlarda Sternum Pansumanı Sırasında Beyaz Gürültü ve Kalp Sesi Dinletmenin Ağrı Üzerine Etkisi: Randomize Kontrollü Çalışma

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ABSTRACT

The research was conducted as a randomized controlled experimental study to determine the effect of listening to white noise and heart sounds during the sternum dressing process on the pain felt by newborns who underwent congenital heart surgery. The research sample consisted of 48 (white noise:16, heart sound:16, control:16) newborns who underwent cardiac surgery in a training and research hospital in Istanbul and met the sample selection criteria. Newborn Pain Scale (NIPS) was used to assess pain. There was a significant difference in physiological parameter values between the groups during the sternum dressing ($p<0.001$). The NIPS pain scores during the sternum dressing procedure differed across groups ($p<0.001$). Newborns in the control group had significantly higher NIPS pain scale scores compared to those in the heart sound and white noise group, while the heart sound group scored similarly to the white noise group ($p<0.001$). These findings support the hypothesis that listening to white noise and heart sounds during sternum dressing in newborns is an effective methods for reducing pain.

Anahtar Kelimeler: Heart sound, Pain, White noise

ÖZ

Araştırma, konjenital kalp ameliyatı geçiren yenidoğanlarda sternum pansumanı işlemi esnasında beyaz gürültü ve kalp sesi dinletmenin, yenidoğanların hissettiği ağrı üzerindeki etkisini belirlemek amacıyla randomize kontrollü deneysel olarak yapılmıştır. Araştırma örneklemini İstanbul'da bulunan bir eğitim araştırma hastanesinde kalp cerrahisi geçiren ve örneklem seçim kriterlerine uyan 48 (beyaz gürültü:16, kalp sesi:16 ve kontrol:16) yenidoğan oluşturmuştur. Ağrı değerlendirilmesi için Yenidoğan Ağrı Ölçeği (NIPS) kullanılmıştır. Sternum pansumanı işlemi sırasında gruplar arasında değerlendirmede fizyolojik parametre değerleri açısından istatiksel olarak anlamlı farklılık olduğu görülmüştür ($p<0,001$). Sternum pansumanı işlemi sırasında gruplar arasında yapılan karşılaştırmalarda, NIPS ağrı puanları arasında istatistiksel olarak anlamlı bir fark tespit edilmiştir ($p<0,001$). Kontrol grubundaki yenidoğanların NIPS ağrı ölçeği skorları, kalp sesi ve beyaz gürültü grubuna göre anlamlı derecede yüksekti, kalp sesi grubu ise beyaz gürültü grubuna benzer skora sahiptir ($p<0,001$). Bu bulgular, sternum pansumanı işlemi sırasında beyaz gürültü ve kalp sesi dinletmenin, yenidoğanlarda ağrıyı azaltmada etkili bir yöntem olduğu hipotezini desteklemektedir.

Keywords: Kalp sesi, Ağrı, Beyaz gürültü

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INTRODUCTION

Congenital heart disease (CHD) stands as the most prevalent congenital malformation, accounting for 28% of major anomalies and 6-10% of neonatal deaths.[1] CHD can be diagnosed through fetal echocardiography, which can be performed from the 14th week of pregnancy.[2]

In contemporary medicine, corrective operations for congenital heart diseases are applicable, with the majority of these surgeries being performed during the neonatal period. Studies have demonstrated that the intensive care and hospitalization durations for surgeries conducted in the neonatal and early childhood periods are longer than those in adults.[3,4,5] Exposure to unpleasent treatments in the postoperative care of newborns in the intensive care unit procedures stress for them.[6] The pain and stress experienced by the newborn can lead to disturbances in the hemodynamics during the clinical monitoring of the newborn.[7] The focus of a team equipped with technological resources is on achieving cardiopulmonary stabilization and maintaining the newborn's hemodynamics. [8]

The personalized care of a child undergoing congenital heart surgery is planned, implemented, and evaluated by nurses. However, in some cases, certain nursing practices may be limited due to the observation of an open sternum during clinical monitoring .[8,9]

While pharmacological methods are considered the gold standard in pain management for newborns, non-pharmacological methods are preferred due to the side effects of pharmacological agents.[10,11]

The use of non-pharmacological methods to ensure pain control during painful invasive procedures is the responsibility of nurses.[12]

In the literature, there are numerous studies examining non-pharmacological methods for pain management in newborns. Non-pharmacological methods such as Kangaroo care,[13] massage,[14] positioning,[15] pacifier use,[16] oral sucrose administration,[17] breastfeeding with mother's milk,[18,19] aromatherapy,[20] music therapy,[21,22,23] and acupressure [24] are frequently preferred by nurses due to their fewer side effects, reduction of procedure-related pain, and low or no associated costs.[25]

In this study, non-pharmacological methods, specifically white noise and heart sound exposure, were employed during sternum dressing procedures for newborns who underwent congenital heart surgery. White noise and heart sounds mimic the sounds that babies experience in the womb, which is why these sounds may make infants feel safe and calm.[31] This randomized controlled experimental study was conducted to investigate the impact of these two non-pharmacological methods on pain and physiological parameters. Given the absence of similar studies exploring the effect of non-pharmacological methods during sternum dressing of the incision site following congenital heart surgery, this research provides a significant contribution to the literature.

MATERIALS AND METHODS

Type of Research

The research design is a randomized controlled study.

Population and Sample of the Research

The population of the research was determined as newborns undergoing cardiac surgery in the Pediatric Cardiovascular Surgery Intensive Care Unit of an educational research hospital located in Istanbul. The sample consisted of newborns selected based on sample inclusion and exclusion criteria.

Sample Selection Criteria

- The infant's postnatal age being between 0-28 days.
- Having undergone surgical intervention due to congenital heart disease.

- Presence of a sternum incision.
- At least 48 hours elapsed since the surgical procedure.
- No administration of analgesics, sedatives, or any painkillers in the 4 hours preceding the procedure.
- At least 2 hours elapsed since the last painful intervention.
- Fasting duration being less than 3 hours.
- Monitoring of arterial blood pressure.
- Sternum dressing performed after extubation.
- Consent from the parents of the newborn participating in the study.

Exclusion Criteria for Sampling

- Prematurity
- The infant's weight during the study was less than 2500 grams.
- Neonatal monitoring with a mechanical ventilatör.
- Presence of pulmonary hypertension (PH).
- Anomalies other than congenital heart disease.
- Presence of intellectual or neurological impairments.
- Hearing impairment.

The sample size for the study was calculated using G*Power 3.1.9.7 analysis. The error type (α) of the study was set at 5%, test power (1-β) at 95%, and effect size (f) at 0.25. Based on these parameters, it was determined that each study group should include at least 15 newborns, for a total of 45 newborns in the sample group. However, considering the possibility of loss during data collection, it was decided to include 20% more, totaling 54 newborns in the study group. Since there was no similar research design, the medium effect size recommended by Cohen for repeated measures in two-way analysis of variance was used.[26]

The newborns scheduled for sternum dressing procedures were randomly assigned to groups in a randomized controlled manner, with 18 infants allocated to each group. For the randomization process in the research, https://www.randomizer.org was utilized. Using this program, the infants to be involved in the research were assigned to groups in a randomized fashion by entering the case numbers.

During the data collection phase, 2 newborns from the white noise group and the heart sound group were excluded from the study. This exclusion was due to respiratory distress occurring during the sternum dressing procedure for the white noise group and bradycardia occurring in the heart sound group. After accounting for these case losses, the study sample size consisted of 48 infants, with 16 infants in each study group (heart sound, white noise, control group).

Pain Relief Interventions

The sternum dressing procedure was conducted in a designated room. The newborns began listening to the sound 11 minutes before dressing was applied to the sternum and continued listening until 15 minutes after dressing was applied to the sternum. A study found that an average of 70 beats per minute is effective in simulating heart sounds.[31] Therefore, a similar protocol was followed in this study and babies in the Heart Sound group were exposed to heart sounds at an average rate of 70 beats per minute. In the White Noise group, infants listened to the track "Let Your Baby Not Cry 2." After turning on the MP3 player, the sound level at the baby's ear was measured with a decibel(dB) meter, and it was adjusted not to exceed 45 dB.

The sternum dressings for the newborns were performed in line with the clinic's regular dressing requirements, ensuring aseptic conditions. In the clinic's usual dressing application, newborns were placed in a supine position on a radiant heated open bed, with the their heads slightly extended. The previous sternum dressing was removed by moistening it with distilled water. After evaluating the incision site, the dressing

procedure was initiated. A Crystalin solution devoid of iodine and alcohol, was sprayed onto the sternal incision. Once dried, a sterile dressing cover was applied, completing the procedure.

Video recording began 1 minute before the start of listening to the newborn's sound, which is 11 minutes before the sternum dressing application. The video recording continued until 15 minutes after the procedure was completed. For the 15 minutes following the sternum dressing application, the newborns continued to lie in a supine position. The process of listening to sound and recording video was concluded 15 minutes after the sternum dressing application.

Measures

In the study, the Neonatal Infant Pain Scale (NIPS) and physiological parameters including heart rate (HR), respiratory rate (RR), oxygen saturation (SpO2), systolic blood pressure (SBP) and diastolic blood pressure (DBP) measurements were assessed.

Data Collection

Physiological parameters were recorded by the primary investigator, who worked as a nurse in the Pediatric Cardiovascular Surgery Intensive Care Unit. The assessment of newborns' pain was conducted by two independent Pediatric Cardiovascular Surgery Intensive Care Unit nurses, distinct from the primary investigator, who watched video recordings. Both observers had four years of working experience in the Pediatric Cardiovascular Surgery Intensive Care Unit during the data collection period. Before the assessment, the observer nurses received training on the scale and its evaluation. Physiological parameters and pain scores were assessed and recorded four times in total: before the procedure, 1 minute before the sternum dressing procedure, during the procedure, and 15 minutes after the procedure. A Sony video camera was used to determine the newborns' pain levels. Goldmaster MP3-224 brand MP3 player and "JBL" brand speakers were used to play heart sounds and white noise. Nurses evaluated pain scores independently of each other, without interaction, by watching the videos in different rooms at the same time period. Thus, bias among nurses was prevented. The sound level of the played audio was measured using a "Unit" brand decibel meter to ensure no intergroup differences in sound levels. The beginning of the sternum dressing procedure was considered as the removal of the old dressing moistened with distilled water, while the end of the sternum dressing procedure was defined as the closure of the incision site with a new sterile dressing cover.

Data Analysis

The data collected in the research was analyzed with the IBM SPSS Statistics Standard Concurrent User V 26 statistical package. Descriptive statistics, including the number of units (n), percentage (%), mean ± standard deviation ($\bar{x}$ ± sd), median (M), minimum (min), and maximum (max) values, were presented. Additionally, Fisher's exact test was utilized for group comparisons based on the descriptive statistics. In the event of a significant result from the Fisher's exact test, subgroup analyses were conducted using Bonferroni-adjusted two-proportion z-tests. The normality of the data was checked with the Shapiro-Wilk normality test.

Inter-rater agreement for NIPS pain scores was assessed using Fleiss Kappa and Wilcoxon test statistics. In case of normal distribution of the data, group comparisons based on measurement times for numerical variables were conducted using Two-Way Analysis of Variance for Repeated Measures from General Linear Models. Since the data did not follow a normal distribution, non-parametric tests were used for group comparisons. The Kruskal-Wallis H test was employed to determine if there was a significant difference between groups. For comparisons between measurements within groups, the Friedman test was used. To determine if the differences among all groups were statistically significant, a Bonferroni correction was applied, and a significance level of $p < 0.05$ was accepted.

Study Limitations

Despite the contributions of this study, there were some limitations. The fact that the research was carried out in a single center limits the ability to generalize the research findings to the entire population. Blinding could not be performed for the assessment of crying due to the nature of the Neonatal Infant Pain Scale.

Ethical Considerations

The ethical committee approval for the research was obtained from the Non-Interventional Clinical Research Ethics Committee Presidency of Istanbul Mehmet Akif Ersoy Chest, Heart, and Vascular Training and Research Hospital on 22.02.2022 with decision number 2022.02.10.

After providing written and verbal information about the research to the parents of newborns who met the research criteria, written consent was obtained through the Informed Consent Form.

Permission for the use of the Turkish reliability and validity studies of the NIPS scale in the research was obtained through email from Tülin Akdovan (Thesis Advisor Assistant Professor Zerrin Çiğdem)

Written permission for the playback of the white noise 'Let Your Baby Not Cry 2' by Musician Neslihan Karcı Osman and On Production was obtained through email.

The confidentiality of the video recordings to be evaluated as data in the research was ensured by the researcher with an encrypted computer.

RESULTS AND DISCUSSION

Infant Characteristics

A total of 48 newborns were involved in the study, with 16 in the control group, 16 in the heart sound group, and 16 in the white noise group. Descriptive characteristics of the newborns in each group and features related to sternum dressing are presented in Table 1.

Ensuring similarity among variables potentially affecting the newborns' response to pain (gender, postnatal age, weight, type, and experience of painful stimulus) is crucial in demonstrating the impact of white noise and heart sound on pain. It is known that factors affecting the pain of newborns include gestational age, gender, weight, apgar score, type of painful stimulus, and previous experiences of pain.[13] The homogeneity of descriptive characteristics across all groups enhanced the reliability of the study in terms of factors influencing pain (Table 1).

Similar to the results obtained from the literature, the groups listening to white noise and heart sounds in the study had lower pain scores during the sternum dressing procedure compared to the control group. There are studies where white noise is played during

NIPS Score

According to intra-group comparisons, NIPS pain scores exhibit statistical differences across measurement times in all three groups ($p < 0.001$). In all groups, NIPS pain scores during the procedure were statistically higher than at other measurement times.

In inter-group comparisons, there was a statistically significant difference in NIPS pain scores among the groups during the procedure ($p < 0.001$).

During the procedure, the control group's NIPS pain scores were statistically higher than those of the heart sound and white noise groups. There was no statistical difference in pain scores during the procedure between the heart sound and white noise groups (Table 2).

Table 1. Infant Chracteristics

	Groups						Test Statistics	
	Control n=16		Heart Sound n=16		White Noise n=16		x^2	P
	n	%	n	%	n	%		
Postnatal Age							0,819	0,976
4-11 days	3	18,75	4	25,00	3	18,75		
12-19 days	10	62,50	8	50,00	9	56,25		
20-28 days	3	18,75	4	25,00	4	25,00		
Weight							0,878	0,895
3000-3500 g	13	81,25	14	87,50	12	75,00		
3501-4000 g	3	18,75	2	12,50	4	25,00		
Gender							0,590	0,930
Female	6	37,50	5	31,25	7	43,75		
Male	10	62,50	11	68,75	9	56,25		
Nutrition							15,625	0,001
Breast Milk	2	12,50	8	50,00	8	50,00		
Formula	7	43,75[a]	0	0,0[b]	0	0,0[b]		
Breast Milk and Formula	7	43,75	8	50,00	8	50,00		
Diagnosis							0,269	>0,999
HLHS	5	31,25	5	31,25	6	37,50		
TGA	11	68,75	11	68,75	10	62,50		
Surgical Intervention							0,269	>0,999
Norwood	5	31,25	5	31,25	6	37,50		
Arterial Switch	11	68,75	11	68,75	10	62,50		
Number of sternum dressings after extubation							1,191	0,954
1-2 times	8	50,00	8	50,00	6	37,50		
3-4 times	7	43,75	7	43,75	9	56,25		
5-6 times	1	6,25	1	6,25	1	6,25		
The last painful procedure performed							1,182	0,967
Postural Drainage	10	62,50	11	68,75	10	62,50		
Nasotracheal Suction	3	18,75	3	18,75	2	12,50		
Dressing Change	3	18,75	2	12,50	4	25,00		
Time of the last painful procedure							1,141	>0,999
4-7 hours ago	12	75,00	13	81,25	12	75,00		
8-11 hours ago	2	12,50	2	12,50	3	18,75		
12 hours ago	2	12,50	1	6,25	1	6,25		

[x2]: Fisher exact test statistic

painful interventions in neonates. However, there are fewer studies on the application of heart sounds. Küçükoğlu et al. (2016), for instance, evaluated the effect of white noise on grafting pain. The newborns in their study group were exposed to white noise 1 minute before vaccination, and the pain level was found to be lower in the babies in the experimental group.[27] In another study, Rossi et al. (2018) made healthy newborns listen to 2 different music and heart sounds, and reported that the babies in the experimental groups had a decrease in pain perception compared to the control group.[28] In the study of Küçük Alemdar and Güdücü Tüfekçi (2018), maternal heart sounds were played to 62 premature babies before, during and after the aspiration procedure. As a result of their study, it was found that maternal heart sound positively affected the pain and comfort levels of premature babies[29]. Our study found a substantial decrease in the NIPS in heart sound neonates, which is consistent with the limited studies on heart sound.

Table 2. NIPS Score

	Groups			Test Statistics†	
	Control n=16 *M* (*min-max*)	**Heart Sounds n=16** *M* (*min-max*)	**White Noise n=16** *M* (*min-max*)	***H***	***P***
Before the procedure	1 (1-2)^{a}	1,8 (0,5-2)^{a}	2 (0,5-2)^{a}	1,898	0,387
1 minute before sternum dressing procedure	2 (1-2,5)^{aX}	1,5 (1-2)^{aX}	1 (1-1,5)^{aY}	**12,913**	**0,002**
During the process	6 (5-7)^{bX}	5 (4-6)^{bY}	4,3 (3,5-6)^{bY}	**25,826**	**<0,001**
15 minutes after the procedure	2 (1,5-2)^{aX}	2 (1-2)^{aXY}	1,7 (1-2)^{aY}	**8,144**	**0,017**
X^2	**40,023**	**42,455**	**38,417**		
p	**<0,001**	**<0,001**	**<0,001**		

H: Kruskal-Wallis Analysis | †: Between-group comparisons at each measurement time
‡: Within-group comparisons within each group | ‡: Within-group comparisons within each group

When the literature is examined, it is seen that non-pharmacological methods are effective in relieving procedural pain, but no othr study has been found in which the study group consisted of newborns who underwent congenital heart surgery. To the best of our knowledge, this is the first study examining the effect of non-pharmacological methods on pain during the dressing of the sternum incision area. In this sense, it makes an important contribution to the literature.

In this study, a positive effect of white noise on NIPS pain score was observed. Likewise, in Döral and Büyük (2021)'s study newborns listened to white noise and lullabies starting 2 minutes before the painful procedure, during and after the procedure. It was observed that the highest pain score was in the control group and the lowest score was in the white noise group.[30]

In Kanbur's (2021) study, different groups were exposed to white noise, music listened to while the mother was pregnant, and the mother's heart sound during the heel prick procedure, and the pain score averages of the groups were compared. The results showed that the pain scores of the white noise group during the procedure were significantly lower than the control group.[31]

In their study, Tavlar and Karakoç (2022) used non- pharmacological methods such as breastfeeding, breast milk smell and maternal heartbeat sound during the heel prick procedure in newborns. According to the study results, it was determined that newborns in the breast milk smell group experienced the highest level of pain, newborns in the mother's heartbeat sound group experienced mild pain, and newborns in the breastfeeding group experienced the least pain.[32]

In the study of Midilli and Ergin (2023), white noise and Brahms lullaby were played to newborns during venous blood collection, and the mean NIPS pain scores of the white noise and Brahms lullaby groups during the procedure were found to be lower than the control group.[33] In the examined studies, listening to white noise and heart sounds during painful interventions has been shown in trials to reduces pain in neonates.[27,28.29,30,31,32,33] are consistent with this study. Solely Ren et al. (2022) made newborns listen to white noise during arterial blood collection, found that it had no effect on

the pain score and physiological parameters during the procedure.[40] Such contrast between the current study and their study can be attributed to the decibel difference in the use of white noise. While their study used white noise at 50 dB, in our study it was 45 dB. Although it is assumed that a difference of 5 dB may cause stress in babies, it is not possible to make a definitive judgment on this matter. More research examining the effect of the difference in decibel levels on pain is needed to expand the findings.

Physiological Parameters

During the procedure, there was a statistically significant difference in the mean values of HR among the groups ($p < 0.001$). The mean HR values of the control group during the procedure were statistically higher than those of the heart sound and white noise groups. There was no statistically significant difference in mean HR values between the heart sound and white noise groups during the procedure.

During the procedure, there was a statistically significant difference in mean SpO2 values among the groups ($p = 0.033$). The mean SpO2 values of the control group during the procedure were statistically lower than those of the heart sound and white noise groups. There was no statistically significant difference in mean SpO2 values between the heart sound and white noise groups during the procedure. Similarly, mean RR and SBP values were statistically different among the groups ($p < 0.001$). The mean SBP values of the white noise group during the procedure are statistically lower than those of the control and heart sound groups (Table 3).

Heart rate, blood pressure, respiratory rate, and SpO2 values are physiological variables used in the assessment of pain and stress in painful interventions applied to newborns.[19,34] Pain leads to an increase in physiological parameters such as heart rate, blood pressure, and respiratory rate while causing a decrease in oxygen saturation.[35,36]

In the literature, no other study has been found comparing the effects of white noise and heart sound during sternum dressing on physiological parameters and pain. To the best of the authors' knowledge, this study is the first to compare the effects of white noise and heart sounds during sternum dressing on physiological parameters and pain, contributing new knowledge to the field. However, there are studies examining the application of music therapy in different painful interventions.

In studies investigating the impact of music therapy on physiological parameters, it has been found that music has enhancing effects on newborns' oxygen saturation, reducing heart rate, blood pressure, respiratory rate, stress behaviors, and length of hospital stay.[21,37,38]

The research findings indicate that the presentation of white noise and heart sounds positively influences oxygen saturation during the painful intervention of sternum dressing. Other studies in the literature also support the positive effects of listening to heart sounds and white noise on oxygen saturation levels.[29,39]

Table 3. Physiological Parameters

	Groups			Test Statistics†	
	Control	**Heart Sound**	**White Noise**	***F***	***P***
	x̄±ss	**x̄±ss**	**x̄±ss**		
Heart Rate					
Before the procedure	132,0±3,5^{aX}	132,8±2,7^{aX}	137,6±7,2^{aY}	**6,205**	**0,004**
1 minute before sternum dressing procedure	135,9±3,9^{bX}	130,2±4,1^{bY}	132,3±5,6^{bXY}	**6,183**	**0,004**
During the process	157,3±5,8^{cX}	147,3±3,5^{cY}	143,1±6,9^{cY}	**27,172**	**<0,001**
15 minutes after the procedure	139,6±4,7^{d}	138,0±2,1^{d}	138,5±7,6^{a}	0,367	0,695
Oxygen Saturation					
Before the procedure	92,8±2,8^{a}	92,5±2,4^{a}	92,1±2,1^{a}	0,316	0,731
1 minute before sternum dressing procedure	92,3±2,4^{a}	92,8±2,7^{ac}	93,2±2,5^{b}	0,479	0,623
During the process	88,5±2,1^{bX}	90,6±2,4^{bY}	90,3±2,4^{bXY}	**3,683**	**0,033**
15 minutes after the procedure	91,9±1,7^{a}	93,6±2,9^{c}	92,2±2,2^{a}	2,323	0,110
Systolic Blood Pressure					
Before the procedure	69,3±5,0^{a}	71,0±3,3^{a}	69,8±4,2^{a}	0,654	0,525
1 minute before sternum dressing procedure	73,5±5,5^{bX}	68,5±2,8^{bY}	66,2±3,0^{bY}	**13,732**	**<0,001**
During the process	114,3±8,5^{cX}	107,4±10, 7^{cX}	84,01±3,8^{cY}	**59,627**	**<0,001**
15 minutes after the procedure	74,5±6,3^{bXY}	78,9±11,2^{dX}	70,4±3,4^{aY}	**4,824**	**0,013**
Diastolic Blood Pressure					
Before the procedure	39,6±4,4^{a}	37,6±3,7^{a}	38,3±2,4^{a}	1,309	0,280
1 minute before sternum dressing procedure	41,6±5,1^{aX}	35,5±4,8^{aY}	33,6±2,9^{bY}	**14,311**	**<0,001**
During the process	56,4±10,7^{bX}	49,1±5,8^{bY}	41,8±3,1^{aZ}	**16,074**	**<0,001**
15 minutes after the procedure	40,8±3,2^{aXY}	43,3±8,1^{cX}	38,1±2,7^{aY}	**3,916**	**0,027**

Two-Way Analysis of Variance | p<0.001

CONCLUSION AND RECOMMENDATIONS

What this study reveals is that nurses should be aware of the baby's pain and use non-pharmacological methods that are low-cost, easily applicable and have no side effects, in the light of their professional knowledge and skills, to relieve pain. It is also recommended to disseminate these practices, make necessary workload plans, and provide training on the application of non-pharmacological methods.

To the best of the our knowledge, this is the first study to investigate the effects of heart sound and white noise on the pain level during sternum dressing changes in newborns who underwent congenital heart surgery. Similarly, following a randomized controlled experimental study design, this is known to be the first study to compare the effects of the abovementioned variables on newborns' pain levels.

In the intergroup evaluation during the sternum dressing change procedure, statistically significant differences were found in mean values of HR, SBP, DBP, and SPO2 ($p<0.001$). The control group presented significantly higher mean values for HR, SBP, and DBP compared to the white noise and heartbeat sound groups, while SPO2 values were lower in the control group. Additionally, the white noise group presented significantly lower mean values for SBP and DBP during the sternum dressing change procedure compared to the other two groups ($p<0.001$).

Intergroup comparisons revealed statistically significant differences in NIPS pain scores during the sternum dressing change procedure ($p<0.001$). Newborns in the control group had significantly higher NIPS pain scale scores than those in the heartbeat sound and white noise groups, while the NIPS pain scale score of the heartbeat sound group was similar to that of the white noise group ($p<0.001$).

Based on the study's findings, the use of white noise and heartbeat sounds during painful procedures in newborns is recommended.

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