

## Original Article

## The Effect of Local Application of Heat before Heel Lancing Procedure on Duration of Crying and Procedure

Esra Tural Buyuk, PhD

Assistant Professor, Samsun Health School, Ondokuz Mayıs University, Kurupelit Campus, Atakum, Samsun, Turkey

**Correspondence:** Esra Tural Buyuk, PhD Assistant Professor, Samsun Health School, Ondokuz Mayıs University Kurupelit Campus, 55139 Atakum, Samsun, Turkey e-mail: esratural55@gmail.com

### Abstract

**Purpose :** The present study aims to determine the effect of hot application prior to pre-heel stick operation on babies' crying and operation length.

**Design and sample:** A questionnaire was applied to mothers of 120 healthy neonatals, who gave birth at Samsun Women-Birth and Children's Hospital and who volunteered to participate in the study between October and December 2008. After the questionnaire was completed, 60 babies were not given hot application prior to heel stick blood screening (group 1), while the remaining 60 (group 2) were given hot application 10 minutes before the practice. The data were evaluated by means of percentage and chi-square test.

**Results:** Of the babies, 53.3% were female and the state of feeding an hour prior to blood stick screening was %83.3. In the group which received hot application prior to heel stick screening, the babies' crying length and total operation length was shorter than the other group and the between-groups relationship was found to be statistically significant ( $p < 0.05$ ).

**Conclusion:** It was determined that the hot application given prior to heel stick blood screening shortened the operation length and babies were exposed to less painful stimuli.

**Keywords:** Heel lance; hot application; pain

### Introduction

In the first week of life, newborns experience numerous pain and stress due to many different reasons. They are exposed to several invasive procedures such as heel lancing without analgesia administration. Heel lancing is a routine practice used for newborn screening tests. Heel lancing which may lead to tissue destruction is a painful application for infants (Ozer et al 2006). In some studies, heel lancing was found to be much more painful than taking venous blood (Lilmaz et al 2002; Cocelli et al 2008). The pain experienced by the newborn can affect his/her behavior, family infant interactions and infant adaptation to outer world as well as his/her growth. It may also cause changes in brain and sensory development (Srouji et al 2010; Lago et al 2009).

Several pharmacological and non-pharmacological methods have been used to

reduce pain in invasive procedures namely, the use of automatic pricking tool and pacifier, shaking, making the baby to listen to music, singing, administration of sucrose or glucose solution, anesthetic cream like EMLA and analgesic drugs (paracetamol) and keeping the baby in his/her mother's lap (Lago et al 2009; Derebent & Yigit, 2006).

Nurses and doctors have attempted to apply several approaches for the relief of pain during heel lancing procedure (Beytut et al 2009). These include administration of paracetamol prior to the procedure or topical analgesic during heel lancing. Recent studies have shown that oral sucrose is safe and effective in reducing pain for short-acting procedures (Aliefendioğlu & Guzoglu 2015). The studies have also demonstrated that the type of lancet used and tightening of heel may have an influence on the pain felt lap Lago et al 2009). Protecting the

baby from intense light, making the baby to sit in a comfortable position, taking the baby on his/her mother's lap, letting the baby to grasp something or using a pacifier have been reported effective in relieving the pain felt during painful procedures (Derebent & Yigit 2008).

Applying a heat pack to the skin increases the skin surface temperature, and the increase in the skin surface temperature causes proximal blood vessels to dilate. Vasodilatation may reduce the squeezing pressure on the heel of neonates, because drawing blood becomes easy, which may mitigate the pain perception in neonates when the heel stick is performed. Warm compression also enables procedures such as heel lance to be completed in a shorter time and thus decreases the time the infant is exposed to painful procedure by increasing the blood flow to that area. Heel warming using heat packs has been applied as a routine practice before heel stick in some neonatal care units( Gray et al 2012; Shu et al 2014).

**The purpose of study:** This study was designed to determine the effect of local application of heat prior to heel lancing on duration of crying and procedure.

### Material and Method

**Design:** The study has a quasi-experimental study design. It was conducted in a children's hospital located in a city center.

**Study sample and population:** The population of the study is the all healthy newborns staying with their mothers in the postnatal ward of the hospital for a period of three months. The study sample includes 120 healthy newborns meeting the study criteria and those whose mothers agreed to participate in the study (with written consent). A total of 120 newborns to be undergone heel lancing for phenylketonuria (PKU) and hypothyroidism screening before discharging from the hospital were included in the study. No treatment was performed to the first sixty infants prior to heel lancing procedure (Group 1) whereas the remaining 60 underwent application of heat ten minutes before to the procedure (Group 2).

**Inclusion criteria:** Having birth weight of  $\geq$  3000 g, gestation week of 37 - 40, breast fed and

having no health problem. Infants of mothers who voluntarily agreed to participate in the study compromised the study sample.

**Data collection tool:** Data were collected through a questionnaire. The questionnaire was filled by the researcher after obtaining written consent from the mothers of infants agreed to participate in the study. The questionnaire form includes data about the newborn (weight, sex, gestational week), a chart showing the application to be performed (pre-procedure hot application group and no application group, frequency of heel pricking, duration of crying and procedure).

**Nursing intervention:** Heel lancing was performed by the same nurse working on the day shift using the same materials. Heat was applied using a thermophore (hot-water bottle) prepared by the researcher. Water temperature was about 35-38 °C. Approximately 2/3 of the thermophore was filled with water and deaerated to prevent heat loss. After filling, thermophore was checked for leaks by the bottle turning upside down, wiped and encased. Heat was applied for 10 minutes and then the newborn was placed onto the examination couch and underwent heel lancing. No breast milk and pacifier was used during the procedure.

**Data analysis:** Data were analyzed using SPSS 13 statistical software package. Percentage, mean and chi-square test were utilized.

**Ethical considerations:** The study was approved by the hospital administration. In addition, written informed consent was obtained from all mothers participating in the study.

### Results

Fifty percent of the newborns in Group 1 and 56.7% in Group 2 were female. 40.8% of the infants in Group 1 and 42.5% in Group 2 were fed before heel lancing (Table 1). The mean crying time was found  $2.37 \pm 1.62$  minutes (1-8min) and total completion time of the procedure was found  $2.84 \pm 2.02$  minutes (1-12 min) (Table 2). Considering the frequency of heel pricking, it was observed that 38.3% of the neonates in Group 1 underwent one, 43.4% two and 18.3% three heel lancing procedures.

**Table 1:** Characteristics of neonates and the relationship between groups (n:120)

		<b>(Group 1 n(%))</b>	<b>Group 2 n(%))</b>
<b>Gender</b>	Female	30(50.0)	34(56.7)
	Male	30(50.0)	26(43.3)
<b>Nutritional status</b>	Fed	49(81.7)	51(85.0)
	Unfed	11(18.3)	9(15.0)
<b>Total</b>		60(100.0)	60(100.0)

**Table 2:** According to the group of newborns crying time and total completion time of the procedure(n:120)

	<b>Grup 1(n=60)</b>	<b>Grup 2(n=60)</b>	<b>Total(n=120)</b>
<b>Crying time</b>	2.70± 1.93(1-8min)	2.05± 1.15(1-6 min)	2.37 ± 1.62(1-8 min)
<b>Total completion time of the procedure</b>	3.36 ± 2.45(1-12min)	2.33 ± 1.31(1-6 min)	2.84 ± 2.02(1-12 min)

**Table 3:** The frequency of heel lancing and duration of crying in the groups (n:120)

		<b>Group 1 n(%))</b>	<b>Group 2 n(%))</b>	<b>X<sup>2</sup></b>	<b>p</b>
<b>The frequency of heel pricking</b>	<b>1 times</b>	23(38.3)	41(68.3)		
	<b>2 times</b>	26(43.4)	18(30.0)		
	<b>3 times and more</b>	11(18.3)	1(1.7)		
<b>Crying time</b>	<b>1-2 min</b>	33(55.0)	53(88.3)	17.910	*0.000
	<b>2-4 min</b>	20(33.3)	7(11.7)		
	<b>4 min and more</b>	7(11.7)	-		
<b>Total completion time of the procedure</b>	<b>1-2 min</b>	23(38.3)	47(78.3)	27.354	* 0.000
	<b>2-4 min</b>	19(31.7)	13(21.7)		
	<b>4 min and more</b>	18(30.0)	-		
<b>Total</b>		60(100.0)	60(100.0)		

X<sup>2</sup>=ki-kare test \*p<0.00**Table 4:** Gender and nutritional status of newborns, procedure repetition frequency, the duration of crying and total time of application. (n:120)

		<b>Gender</b>			<b>Nutritional status</b>		
		<b>Female n(%))</b>	<b>Male n(%))</b>	<b>X<sup>2</sup> p</b>	<b>Fed n(%))</b>	<b>Unfed n(%))</b>	<b>X<sup>2</sup> p</b>
<b>The frequency of heel pricking</b>	<b>1 times</b>	37(57.8)	27(48.2)		4.412	56(46.6)	
	<b>2 times</b>	20(31.3)	24(42.9)	0.220	36(30.0)	8(6.6)	
	<b>3 times and more</b>	7(10.9)	5(8.1)		8(6.6)	4(3.3)	
<b>Crying time</b>	<b>1-2 min</b>	47(73.4)	39(69.6)	0.392	74(61.6)	11(9.1)	4.225 0.121
	<b>3-4 min</b>	13(20.3)	14(25.0)	0.822	18(15.0)	6(5.0)	
	<b>5 min and more</b>	4(6.3)	3(5.4)		8(6.6)	3(2.5)	
<b>Total completion time of the procedure</b>	<b>1-2 min</b>	41(64.1)	29(51.8)	2.033	61(50.8)	9(7.5)	2.331 0.312
	<b>3-4 min</b>	14(21.9)	18(32.1)	0.362	24(20.0)	8(6.6)	
	<b>5 min and more</b>	9(14.0)	9(16.1)		15(12.5)	3(2.5)	

X<sup>2</sup>=ki-kare test

These values were 68.3%, 30 % and 1.6% in Group 2 respectively. The frequency of heel pricking procedure was higher in Group 1 than that in Group 2 and a significant difference was observed between groups with respect to the frequency of heel lancing procedure.

When the durations of crying in groups were analyzed, the average of crying which lasted for 1-2 minutes in Group 1 and Group 2 were found to be 55.0% and 88.3% respectively. Considering the frequency of heel pricking, it was observed that 38.3% of the neonates in Group 1 underwent one, 43.4% two and 18.3% three heel lancing procedures. These values were 68.3%, 30 % and 1.6% in Group 2 respectively.

The frequency of heel pricking procedure was higher in Group 1 than that in Group 2 and a significant difference was observed between groups with respect to the frequency of heel lancing procedure. When the durations of crying in groups were analyzed, the ratios of crying which lasted for 1-2 minutes in Group 1 and Group 2 were found to be 55.0% and 88.3% respectively. For Group 1 and Group 2, the ratios of crying which lasted for 3-4 minutes were 33.3% and 11.7% respectively. No crying which lasted for 5 minutes or longer was observed in Group 2. The duration of crying in Group 2 was shorter than that in Group 1. Statistically significant difference was observed between groups with respect to the duration of crying ( $p < 0.005$ ). Analysis of the duration of heel lancing showed that while the ratio of procedure which lasted about 1-2 minutes was 38.3% in Group 1, it was 78.3% in Group 2. The ratio of total duration which lasted 5 minutes or longer was 30% in Group 1. It did not last more than 4 minutes in Group 2. The duration of heel lancing was shorter in Group 2 than that in Group 1. Statistically significant difference was observed between groups with respect to the total procedure duration (Table 3).

Statistically significant differences were observed between groups with respect to gender characteristics of newborns, the frequency of heel lancing, duration of crying and total completion time of the procedure ( $p > 0.05$ ). While 83.3% of the neonates were fed, 16.7% were not fed before heel lancing. Adequate feeding affects the blood collection process positively. Especially, insufficient liquid-nutrient intake affects blood collection. In this case, the frequency of procedure and the duration of infant's exposure

to the invasive procedure will also increase too. No significant relationship was observed between feeding status of newborn (one hour before heel lancing) and the frequency of procedure and the duration crying and the total time of application ( $p > 0.05$ ) (Table 4).

## Discussion

In the literature, there are several studies that use different methods to reduce the pain which occurs during heel lancing procedure but we have not encountered any study using hot application to warm up the site of heel. Our study showed that local application of heat increases regional cerebral blood flow and allows completion of the procedure at once and also reduces the duration of crying and ensures completion of the procedure in a short time.

No statistically significant relationship was observed between gender characteristics of newborns and the frequency of heel lancing procedure and the duration of crying and total completion time. Guinsburg et al. (2000) reported that newborn female infants exhibit much more pain in their facial expression while obtaining capillary blood than those in male infants. In Fuller's study (2002), crying of female infants was found to be at higher tones than that in male infants. Similar results were not obtained in our study.

In this study, no significant relationship was observed between the nutritional status of infants one hour before heel lancing and the repetition frequency of the procedure and the duration of crying time and the total time of the application. Inadequate feeding of the newborn affects the blood collection process. Especially inadequate liquid-nutrient intake also affects blood collection too. In this case, the frequency of procedure and the duration of newborn's exposure to invasive procedure would also increase.

Pharmacological and non-pharmacological methods which are used for relieving pain may vary. No study using hot application prior to heel lancing is available in the literature. The studies conducted so far have involved the use of pacifiers or taking the baby on one's lap, skin to skin contact, breast feeding and administration of oral sucrose solution. Lilmaz et al (2002) measured the crying duration of 302 infants (aged 10-18 days) during heel lancing procedure and found that crying duration of infants who laid down on examination couch was longer than

those kept on nurse's lap. In a study conducted by Savaser (2000) which aims to determine the calming effect of mother's lap in reducing the discomfort during heel pricking sampling of infants, neonates in the study group were taken on one's lap (nurse, mother or etc) and given pacifier and those in the control group were given pacifier lying on the bed. Mean pain scores of newborns in the study group were found to be significantly lower than those in control. In Gray et al (2000) study of healthy neonates to be undergone heel lancing (n = 27), blood samples of the neonates in the experimental group were collected by pricking the baby's heel in the way that skin to skin contact between the mother and the infant. They found that crying and facial grimacing was less frequent in infants in experimental group than those in control group (crying 82%, facial grimacing 65%) and that a significant reduction was observed in heart rates. In their study investigating the pain response of newborns before, during and after heel pricking, Akyurek & Conk (2006) made some intervention such as changing the baby's diaper, reducing the intense of light and sound, supporting the baby's individual behavior (grasping, snatching), speaking in a soft tone of voice with the soothing sounds and using slight manipulation. These interventions reduced the average pain score before and after heel lancing procedure ( $p < 0.05$ ) but did not affect the while-procedure average pain scores. In these studies, it was determined that breast-feeding and oral sucrose solution is effective in reducing the pain while performing invasive procedures in neonates. Efe & Savaser (2007) investigated the analgesic effects of breastfeeding and sucrose solutions in reducing the pain that occur during venipuncture procedure and found that the average crying duration in the control was longer than that in breastfeeding and sucrose group. They also found that average oxygen saturation levels in sucrose group were significantly higher than those in control group. But no significant difference was observed between sucrose and breastfeeding groups.

Little has been published on the effect of heel warming on the pain responses of neonates. Furthermore, few studies have compared the efficacy of heel warming and on the pain response in neonates. In this study, Pasha et al (2016) found that local warm compress before Vit K injection decreased the pain scores of newborns and as the time of warm compression

increased, average pain scores were found to decrease. Gray et al (2012) found that the method of warming under radiant heater caused shorter periods of crying and grimacing after vaccination when compared with the methods of giving pacifier and sucrose.

### Conclusion

The study showed that application of heat increases the peripheral circulation, facilitates the heel prick procedure and shortens the duration of procedure-related pain and pain-related crying. In locally heat applied group (hot application group), the repetition of the procedure was less in comparison to no application group. More than one pricking was needed in Group 2 (no application group).

**Its implementation to Nursing:** The duration of painful interventions in newborns should be kept short and need to be completed as soon as possible. Thus, newborns experience less pain. For this purpose, nurses are recommended to perform local application of heat (wet or dry) before heel lancing. Especially, local application of heat would be beneficial in the case of premature, low-birth-weight neonates or those who cannot maintain their body temperature and in the absence of adequate ambient temperature.

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