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Effects of three different methods used during heel lance procedures on pain level in term neonates

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Abstract

Aim: This study aims to experimentally determine effects of three different methods (swaddling; swaddling and holding; swaddling, holding and breastfeeding) used during heel lancing on pain levels in healthy term neonates.

Methods: This study was a prospective, randomized controlled trial. The sample of newborns (n = 160) were allocated to the groups (group 1, control; group 2, swaddling; group 3, swaddling and holding; group 4, swaddling, holding and breastfeeding) by blocked randomization. The study data were obtained using an information form, and the Neonatal Infant Pain Scale (NIPS).

Results: The procedural pain scores of group 4 were lower than group 1, group 2 and group 3. Both the total crying time and the first calming time of the groups swaddling, holding and breastfeeding, were shorter than the swaddling, swaddling and holding and the control group.

Conclusions: As a result, all the three methods are effective in reducing the pain felt during heel lancing in the newborn. However, swaddling, holding and breastfeeding is more effective than the other methods.

KEYWORDS

breastfeeding, newborn, pain, swaddling

1 | INTRODUCTION

All newborns face several painful treatments starting from their birth. An acute pain associated with interventions causes behavioral stress and physiological changes such as decrease in oxygen saturation, hemodynamic instability and increase in intracranial pressure. These pain-related problems adversely affect the baby's adaptation to the outside world, growth and development and family-baby interaction (Committee on Fetus and Newborn and Section on Anesthesiology and Pain Medicine, 2016; Mangat, Oei, Chen, Quah-Smith, & Schmölzer, 2018; Obeidat & Shuriquie, 2015; Pancekauskaitė & Jankauskaitė, 2018). In order to minimize these adverse conditions are recommended interventions to reduce pain in newborns and use non-pharmacological pain-relieving methods (American Academy of Pediatrics, 2016; Anand & International Evidence-Based Group for Neonatal Pain, 2001; Pölkki, Korhonen, & Laukkala, 2018).

Heel lance procedure for diagnosis is one of the most common painful medical procedures in newborns (Erkut & Yildiz, 2017; Morrow, Hidinger, & Wilkinson-Faulk, 2010; Motta & Cunha, 2015; Okan, Ozdil, Bulbul, Yapici, & Nuhoglu, 2010). Although heel lancing is considered to be an easy process, its repetition because of reasons like needling the heel, squeezing the heel to get the right amount of blood, the change in the quality of the sample and its contamination or the sample is not enough, the process might take longer than normal and

may become painful and stressful for newborns (Morrow et al., 2010; Okan et al., 2010; Shah & Ohlsson, 2011). Today, pharmacological or non-pharmacological methods can be used to relieve pain during the heel lance process which is one of the invasive procedures applied to a newborn (Erkut & Yildiz, 2017; Motta & Cunha, 2015; Shu, Lee, Hayter, & Wang, 2014). Among the non-pharmacological methods commonly used in pain management for painful medical procedures in newborns are breastfeeding (Aguilar Cordero, Mur Villar, García García, Rodríguez López, & Rizo-Baeza, 2014; Gabriel et al., 2013; Harrison et al., 2016; Obeidat & Shuriquie, 2015; Okan et al., 2010; Pillai Riddell et al., 2015; Shah, Herbozo, Aliwalas, & Shah, 2012; Uga et al., 2008; Zhu et al., 2015), a pacifier (Motta & Cunha, 2015), and sucrose and sweet solutions (Kassab, Anabrees, Harrison, Khriesat, & Chen, 2017; Kassab, Foster, Foureur, & Fowler, 2012; Pillai Riddell et al., 2015). Further, music listening, massage, touching and positioning, nesting and kangaroo mother care are among the other non-pharmacological methods used in pain management (Ali, McGrath, & Drendel, 2016; Cong, 2015; Morrow et al., 2010; Obeidat & Shuriquie, 2015; Okan et al., 2010; Shu et al., 2014).

One of the non-pharmacologic methods is swaddling. In the literature, it is depicted that swaddling relieves pain via sensorial or multi-dimensional stimulation and creates an analgesic effect during heel lance procedure (Ho, Ho, Leung, So, & Chan, 2016). Swaddling has a number of positive effects on neonates (Ho et al., 2016; Leng et al., 2016; Morrow et al., 2010; Motta & Cunha, 2015; Nelson, 2017; Pillai Riddell et al., 2015). Wrapping procedure has been reported to contribute to the calming of newborns by supporting their self-regulation ability, to regulate sleep and to effectively reduce the level of pain (Ho et al., 2016; Leng et al., 2016; Morrow et al., 2010; Nelson, 2017; Sinpru & Tilokskulchai, 2009). In addition, wrapping procedure has been shown to facilitate the adaptation of newborns to the extrauterine environment, promote neuromuscular and motor development, prevent hypothermia by contributing to thermoregulation, reduce the risk of sudden infant death syndrome, and regulate the heart beat rate and the oxygen saturation by relieving the pain caused by invasive procedures. (Erkut & Yildiz, 2017; Nelson, 2017). Swaddling can also reduce the pain associated with the heel lance procedure (Erkut & Yildiz, 2017; Shu et al., 2014).

Another non-pharmacologic method for newborns is maternal holding (Bembich et al., 2018; Okan et al., 2010). Being in the mother's arms can decrease pain during minor procedures, such as a heel lance (Bembich et al., 2018). Maternal holding and touching are used as efficient methods to reduce pain during heel lance and vaccination procedures in newborns (Obeidat & Shuriquie, 2015; Pillai Riddell et al., 2015).

One of the non-pharmacologic methods is breastfeeding. It has been reported effective in reducing pain that occurs during minor painful procedures (Motta & Cunha, 2015; Obeidat & Shuriquie, 2015; Shah et al., 2012). Breastfeeding is the sum of skin-ship, mother-infant interaction, the sense respirators on skin and the activation of taste. The analgesic effect of breast milk and the fat, protein and the other tastes it contains stimulate the opioids and stops the transmission of the feeling of pain by blocking the pain fibers (Motta & Cunha, 2015). It is recommended in studies that breastfeeding should be used to reduce pain during procedural applications in newborns (Ali et al., 2016; Reece-Stremtan et al., 2016; Shah et al., 2012; Zhu et al., 2015).

In our country, none of the methods are being commonly used to reduce pain during the heel lancing processes that are applied for newborn screening. In the literature, the non-pharmacological methods, which are used to reduce pain during the heel lance process, are recommended to be practical, cheap and easy to use and preferable by nurses (Hashemi, Taheri, Ghodsbin, Pishva, & Vossoughi, 2016; Mangat et al., 2018). In the literature, the methods of breastfeeding, swaddling and holding are being recommended as effective methods in reducing the physiological changes caused by pain during some treatments in newborns (Bembich et al., 2018; Erkut & Yildiz, 2017; Shah et al., 2012). Although there is some research which shows that methods of swaddling, holding and breastfeeding are effective in reducing pain (Motta & Cunha, 2015; Obeidat & Shuriquie, 2015), there is no any research comparing the effectiveness of swaddling, swaddling and holding and swaddling, holding and breastfeeding methods in reducing the pain during the heel lance process in newborns.

In the light of this information, the study was planned to evaluate the effect of three different non-pharmacological pain relief methods; swaddling, swaddling and holding and swaddling, holding and breastfeeding used during the heel lance procedure in healthy term newborns on pain level.

The hypotheses of the study:

Hypothesis 1 Swaddling method is effective in reducing pain due to the heel lance procedure in newborns.

Hypothesis 2 In reducing heel lance-related pain in newborns, the method of swaddling and holding is more effective than only swaddling.

Hypothesis 3 In reducing the heel lance-related pain in newborns, swaddling, holding and breastfeeding is more effective than only swaddling and swaddling and holding.

2 | METHODS

2.1 | Study design

2.1.1 | Study design

The study was carried out in the baby's room of a public hospital in Bandirma. It was planned as a randomized controlled experimental study evaluating the effect of swaddling, swaddling and holding and swaddling, holding and breastfeeding methods used during heel lance procedure in healthy term newborns on pain level.

2.1.2 | Setting and sample

The sampling of the research consisted of 160 healthy newborns who needed to undergo a routine heel lancing for metabolic screening.

The inclusion criteria was 2 to 4 days old newborns (38–42 weeks gestation) who needed a routine heel lance. Newborns who had congenital feeding-related anomalies were not included in the research.

For 80% reliability, $\alpha = 0.05$ was calculated as 40, and the total for the experimental groups was 160 according to the power analysis done using heel lance literature (Obeidat & Shuriquie, 2015; Shu et al., 2014; Zhu et al., 2015). The groups were randomized by the researcher using a computer-based random number table program.

The researcher randomized the newborns into three groups: swaddling (n = 40), swaddling and holding (n = 40), swaddling, holding and breastfeeding (n = 40), and the control group (n = 40) (Figure 1). Among the four groups, the numbers from 1 to 160 were randomly distributed without repetition by a computer program in order to include the babies into the suitable groups. A random code was picked for each newborn by the researcher and the 160 newborns were shared equally into three groups with the group numbers group 1 (control group - C group), group 2 (swaddling group - S group), group 3 (swaddling and holding group - SH group) and group 4 (swaddling, holding and breastfeeding group - SH + B group).

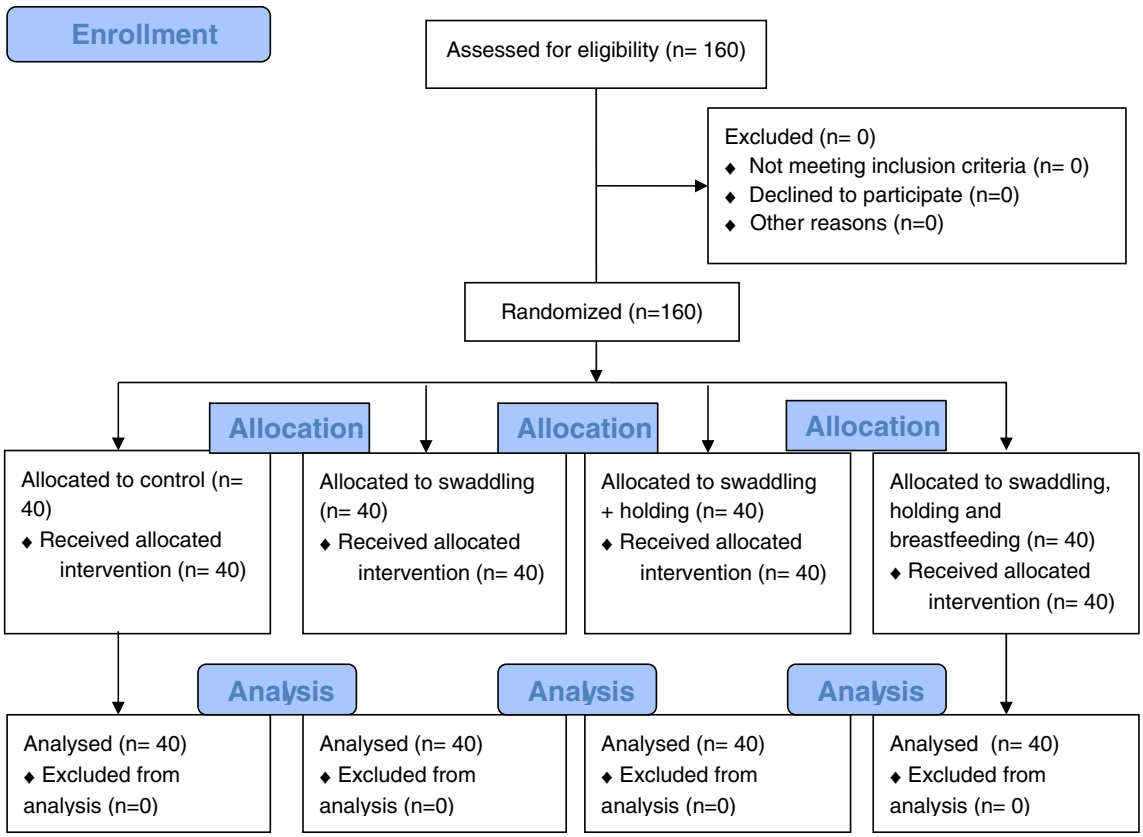

FIGURE 1 Study flow diagram

2.1.3 | Measurements

Data were collected using an information form and the Neonatal Infant Pain Scale (NIPS).

Information form: this form contained questions about the socio-demographic characteristics of the neonates and families.

NIPS: the scale was developed by Lawrence et al. (1993) to evaluate the behavioral and physiological pain responses of preterm and term infants and was adapted into Turkish by Akdovan (1999). In this study, NIPS scale was used to evaluate the procedural pain of the newborn. The scale consists of five behavioral factors (facial expression, crying, state of arousal, arm and leg movements), and a physiological (breathing patterns) factor. Factor of crying is given 0–1–2 points, other factors are given 0–1 points, and the total score is between 0–7. A high score indicates that the severity of pain is great. In the study by Lawrence et al., the reliability coefficient of NIPS was found to be between .92 and .97 and in the study of Akdovan it was between .83 and .86.

2.1.4 | Data collection

Standard heel lance procedure was applied to the newborns in the baby's room between 9–11 a.m. The heel lance procedure of the newborns was performed by the same nurse who worked in the baby's room and had at least 5 years of experience. The nurse does not have any kind of benefits. The decision about the heel lance is made by a pediatrician.

Before starting the research, we informed the parents about the goals and the context and received their approval. Self-report information forms have been used to collect newborn and family demographics. The form included the infant's gender, date of birth, gestational age, postnatal age, method of delivery, birth weight length, head circumference, parents' ages, educational background and working conditions, duration of sampling, total duration of crying and the duration from the beginning of the newborn's first cry to the first calm during the procedure.

The newborns were kept in a quiet room far enough not to hear other crying babies and their diapers were refreshed before the attempt. For each group, the blood collection technique used during the blood collection process, the area of blood collection (the outer lateral side of the right heel), the needle used in the procedure (21-gage needle), the environmental factors for the newborn (heat, light, noise), and the antiseptic solution used (70% alcohol) were standardized. Starting from the preparations until 2 min later than the application, the process was video-recorded.

The newborns' blood-letting procedure was performed within the scope of the newborn Guthrie screening test. Before the procedure, the newborns feeling nervous and crying were soothed. They were fed and their diapers were changed at least half an hour before the heel lance procedure. All the relieved newborns were taken to the baby room. A few drops of heel blood were dripped onto the Guthrie screening test filter paper. The heel lance procedure was carried out by an experienced neonatal nurse drawing nearly the same amount of blood from each infant each time. The researchers video-recorded all the procedures from the beginning, both in experimental and control groups. To be sure that the groups are at a certain standard, the following 2 min after the end of the process were recorded as well. In all the groups mothers were by their babies' sides during the processes. Right after the procedure, the newborns were soothed in their mothers' arms. Following the procedure, the pain levels and durations of crying of the newborns were evaluated through recordings. The researchers took care of the recording processes as well. To prevent prejudgement, NIPS has been used by an independent observer, blinded to the group allocations of newborns, to evaluate the pain. Those observers were nurses with at least 5 years of experience in newborn care and pain assessment. On the other hand, the researcher recorded the total procedural crying time of the newborn, the duration of the procedure and the first soothing moment. The total crying time of the newborns defines the time interval between the period during which the newborn starts to cry after the beginning of the heel lance procedure and the period during which the crying completely ends, whereas the duration of the procedure defines the process from the beginning of the blood collection to the end, and the duration of calming defines the period from the beginning of the heel lance procedure to the time in which the newborn first calms / crying ends.

For all the groups, the sum of crying duration and soothing duration of the newborns were assessed through video records by the nurse who was serving as an independent observer.

Control group (Group C - Group 1) In this group, the heel lance procedure was performed while the newborns were in a routine position. No intervention was performed for the newborns during the procedure. In the institution where the study was performed, there was no routine method used to relieve pain during heel lance procedures.

Swaddling group (Group S - Group 2) Swaddling is a wrapping procedure in which a baby's arms and legs are comfortable, sometimes only the arms are wrapped

inside, and two ends of fabric are crossed on the chest of the baby, generally with thin cotton and soft fabric or a blanket. In compliance with the newborn anatomic posture, the legs were wrapped in the flexion and abduction position. The arms of the newborns were placed close to their body so as not to restrict their movement. Swaddling was carried out 1 min before the heel stich procedure and continued 2 min after the procedure. The neonate remained on the examination table during the swaddling procedure. Swaddling was applied not too loose or too tight during the procedure. This swaddling method is also called safe swaddling (Erkut & Yildiz, 2017).

Swaddled and holding group (Group SH - Group 3) The mothers in this group sit down on a comfortable chair and following the safe swaddling of the newborns, the baby is placed in the mothers' arms and the heel lance process is applied. The newborn is kept in this same position for two more minutes following the process.

Swaddling, holding and breastfeeding group (Group SH + B - Group 4) The criteria set in both of the groups have been applied on the newborns in this group. First, the newborn has been swaddled proper to its anatomy, legs are in flexion and abduction and in a way that does not limit movement. The mother is seated on a comfortable chair and encouraged to breastfeed the baby in her arms. Heel lance procedure was initiated after the newborn held and sucked the mother's breast. Breastfeeding began immediately before the heel lance procedure (about 1 min before) and continued for a minimum of 2 min during and after the procedure.

2.1.5 | Data analysis

The SPSS (version 19) program was used for statistical analysis. Descriptive statistical methods were used when study data were evaluated. One-way analysis of variance test was used for normally distributed conditions. In the detection of the group that causes the difference, Dunnett's T3 test was used, from the post hoc tests. Estimated sample effect size was determined as d = 0.30 in 95% confidence range at the $\alpha = .05$ level. Pearson's Chi-square test was used for the comparison of quantitative data. Significance was considered as $p < .05$.

2.1.6 | Ethical consideration

To conduct this study, the research was approved by the authors' university ethics review board (dated: January 27th, 2016 and numbered: 2016/12). After explaining the purpose, method, quality and confidentiality of the study to the mothers, an informed consent was obtained on a voluntary basis. They were also informed that they could leave the study without any explanation.

3 | RESULTS

3.1 | Comparison of the groups in terms of demographic data

In the study, 160 neonates (girls n = 80, 50%; boys n = 80, 50%) were included. The neonates were randomized into the swaddling (S) (n = 40), swaddled and holding (SH) (n = 40), swaddling, holding and breastfeeding (SH + B) (n = 40), and control (n = 40) groups. There was no significant difference between groups in terms of gender, delivery method, gestational age, postnatal age, birth weight-height and head circumference ($p > .05$). The other demographic data are shown in Table 1.

3.2 | Comparison of the groups in terms of pain scores

When the pain levels of the newborns during the procedure were compared by groups, a statistically significant difference was found between the groups. It was observed that procedural pain levels were the lowest in the SH + B group (4.47 ± 1.19), followed by SH (5.57 ± 1.23), S (5.85 ± 0.86) and the controls (6.40 ± 0.95). Although there was no statistically significant difference between S and SH groups in between-group paired comparisons, it was determined that the mean pain score of SH + B group was significantly lower than the SH group, S group and control group (Table 2).

3.3 | Comparison of the groups in terms of crying times and calming times

A statistically significant difference was found between the groups according to the total crying time of newborns and the time to calming ($p = .000$; $p < .01$, respectively) (Table 3). When the groups were compared by crying time, the duration of crying of the SH + B (40.92 ± 28.83) was statistically significantly shorter than in the SH (77.37 ± 44.01) ($p = .000$; $p < .01$, respectively), S group (69.75 ± 33.43) ($p = .001$; $p < .01$, respectively), and the control group (79.25 ± 41.47) ($p = .000$). When the total crying times were compared, no statistically significant difference was found between the S group and control group ($p = .833$; $p > .05$, respectively), the SH

TABLE 1 Comparison of demographic characteristics of newborns by groups

			C group (n = 40)	S group (n = 40)	SH group (n = 40)	SH + B group (n = 40)	Test, *p** value
Gender n (%)	Female	80 (50.0)	20 (50.0)	20 (50.0)	20 (50.0)	20 (50.0)	*1.000*[a]
	Male	80 (50.0)	20 (50.0)	20 (50.0)	20 (50.0)	20 (50.0)	
Delivery method	Vaginal	95 (59.4)	24 (60.0)	22 (55.0)	26 (65.0)	23 (57.5)	*.824*[a]
	Cesarean	65 (40.6)	16 (40.0)	18 (45.0)	14 (35.0)	17 (42.5)	
Gestational age (weeks)	Min-max (median)	37–41 (39)	37–40 (39)	37–41 (39)	36–41 (39)	37–41 (39)	*.244*[b]
	Mean ± Sd	39.02 ± 1.12	38.92 ± 1.20	38.85 ± 1.00	39.00 ± 1.24	39.32 ± 0.99	
Postnatal age (weeks)	Min-max (median)	37–40 (39)	37–40 (39)	37–41 (39)	36–41 (39)	37–41 (39)	*.244*[b]
	Mean ± SD	39.02 ± 1.12	38.92 ± 1.20	38.85 ± 1.00	39.0 ± 1.24	39.32 ± 0.99	
Birth weight (g)	Min-max (median)	2,130–4,720 (3320)	2,220–4,480 (3160)	2,260–4,220 (3325)	2,545–4,720 (3375)	2,130–4,720 (3400)	*.258*[b]
	Mean ± SD	3,369.06 ± 484.05	3,248.12 ± 514.30	3,369.75 ± 386.20	3,459.62 ± 476.88	3,398.75 ± 538.40	
Birth height (cm)	Min-max (median)	45–59 (51)	45–59 (50)	47–57 (51)	47–56 (51)	46–54 (51)	*.219*[b]
	Mean ± SD	50.61 ± 2.16	50.05 ± 2.75	50.62 ± 1.94	51.05 ± 1.97	50.72 ± 1.82	
Head circumference (cm)	Min-max (median)	32–38 (35)	32–38 (35)	32–38 (35)	32–38 (35)	32–37 (35)	*.692*[b]
	Mean ± SD	35.20 ± 1.33	35.25 ± 1.40	35.35 ± 1.29	35.22 ± 1.47	35.00 ± 1.15	

[a]Pearson's Chi-square test.
[b]One-way analysis of variance test.
*$p > .01$.
Abbreviations: C, control; S, swaddling; SH, swaddling and holding; SH + B, swaddling, holding and breastfeeding

TABLE 2 Comparison of pain scores of newborns by groups

NIPS total score		Total	Group				p^a	Group[b] 1–2	Group[b] 1–3	Group[b] 1–4	Group[b] 2–3	Group[b] 2–4	Group[b] 3–4
			C group (n = 40)	S group (n = 40)	SH group (n = 40)	SH + B group (n = 40)							
During procedure	Min-max (median)	2–7 (5)	3–7 (6)	3–7 (5)	4–7 (5)	2–7 (4)	.000*	.049	.008	.000	.819	.000	.001
	Mean ± SD	5.57 ± 1.27	6.40 ± 0.95	5.85 ± 0.86	5.57 ± 1.23	4.47 ± 1.19							

[a]One-way analysis of variance test.
[b]Dunnett's T3 test.
*$p < .01$.
; Abbreviations: NIPS, Neonatal Infant Pain Scale; C, control; S, swaddling; SH, swaddling and holding; SH + B, swaddling, holding and breastfeeding.

TABLE 3 Comparison of crying of newborns by groups

		Total	Group				p*	Group[b] 1–2	Group[b] 1–3	Group[b] 1–4	Group[b] 2–3	Group[b] 2–4	Group[b] 3–4
			C group (n = 40)	S group (n = 40)	SH (n = 40)	SH + B group (n = 40)							
Total crying time (seconds)	Min-max (median)	5–180 (60)	5–160 (80)	5–160 (65)	15–180 (70)	5–100 (30)	*.000*[a]	.833	1.000	.000	.943	*.001*	.000
	Mean ± SD	66.82 ± 40.16	79.25 ± 41.47	69.75 ± 33.43	77.37 ± 44.01	40.92 ± 28.83							
Time to first calming	Min-max (median)	5–180 (40)	5–160 (50)	2–150 (50)	5–180 (50)	5–100 (20)	*0.000*[a]	.997	.996	*.000*	.900	*.000*	*.000*
	Mean ± SD	52.06 ± 42.31	60.27 ± 42.52	56.00 ± 36.65	65.75 ± 50.25	26.25 ± 25.75							

[a]One-way analysis of variance test.
[b]Dunnett's T3 test.
*$p < .01$.
Abbreviations: C, control; S, swaddling; SH, swaddling and holding; SH + B, swaddling, holding and breastfeeding.

group and control group ($p = 1.000$; $p > .05$, respectively), and the S group and SH group ($p = .943$; $p > .05$, respectively). When the first calming times of the newborns was compared, it was determined that the calming time of the SH + B group (26.25 ± 25.75) was statistically significantly shorter than in the S (56.00 ± 36.65), SH (65.75 ± 50.25) and control groups (60.27 ± 42.52) ($p < .05$). When the calming times were compared, there was no statistically significant difference found between the S group and the control group ($p = .997$; $p > .05$, respectively), the SH group and control group ($p = .996$; $p > .05$, respectively), and the S group and SH group ($p = .900$; $p > .05$, respectively) (Table 3).

4 | DISCUSSION

For an effective pain relief, it is important to detect the pain correctly and on time. To ensure that the methods are satisfactory, a multidisciplinary team approach is required. Especially to relieve the pain, non-pharmacological methods are beneficial as much as pharmacological methods.

Non-pharmacological analgesia is commonly used in neonatal units during minor painful procedures such as the heel lance procedure (Bembich et al., 2018). Swaddling, holding and breastfeeding are among non-pharmacological analgesic methods and because of their analgesic effects they are being used to monitor painful procedures in newborns (Erkut & Yildiz, 2017; Mangat et al., 2018). Swaddling reduces the physiological stress of the newborn by easing its adaptation to the extrauterine environment and preventing physical and behavioral anxiety (Erkut & Yildiz, 2017; Nelson, 2017). In recent research, it is obvious that swaddling is effective in reducing the newborn's pain during invasive attempts (Cong, 2015; Leng et al., 2016; Morrow et al., 2010; Shu et al., 2014). Swaddling reduces pain equal to breastfeeding during a painful heel lance and can also shorten the pain recovery time (Cong, 2015;Erkut & Yildiz, 2017; Shu et al., 2014). In our study, newborns in the swaddling group had significantly lower procedural pain scores compared with newborns in the control group (Table 2). The results of our research are in line with the results of other research in the literature (Erkut & Yildiz, 2017; Shu et al., 2014) and the pain scores of the newborns in the swaddling group are found to be lower than the control group. Therefore, hypothesis is verified in the research.

Holding in arms soothes the repetitive movement of newborns and it is known to be an effective analgesic practice in reducing pain, by reducing crying (Bembich et al., 2018; Motta & Cunha, 2015). Holding can be used solely as well as it can be used along with other methods in newborns. Holding and touching are used as effective methods for reducing pain during procedures such as heel lance and vaccination (Obeidat & Shuriquie, 2015; Okan et al., 2010). In the literature, while meaningful reduction in the pain levels is observed as in the research of Okan et al. (2010), in the research of Obeidat and Shuriquie (2015) and Karakoç and Türker (2014), although a reduction was observed in the pain levels, they were not more meaningful than the other groups. In our research, no meaningful difference was detected between the pain scores of the newborns who had been swaddled and held and the newborns who had been swaddled only ($p = .819$). According to these results, hypothesis is verified in the research.

It is stated in the literature that besides its known benefits, breastfeeding is effective in relieving pain that occurs during the minor painful procedures of newborns (Bembich et al., 2018; Motta & Cunha, 2015; Obeidat & Shuriquie, 2015; Shah et al., 2012). Breastfeeding is the sum of skin-ship, mother-infant interaction, the sense respirators on skin and the activation of taste. The analgesic effect of breastmilk (Ali et al., 2016; Bembich et al., 2018; Okan et al., 2010; Shah et al., 2012; Witt, Coynor, Edwards, & Bradshaw, 2016) and the fat, protein and the other tastes it contains stimulate opioids and stops the transmission of the feeling of pain by blocking the pain fibers. In the literature, it is recommended that breastfeeding should be used to reduce pain during procedural applications in newborns (Bembich et al., 2018; Reece-Stremtan et al., 2016; Shah et al., 2012). Sucking reflex of the newborn is a multifaceted sensory approach which combines the taste and sucking of breastmilk while in his/her mother's arms and is a condition that includes tactile, auditory, visual and olfactory components that can lead to pain-relieving sensory saturation for all newborns (Obeidat & Shuriquie, 2015). In the literature, in research which uses breastfeeding alone or along with several non-pharmacological methods, it has been stated that the level of pain decreases more meaningfully (Bembich et al., 2018; Hashemi et al., 2016; Obeidat & Shuriquie, 2015; Uga et al., 2008; Zhu et al., 2015). Hashemi et al. (2016) reported that both oral glucose and breastfeeding showed the greatest analgesic effect of breastfeeding in the maternal relationship. The results of our research have been found to be in line with the literature (Bembich et al., 2018; Hashemi et al., 2016; Obeidat & Shuriquie, 2015; Uga et al., 2008; Zhu et al., 2015) and the pain scores of the newborns who have been swaddled, held and breastfed have been found to be less than all the other groups. According to these results, hypothesis has been verified.

The most distinct and observable behavioral response of newborns to painful interventions is crying

(Nelson, 2017). In our study, on comparison of crying times of neonates during minimal invasive interventions, statistically significant differences were detected between the groups in terms of total crying times, procedure periods, and time to first calming ($p < .05$). Karakoç and Türker (2014) observed that the total crying times of their white noise group was less than holding, holding + white noise group, and control groups. When Shu et al. (2014) compared crying times of groups during heel lance procedures, it was determined that crying times of heel-warmed and swaddled neonates were less than the control group. Erkut and Yildiz (2017) reported in their study that swaddling is an effective non-pharmacological method for calming a crying newborn. Cong (2015) found that the crying time of the newborns in the control group was significantly longer than that of the newborns in the group subject to swaddling and heel warming.

In the results of our study, it was determined that the mean total crying time of the newborns who were wrapped, placed in their mothers' arms and breastfed was statistically significantly lower than those of the newborns who were only wrapped and placed in their mothers' arms. The difference between the groups was statistically significant. These results show that swaddling, holding and breastfeeding of newborns are effective in soothing them and shortening the duration of crying during heel lancing. To easily soothe the newborn, we can suggest swaddling and breastfeeding the newborn in the mother's arms during heel lancing.

4.1 | Limitations

The study has two limitations. The first is that the pain assessment of the newborn was performed by the researcher. In order to reduce the limitation of the researcher's participation in pain scoring, the pain assessment was evaluated with objective parameters using a validated and reliable scale. The other limitation of the study was the lack of any method to reduce pain in the newborns in the control group because there was no pain-relieving method that was applied routinely during the heel lance procedure in the unit where the study was performed. In this study, newborns in the control group were also placed in the mothers' arms after the observation period was completed.

5 | CONCLUSIONS AND RECOMMENDATIONS

Swaddling, holding and breastfeeding was more effective than swaddling and swaddling and holding in reducing pain during heel lance procedures. Swaddling, holding and breastfeeding, contributes to calming babies in a shorter period. The contribution of swaddling, holding and breastfeeding to the calming period of babies is greater than swaddling, and swaddling and holding. Breastfeeding while wrapping the newborn and placing him/her in the mother's arms may be used to reduce pain and shorten the calming time during heel lance procedures.

The results of this randomized controlled trial are important in clinically proving that breastfeeding in newborns by wrapping and placing them in their mothers' arms is effective in reducing pain caused by the heel lance procedures. The findings of this study are that swaddling, holding and breastfeeding can provide an analgesic effect in newborns. This result shows that health professionals, especially nurses and midwives, who perform the heel lance procedure, can provide effective analgesia by wrapping the newborns and placing them in the mothers' arms and breastfeeding.

On the other hand, using the swaddling and breastfeeding methods simultaneously during painful procedures can also reduce the anxiety the mothers feel. Therefore, it is considered as a soothing measure as it can prevent mothers' concerns about despair or separation and can include the mothers actively in the baby care process during invasive attempts. This method is considered to be suitable to be used in more clinics as it is practical, not costly and easy to be employed and preferable by nurses.

As a result, as well as swaddling, swaddling and holding and swaddling, holding and breastfeeding in the mother's arms, are effective in reducing the pain the newborns feel during heel lancing. However, the most effective method is found out to be the swaddling, holding and breastfeeding in the mother's arms throughout the process. Thus, all three methods can be used during heel lancing; nevertheless, swaddling, holding and breastfeeding can be recommended as the most preferable method.

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CONFLICT OF INTEREST

The authors do not have any conflict of interest to declare.

AUTHOR CONTRIBUTIONS

D.Y. and S.İ. contributed to the conception and design of this study; D.Y. carried out the data collection, analyzed the data, and wrote the manuscript; D.Y. and S.İ. read and approved the final manuscript.

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