

ORIGINAL ARTICLE

The Effect of Mother and Baby Skin-to-Skin Contact During Heel Lance on the Pain and Stress of Infants

Topuk Kanı Alma İşlemi Sırasında Uygulanan Anne-Bebek Ten Temasının Yenidoğanın Ağrısı ve Stresi Üzerindeki Etkisi

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ABSTRACT

Aim: Heel lance, a procedure to collect blood from newborns, is known to be a painful experience. This study aims to determine the effects of skin-to-skin contact (SSC) on pain and stress levels in newborns during the heel lance procedure.**Methods:** This experimental study was conducted between October 2021 and December 2021 at a gynecology and obstetrics clinic in a university hospital in Ankara. The study included 98 newborns (intervention group, n=49; control group, n=49). During the heel lance procedure, newborns in the intervention group were held in SSC with their mothers, whereas newborns in the control group were placed in a bassinet. The data were collected using the Mother's Demographic Information Form (MDIF), the Newborn's Demographic Information Form (NDIF), the Procedure Response Evaluation Form (PREV), and the ALPS-NEO Neonatal Pain and Stress Assessment Scale (ALPS-NEO-PSAS).**Results:** The comparisons of crying time during the procedure showed that newborns in the SSC group cried for a shorter period than those in the control group (p<.001). Mothers in the SSC group exhibited calmer behaviors than those in the control group (p<.001). The ALPS-NEO-PSAS scores measured 5 minutes before, during, and 5 minutes after the procedure were lower in the SSC group than in the control group (p<.001).**Conclusions:** Nurses are recommended to implement skin-to-skin contact during heel lance procedures to provide comfort to both mother and infant.**Keywords:** Pain, Stress, Newborn, Heel lance.

ÖZ

Amaç: Topuk kanı alma işlemi, yenidoğan için ağrılı bir işlemdir. Bu çalışmada yeni doğandan topuk kanı alma işlemi esnasında uygulanan anne-bebek ten temasının (TTT) yeni doğanda ağrı ve strese etkisinin belirlenmesi amaçlanmıştır.**Gereç ve Yöntemler:** Araştırma, deneysel olarak, Ekim 2021-Aralık 2021 tarihleri arasında Ankara'da kadın hastalıkları ve doğum kliniği bulunan bir üniversite hastanesinde doğan (girişim grubu; n=49, kontrol grubu; n=49) 98 yeni doğan ile gerçekleştirilmiştir. Girişim grubundaki bebeklerden topuk kanı alınırken anneleri ile ten tene temas halinde olmaları sağlanmış, kontrol grubundaki bebeklerden ise püsette yatarken kan alınmıştır. Veriler; "Anneyle İlişkin Tanıtıcı Özellikler Formu", "Yeni Doğana İlişkin Tanıtıcı Özellikler Formu", "İşleme Yanıtı Değerlendirme Formu" ve "ALPS-NEO Yeni Doğan Ağrı, Stres Değerlendirme Ölçeği" kullanılarak toplanmıştır.**Bulgular:** Grupların işlem esnasında ağlama süresi karşılaştırıldığında, TTT grubundaki bebeklerin kontrol grubundakilerden daha kısa süre ağladığı görüldü (p<.001). TTT grubundaki anneler, kontrol grubundaki annelere göre daha sıklıkla sakin davranışlar sergiledi (p<.001). TTT grubundaki bebeklerin işlemden 5 dk önce, işlem esnasında ve işlemden 5 dk sonraki ALPS-NEO Scale puanları, kontrol grubundan düşüktü (p<.001).**Sonuçlar:** Hemşirelerin, topuk kanı alma esnasında anne ve bebeği rahatlatmak için ten tene temas uygulaması önerilir.**Anahtar Kelimeler:** Ağrı, Stres, Yeni doğan, Topuk kanı.

Introduction

Newborns may be exposed to many invasive interventions that may cause pain and stress for diagnosis and treatment from birth to discharge date (1-3). Heel prick tests and newborn hearing tests are among these interventions (3,4). The heel prick test plays a critical role in the early detection of conditions with potentially life-threatening or long-term adverse effects, enabling timely interventions to reduce mortality and morbidity. It is known that the heel lance procedure increases the newborn's pain and stress levels (3-5). Nonpharmacological methods like, fetal position, massage, music, kangaroo care, breastfeeding, sucrose, and pacifiers are effective in relieving pain and stress (6-9).

Holding a newborn in just a diaper against their mother's bare chest is known as skin-to-skin contact, and is

sometimes referred to as 'kangaroo care' due to its resemblance to how kangaroo mothers care for their babies (5). While existing studies highlight the benefits of skin-to-skin contact in mitigating physiological and behavioral pain responses in newborns, limited research has specifically focused on its effects during heel lance procedures (10-12). Strengthening the evidence for the widespread adoption of skin-to-skin contact (SSC) is crucial for managing pain and stress during heel prick lance. Therefore, this study aims to strengthen the evidence supporting the use of skin-to-skin contact as a nonpharmacological intervention to manage pain and stress during heel lance procedures in full-term newborns.

Materials and Methods

Design

The study was an experimental trial with two groups.

Participants

The population of the study consisted of newborns undergoing heel lance for blood sampling at a university hospital in Ankara between October and December 2021. A power analysis was performed using the G Power 3.1.0 software to determine the sample size. The study by Chang et al. (2020), examining the effects of skin-to-skin contact (SSC) on neonatal pain during heel lance, was used as a reference (SSC group: 3.21 ± 3.17 , Control group: 5.14 ± 2.50), with an effect size of $d=0.68$ (13). For 90% statistical power and a 0.05 margin of error, the minimum sample size required was calculated as 47 for the intervention group and 47 for the control group. Considering a dropout rate of 4%, the total sample size was determined to be 98 (number of intervention group=49, controls=49).

Newborns included in the study were those in the maternity ward undergoing routine heel lance blood sampling, aged 1-2 days, with no health issues, a gestational age of 36 weeks or above, and a birth weight of 2500 grams or more. Newborns with congenital anomalies, and those receiving any analgesic, sedative, or other medication before the procedure were excluded.

Procedure

The study was conducted in two groups. It began by introducing mothers whose infants would undergo heel lance to the procedure. After assessing the eligibility of each newborn, the mothers of eligible infants were informed about the study, and written consent was obtained from the mothers agreeing to participate. All blood samples were collected in a quiet room by a single nurse having no conflicts of interest in the research. The following procedures were applied to each study group as outlined below.

Intervention group

The skin-to-skin protocol for the intervention group in this study was adapted from Johnston et al. (14). Mothers wore hospital gowns opened in the front, and infants wore only diapers. To ensure maximum skin-to-skin contact while maintaining the infants' body temperature, newborns were positioned prone at a 60° angle across their mothers' chests, with the mothers' hands placed securely around their backs under a blanket. Mothers were seated in a chair before the procedure began, and SSC was initiated. Skin-to-skin contact was maintained for a total of 10 minutes prior to, during, and after the heel lance procedure.

Control Group

Infants in the control group were placed in a bassinet, and the heel lance was performed without any additional intervention beyond standard care. These infants were dressed, with only the leg and foot intended for the heel lance procedure exposed. A thin blanket was placed over them to prevent heat loss.

Data Accumulation

The data were collected using the Mother's Demographic Information Form (MDIF), the Newborn's Demographic Information Form (NDIF), the Procedure Response Evaluation Form (PREV), and the ALPS-NEO Neonatal Pain and Stress Assessment Scale (ALPS-NEO-PSAS).

The Mother's Demographic Information Form (MDIF)

This form includes questions on the mothers' socio-demographic and obstetric characteristics, such as age, educational level, income status, number of pregnancies, and chronic disease. It was administered after participants were assigned to the groups.

The Newborn's Demographic Information Form (NDIF)

This form assesses characteristics of the newborn, such as gestational age at birth, birth weight, gender, duration of the procedure, time of procedure, and mode of delivery. It was completed after participants were assigned to the groups.

The Procedure Response Evaluation Form (PREV)

This form, completed through observation during the procedure, assesses the infant's crying duration and the mother's reactions during the procedure.

The ALPS-NEO Neonatal Pain and Stress Assessment Scale (ALPS-NEO-PSAS).

The scale assesses newborn pain and stress levels by observation. It evaluates facial and breathing patterns, hand and foot movements, extremity tone, and activity levels. This Likert-type scale includes five parameters scored on a three-point scale. Scores of 3 to 5 indicate mild pain and stress, while scores above 5 indicate high levels of pain and stress. Ceylan & Bolisik translated the scale into Turkish, reporting a content validity index of 0.90/1.00 and a Cronbach's alpha coefficient ranging from 0.70 to 0.81 (2). In this study, Cronbach alpha coefficients were found to be 0.91 in the first and second measurements and 0.98 in the third measurement. Observations were conducted at three intervals: five minutes before the procedure, during the procedure, and five minutes after.

Ethics

The study received approval from the Faculty of Medicine Human Research Ethics Committee of Ankara University

(Approval No: I7-491-21, Date: 12/08/2021). Before data collection, mothers were informed about the study's purpose, and written consent was obtained.

Data Analysis

The data were analyzed using SPSS for Windows version 27.0, with statistical significance set at $p < 0.05$. The normality of the data set was tested via descriptive statistics. This method uses skewness and kurtosis values obtained from the data set to analyze normality. In the study, skewness and kurtosis values were determined to range between ± 2 , showing evidence that the data set had a normal distribution. The Chi-Square test was applied to assess associations between categorical variables, while the Independent Samples T-test was used for comparisons between two independent groups.

Results

The descriptive characteristics of the mothers are presented in Table 1, while those of the infants are shown in Table 2. The mean age of mothers in the SSC group was 28.51 ± 4.73 , while in the control group it was 29.59 ± 5.22 . In both groups, 38.8% of the mothers had a university level of education. The gestational age at birth of infants in the SSC group was 38.29 ± 1.31 weeks, while in the control group, it was 38.47 ± 1.04 weeks. The birth weight was 3271.12 ± 340.42 g in the SSC group and 3162.14 ± 395.80 g in the control group. Both groups were similar in terms of these characteristics.

Table 1. Demographic characteristics of mothers in the study groups (n=98)

Socio-demographic and Obstetric Characteristics	SSC Group (n=49)	Control Group (n=49)	Analysis	
	Mean $\pm$ SD	Mean $\pm$ SD	t ^a	p
Age	28.51 $\pm$ 4.73	29.59 $\pm$ 5.22	-1.075	0.285
Number of Pregnancies	1.88 $\pm$ 0.66	1.96 $\pm$ 0.91	-0.506	0.614
	n (%)	n (%)	χ^2 ^b	p
Education Level				
Primary School	12 (24.5)	13 (26.5)		
High School	18 (36.7)	17 (34.7)	0.069	0.966
College	19 (38.8)	19 (38.8)		
Employment Status				
Unemployed	25 (51.0)	33 (67.3)	2.703	0.100
Employed	24 (49.0)	16 (32.7)		
Economic Status				
Low	18 (36.7)	27 (55.1)	3.328	0.068
Medium and High	31 (63.3)	22 (44.9)		
Pregnancy Planning Status				
Planned	47 (95.9)	48 (98.0)	0.344	0.558
Unplanned	2 (4.1)	1 (2.0)		

^aIndependent t-test; ^bChi-square, Max: Maximum, Min: Minimum, SD: Standard deviation, SSC: Skin-to-skin contact

Table 2. Demographic and birth characteristics of newborns in the study groups (n=98)

Characteristics	SSC Group (n=49)	Control Group (n=49)	Analysis	
	Mean $\pm$ SD	Mean $\pm$ SD	t ^a	p
Gestational Age at Birth	38.29 $\pm$ 1.31	38.47 $\pm$ 1.04	-0.769	0.444
Birth Weight (g)	3271.12 $\pm$ 340.42	3162.14 $\pm$ 395.80	1.461	0.147
Birth Length (cm)	50.47 $\pm$ 2.44	49.76 $\pm$ 1.79	1.653	0.102
	n (%)	n (%)	χ^2 ^b	p
Gender of Infants				
Female	22 (44.9)	28 (57.1)	1.470	0.225
Male	27 (55.1)	21 (42.9)		
Mode of Delivery				
Vaginal Birth	24 (49.0)	15 (30.6)	3.450	0.063
Cesarean Section	25 (51.0)	34 (69.4)		

^aIndependent t-test; ^bChi-square, Max: Maximum, Min: Minimum, SD: Standard deviation, SSC: Skin-to-skin contact

The crying duration was significantly shorter in the SSC group compared to the control group, indicating reduced distress in the intervention group ($p < .001$). Mothers in the SSC group also exhibited calmer behaviors more frequently than those in the control group ($p < .001$) (Table 3). The ALPS-NEO-PSAS scores were assessed at three time points; that is, 5 minutes before, during, and 5 minutes after the procedure. Scores in the SSC group were consistently and significantly lower than in the control group across all time points ($p < .001$) (Table 4, Figure 1).

Table 3. Comparison of crying duration and maternal reactions during the heel lance procedure (n=98)

Characteristics	SSC Group (n=49)	Control Group (n=49)	Analysis		Cohen's d
	Mean $\pm$ SD	Mean $\pm$ SD	t ^a	p	
Crying Duration (min)	1.27 $\pm$ 1.43	4.82 $\pm$ 2.47	-8.710	<0.001	2.018
	n (%)	n (%)	χ^2 ^b	p	
Mother's Reaction During the Procedure					
Calmed down	47 (95.9)	33 (67.3)	13.339	<0.001	
Stressed	2 (4.1)	16 (32.7)			

^aIndependent t-test; ^bChi-square, Max: Maximum, Min: Minimum, SSC: Skin-to-skin contact

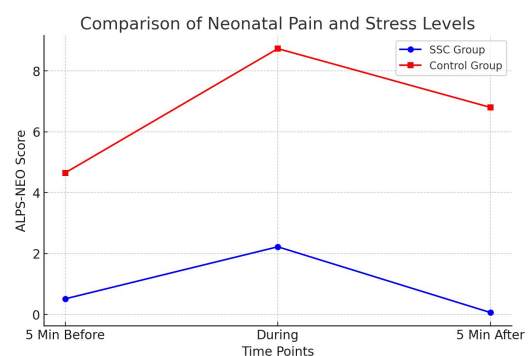


Figure 1. Comparison of Neonatal Pain and Stress Levels

Table 4. Comparison of neonatal pain and stress levels (ALPS-NEO-PSAS scale scores) before, during, and after the procedure (n=98)

Measurement Time	SSC Group (n=49)	Control Group (n=49)	Test/p	Cohen's d
	Mean±SD	Mean±SD		
5 minutes before the procedure	0.51±0.77	4.65±0.97	t=-23.460 p<0.001	0.874
During the procedure	2.22±0.82	8.73±0.97	t=-35.730 p<0.001	0.902
5 minutes after the procedure	0.06±0.24	6.80±1.85	t=-25.291 p<0.001	1.318

^aIndependent t-test; ^bChi-square, SD: Standard deviation, SSC: Skin-to-skin contact

Discussion

This study aimed to investigate the impact of skin-to-skin contact (SSC) on pain and stress in newborns during heel lance. Infants in the SSC group had a shorter crying duration during the procedure than those in the control group ($p<.001$). Similar findings were reported by Okan et al., observing that full-term infants undergoing heel lance with SSC cried less than those lying on a table (12). Castral et al. also noted that both preterm newborns in the SSC and control groups cried during heel lance, but the SSC group had a shorter crying duration (15). Similarly, Gray et al. found an 82% reduction in crying during heel lance for healthy newborns in the SSC group compared to the control group (10). Studies, including those by Avcin & Kucukoglu and Kostandy & Ludington-Hoe, also support that SSC reduces crying duration during painful procedures for healthy newborns (16,17). These findings, along with the literature, indicate that SSC effectively shortens crying duration in newborns during heel lance. These findings reinforce the hypothesis that SSC provides an effective non-pharmacological intervention for neonatal pain management. Future studies could explore whether this effect is influenced by variables such as maternal stress levels, infant temperament, or environmental factors.

The pain and stress levels in the SSC group were lower 5 minutes before, during, and 5 minutes after the procedure compared to the control group ($p<.001$). Chidambaram et al. assessed pain scores for preterm newborns undergoing heel lance for blood glucose measurement at 15 and 30 minutes post-procedure and found lower pain scores in the SSC group than in the control group at both intervals (18). Unlike our study, Chidambaram et al. reported similar pain levels between groups before the procedure. The probable reason for this difference is that while our study was conducted on term neonates, Chidambaram et al.

conducted their study on preterm neonates (32–36 weeks). This difference highlights the potential impact of gestational age on pain perception and response to SSC, suggesting that further research is needed to compare its effectiveness across different neonatal populations. Castral et al. found that preterm newborns in the SSC group had lower pain scores during heel lance, squeezing, and post-puncture phases than those in the control group (15). Okan et al. also noted that term infants undergoing heel lance with SSC exhibited fewer physiological and behavioral pain responses (e.g., heart rate, oxygen saturation changes, crying duration, facial expressions) compared to those lying on a table (12). Gray et al. observed that pain responses such as crying, grimacing, and increased heart rate occurred less frequently in the SSC group than in swaddled infants in a crib (10). Kirbas et al. found that SSC was more effective in reducing total crying time and stabilizing pulse, oxygen saturation, salivary cortisol, and glucose-regulated protein 78-GRP78 levels, which are indicative of pain and stress, compared to white noise and control groups (11). These results collectively support SSC as an effective method for managing pain and stress in newborns during heel lance. These findings suggest that SSC has broad physiological and behavioral benefits beyond pain reduction, potentially improving overall neonatal well-being. Future studies could assess whether SSC has lasting effects on neonatal stress regulation beyond the immediate post-procedure period.

Mothers in the SSC group also exhibited calmer behaviors more frequently than those in the control group ($p<.001$). Based on the literature, no studies were found to evaluate the impact of SSC on mothers during heel lance. However, a systematic review by Athanasopoulou and Fox reported a protective relationship between SSC and maternal mood (19). Scime et al. also found that SSC effectively protected mothers against postpartum depression (20). This suggests that SSC may not only benefit infants but also play a role in enhancing maternal emotional well-being. Investigating whether SSC reduces maternal stress and anxiety during other neonatal procedures could provide valuable insights into its broader psychological impact. While the impact of SSC on maternal mood has been highlighted, the broader significance of this finding in terms of overall maternal health and caregiving should be explored further. Future studies could examine how SSC influences maternal-infant bonding, confidence in caregiving,

and long-term emotional well-being. Based on this information, SSC appears to be a beneficial tool for calming both mothers and infants.

Conclusion

This study demonstrated that SSC during heel lance shortened crying duration, reduced pain and stress in newborns, and helped calm mothers. SSC is a practical, easy-to-implement, cost-effective intervention that benefits both mother and infant and is widely embraced. Therefore, SSC is recommended for use by nurses during heel lance and other painful procedures in newborns. Studies have shown that SSC improves other mental and physical health outcomes of the mother and the baby and increases the quality of the mother-baby relationship (21). It is recommended that these effects of SSC in heel pricks be evaluated in future studies. In this study, term neonates were examined, and short-term follow-up was conducted. Neonatal pain and stress were assessed using ALPS-NEO-PSAS. It is recommended that future studies include pre-term and post-term infants, incorporate long-term follow-ups, and evaluate stress using different parameters to provide a more comprehensive understanding. It is also recommended that studies be conducted to evaluate the mother's emotional state and possible interventions during contact.

Conflict of interest

There are no known conflicts of interest associated with this publication

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