Original Article

Comparison of the Effect of Pressure Massage of Hegu Point with Kunlun-Taixi Points on Pain of Intramuscular Injection in Premature Newborns: A Randomized Clinical Trial

Atefeh Jadidi[1], Fatemeh Ghasemi[2], Rasool Mohammadi[3], Fatemeh Janani[4], Fatemeh Valizadeh[2], Kimia Karami[2]

[1]Department of Pediatrics Nursing, Student Research Committee, School of Nursing and Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran, [2]Department of Pediatrics Nursing, Razi Herbal Medicines Research Center, School of Nursing and Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran, [3]Department of Biostatistics and Epidemiology, School of Public Health and Nutrition, Lorestan University of Medical Sciences, Khorramabad, Iran, [4]Department of Midwifery, Social Determinants of Health Research Center, School of Nursing and Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran

Address for correspondence:
Dr. Fatemeh Ghasemi, Razi Herbal Medicines Research Center, School of Nursing and Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran, Postal Code: 9316568149. E-mail: ghasemi2211156@yahoo.com

Abstract

Background: Performing painful procedures in premature newborns are prevalent. This study compared the effect of the pressure massage of Hegu point with Kunlun-Taixi points on the pain of intramuscular injection in premature newborns. **Materials and Methods:** This triple-blind, parallel, clinical trial was conducted in the Neonatal Intensive Care Unit (NICU) of Shahid Rahimi Hospital, Khorramabad, Iran. Participants included 100 premature newborns randomly assigned to four groups (n = 25). The intervention groups received a counterclockwise pressure massage of the Hegu or Kunlun-Taixi points for two minutes. The placebo group received a pressure massage of the tip of the nose. The control group received routine care. The Astrid Lindgren and Lund Children's Hospital Pain Scale was used to observe pain behaviors before, during, and after intramuscular injection of vitamin K. One-way Analysis of Variance (ANOVA), repeated measures ANOVA, and Chi-square tests were used for data analysis. **Results:** The mean (Standard Deviation) of pain scores during injection in the Hegu massage, Kunlun-Taixi massage, control, and placebo groups were 5.92 (1.99), 5.94 (1.75), 6.66 (1.45), and 6.56 (1.61), respectively. Despite the lower pain scores of the intervention groups compared to the control and placebo groups, their difference was not statistically significant (F = 1.32; p = 0.27). **Conclusions:** Using pressure massage before intramuscular injection of vitamin K has no significant effect on intramuscular injection pain in premature newborns. It is suggested that future studies of massage be performed for a more extended period, along with other pain relief methods for premature newborns.

Keywords: *Acupressure, infant, injections, intramuscular, newborn, pain, premature birth*

Introduction

Newborns hospitalized in the Neonatal Intensive Care Unit (NICU) are often exposed to painful and repetitive medical procedures.[1] Newborns undergo from 1 to 14 procedures per day. The prevalence of painful procedures in premature newborns without pain relief is 79%.[2-4] Repeated painful interventions in newborns cause different complications such as increased heart rate, oxidative stress, and decreased growth, weight, head circumference, and gray matter of the brain.[3] Moreover, they increased cortisol levels, decreased vagal activity, and intraventricular hemorrhage, causing motor and cognitive abnormalities.[3,5,6] In addition, child suffering pain involves parents with complex emotions that reduce their ability to meet their children's needs.[7] Therefore, pain control is essential, and should be reduced to the point where the patient feels comfortable.[8]

Nurses have a great responsibility in this regard such as using pharmaceutical and nonpharmacological methods, and evaluating their results.[8,9] Pharmacological methods have many limitations and side effects for newborns. Therefore, today, non-pharmacological pain reduction methods such as complementary or alternative medicine have attracted nurses' attention. One of the complementary medicine methods is acupressure, a safe non-pharmacological alternative for pain relief in newborns.[1] This safe treatment method significantly and positively affects premature newborns' weight gain and physical growth indicators.[10,11]

According to the Meridian theory of Chinese Medicine, the body's vital energy, or Chi, flows in the Meridian channels and regulates the body's function.

How to cite this article: Jadidi A, Ghasemi F, Mohammadi R, Janani F, Valizadeh F, Karami K. Comparison of the effect of pressure massage of hegu point with kunlun-taixi points on pain of intramuscular injection in premature newborns: A randomized clinical trial. Iran J Nurs Midwifery Res 2025;30:606-11.

Submitted: 14-Oct-2023. **Revised:** 09-Oct-2024. **Accepted:** 13-Oct-2024. **Published:** 24-Jul-2025.

Access this article online

Website: https://journals.lww.com/jnmr

DOI: 10.4103/ijnmr.ijnmr_313_23

Quick Response Code:

Blockage of energy in these channels causes disturbances and produces pain. Massaging some points in the body allows us to access these channels, balance energy, and improve pain.[12-14] In this pain relief method, fingers press or massage acupressure points on the skin's surface to stimulate the body's regulation processes.[11]

Hegu is one of the pressure points related to the large intestine energy channel called *LI4*. This point is an essential analgesic point, situated in the middle of the angle between the thumb and index fingers on the back of the hand [Figure 1].[15] The researchers stated that Hegu point massage relieves the pain caused by venipuncture and administering the pentavalent vaccine in children.[16,17] Other essential points in acupressure are Kunlun point (*BL60*) and Taixi (*k3*), which are areas rich in pain receptors in the ankle. The Kunlun point is in the depression between the tip of the external ankle protrusion and the Achilles tendon. The Taixi point is located on the foot's inner side, behind the internal ankle protrusion, and in the depression between the tip of the internal ankle protrusion and the Achilles tendon [Figure 2].[18] Studies have shown that the simultaneous massage of these two points can reduce the duration of crying due to the blood sampling from the soles of premature newborns.[19,20]

One of the painful procedures for newborns is the intramuscular injection of vitamin K. Therefore, the present study was conducted with the aim to compare the effect of the pressure massage of Hegu point with Kunlun-Taixi points on the pain of intramuscular injection in premature newborns.

Materials and Methods

This article is a part of a student's thesis for a master's degree in pediatric nursing. This triple-blind, parallel, clinical trial (IRCT20210630051743N1) was conducted on hospitalized premature newborns. The study population included all premature newborns hospitalized in the NICU of Shahid Rahimi Hospital affiliated to Lorestan University of Medical Sciences, Khorramabad, Iran, during 2021–2022. The NICU of this hospital has 20 intensive care beds and two incubators. Most of its admissions are premature newborns, who routinely receive a prophylactic intramuscular vitamin K weekly until discharge. Newborns with a gestational age of 32–36 weeks, a weight of more than 1500 g, an Apgar score above seven in the first minute after birth, and stable clinical or physiological status were entered into the study. The newborns with congenital anomalies, neurological or metabolic disorders, history of seizures and drug addict parents were not entered into the study. Based on the mean (Standard Deviation) of the pain score in the first intervention group [70.70 (1.26)], second intervention group [8.03 (1.06)], and the control group [9.23 (0.89)] and according to the study of Khosravan *et al*.,[17] $\alpha = 0.05$, statistical power of 90%, and $Z\ (1- \alpha/2) = 1.96$, $Z\ (1- \beta) = 0.84$, the sample size was calculated as 20 newborns in each group. Considering the possibility of a 20% sample drop, the final sample size was estimated to be 25 newborns in each group. Eligible participants were enrolled in the study using continuous non-probability sampling method according to the chronological order of neonates' admission to the NICU. However, to equalize the distribution of confounders, the stratified block randomization method, according to the birth weight (1500–2000/2000–2500 g), gender (boy/girl), and gestational age (32–34/34–36 weeks) was used to allocate them to the four groups of Hegu massage, Kunlun and Taixi massage, placebo, and control. The epidemiologist consultant created the random sequence using the block randomization package in R software (R Foundation for Statistical Computing, Vienna, Austria). It was given to the supervisor of the NICU. When a new patient was eligible to participate in the study, the researchers asked the supervisor which group to assign the new participant to. In the Hegu group, the middle of the angle between the thumb and index fingers on the back[15] of the right hand was massaged. In the Kunlun-Taixi group, the Kunlun point on the depression between the tip of the external ankle protrusion and the Achilles tendon and the Taixi point on the foot's inner side, behind the internal ankle protrusion, and in the depression between the tip of the internal ankle protrusion and the

Figure 1: Hegu point (*LI4*) and how to find this point correctly

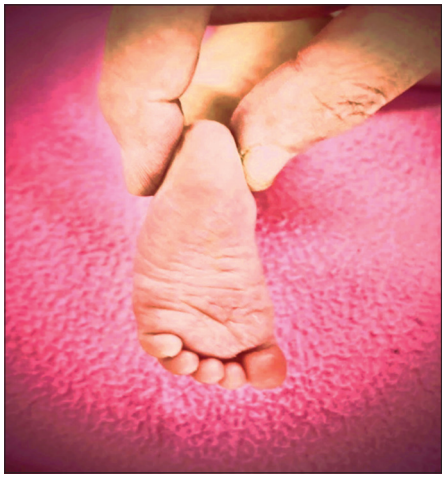

Figure 2: Kunlun (*BL60*) and Taixi (*K3*) points

Achilles tendon[18] were simultaneously massaged on the right foot. A trained nurse performed the pressure massage. To determine the mentioned acupressure points, in addition to receiving training from a Chinese medicine specialist before the intervention, the location of the desired points on the body of the newborns was confirmed with 100% accuracy. To perform pressure massage, the newborn was placed in a lying position on his/her back. The pressure massage was done before the intramuscular injection diagonally using the soft part of the thumb, rotating counterclockwise for 2 min (1-min massage, 30 sec break, and again 1-min massage consecutively). The massage was performed with a gentle and regular rhythm in a way that the newborn could tolerate and did not cause pain and distress to the newborn. In the placebo group, the tip of the newborn's nose, which is not an acupressure point, was massaged with the same massage method of the acupressure points.[15,18] In the control group, the usual care of the department was performed. In this department, no intervention is performed to relieve the pain of intramuscular injection.

The vitamin K ampoule was K_1 (phytonadione) 10 mg in 1 cc, manufactured by a same company. Vitamin K dose was 0.5 mg for newborns weighing ≤1500 g or 1.0 mg for infants weighing >1500 g. The same intramuscular injection technique was used for all the participants. The newborns were in a supine position. The skin was wiped clockwise with cotton dipped in 70% ethanol alcohol for 30 sec and allowed to dry completely. Then, the vitamin K was injected intramuscularly in the vastus lateralis muscle of the left leg with a sterile 100-unit continuous insulin syringe of a same company with needle gauge 30 (diameter 0.3 mm and length 12 mm) at an angle of 90 degrees. All the injections were performed by the same nurse in the painful procedures room, on a fixed resuscitation bed, under a warmer with a temperature of 36.7 degrees Celsius. The nurse tried to provide a calm and uniform environment during the procedures for all newborns. From the beginning of using the alcohol cotton, during and up to 2 min after the intramuscular injection, the newborn was filmed with the Samsung S8 phone camera. The videos were used to measure the pain score; two research assistants evaluated the films to assess the pain. The time of measuring pain was from 3 sec before intramuscular injection (to determine the baseline pain level) to 15 sec after intramuscular injection, and the highest reaction observed during that period was considered as the newborn's pain score.

The tools used for data gathering were demographic characteristics form and the Astrid Lindgren and Lund Children's Hospital Pain Scale (ALPS-Neo)[21]. The demographic characteristics form used included items on fetal age, gender, initial diagnosis, final diagnosis, birth weight, and weight at the time of admission, Apgar score in the first minute after birth, method of birth, age after birth, length of hospitalization, number of births, and birth rank. It was completed using the newborn's hospital file. The ALPS-Neo 2013 version was used to measure the pain in newborns before, during, and after intramuscular injection. This newborns' observational pain assessment tool includes five parameters: facial expression, breathing pattern, tonus of extremities, the activity of hands and feet, and the activity level. Each item is scored on a scale ranging from 0 to 2. The pain level of newborns during intramuscular injection is calculated according to the sum of the scores of the 5 areas. The minimum total score of the scale is 0, and the maximum score is 10.[21] The validity of the scale in Iran has been examined and confirmed in the study of Pourashori *et al*.[22] In the study by Mirlashari *et al*.,[23] the inter-rater reliability of the APLS was reported as 0.91, and its Cronbach's alpha was 0.95. In the present study, the two research assistants scored the pain of the first 10 newborns to determine the inter-rater reliability. These experienced nurses (with more than 5 years of experience working in the NICU) independently evaluated the recorded videos and determined the pain score of the studied newborns. The inter-rater correlation coefficient of these observers was 0.93. The method of blinding in this study was such that the samples (newborns), the pain assessor nurses, and the statistical consultant were not informed about the type of intervention used in the groups. The process of research stages is presented in Figure 3.

Data were analyzed using the SPSS software (version 25.0; IBM Corp., Armonk, NY, USA). Descriptive statistics were used to describe the data, calculating mean and Standard Deviation (SD) for quantitative variables and frequency and percentage for qualitative variables. The normality of the data was assessed using the Shapiro-Wilk test. Due to the normality of data distribution, one-way analysis of variance (ANOVA) with Tukey's *post hoc* test, and repeated measures ANOVA were used to analyze the quantitative data. The Chi-square test was used to compare qualitative variables between groups. A $p < 0.05$ was considered significant.

Ethical considerations

Ethics approval was obtained from the Ethics Committee of Lorestan University of Medical Sciences with the code IR.LUMS.REC.1399.264. Written informed consent was obtained from the parents of the newborns for participation in the research and filming. Complete explanations about the goals of the research and its steps were provided to the newborn's parents. In addition, the newborns' parents were assured about the confidentiality of the collected information. The parents were informed that participation in the study is optional and they have the right to withdraw from the study at any stage, and not participating in the study does not affect the services and care provided for their newborn.

Results

There was no statistically significant difference ($p < 0.05$) between the studied groups in terms of individual characteristics [Table 1]. Table 2 compares the average pain score of the newborns (before, during, and after intramuscular injection of vitamin K) in the groups. Repeated measures ANOVA showed that the changes in the average pain score of newborns in all groups over time

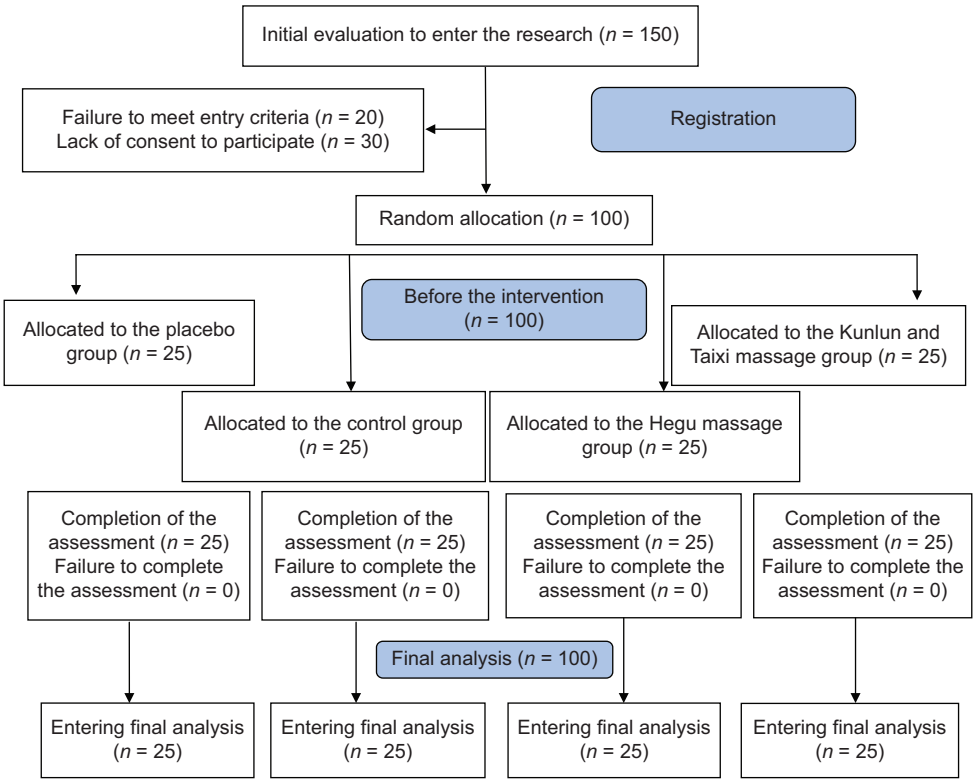

Figure 3: Flow diagram of the study

were significant ($p < 0.001$). The highest average pain score before, during, and after intramuscular injection was related to the control group and was 0.91 (0.84), 6.66 (1.45), and 6.62 (1.64), respectively. However, comparing the average pain score before, during, and after the intramuscular injection of vitamin K between the groups using ANOVA did not show any significant difference ($p > 0.05$).

Discussion

This study was conducted to compare the effect of Hegu point massage and simultaneous massage of Kunlun and Taixi points on the pain caused by intramuscular injection of premature newborns in the NICU. The study results indicated that, despite the difference in average pain score in the intervention group with the control and placebo groups, the intensity of pain in these groups was almost average. The results are consistent with the study by Abbasoglu *et al*.,[19] which investigated the effect of acupressure on Kunlun-Taixi points before taking blood from the heel in premature newborns. In their study, the pain score of newborns in the acupressure group was lower, but there was no statistically significant difference between the groups.[19] Since acupressure relieves pain through the effect on the nervous system[13] and both of these studies were conducted on the premature newborns, perhaps the lack of full development of the nervous system in these infants caused the premature infant's poor and slow response to pressure massage points in controlling pain. It is suggested that other methods that do not require nerve transmission to control pain be used in future studies.

However, contrary to the results of this study and the present study, the results of studies that evaluated the analgesic effects of acupuncture in newborns during painful interventions showed that the pain scores during blood sampling from the heel in newborns, who received acupuncture were significantly lower.[20,23,24] The function of acupressure and acupuncture is the same; both access energy channels by stimulating specific points in the body through massage or needles and cause energy balance and pain relief, and the releasing of endorphins, enkephalins, and serotonin, and the increased level of these substances in the plasma and brain tissue relieves pain.[25-27] The inconsistency of the results of these studies may be due to the difference in the pain level of drawing blood from the heel and intramuscular injection. The researchers stated that the response rate of pain to acupressure depends on the intensity of pain. The more intense the pain, the less responsive it is to acupressure.[27,28] Similarly, Daihimfar et al. reported that while acupressure reduced venipuncture pain in children, its effectiveness varied depending on the individual pain threshold and method of application.[29] Therefore, conducting more studies in this field and combining acupressure with other complementary medical methods is recommended. Other inconsistent findings are that of Moghaddam *et al*.[30] who showed that Hegu point acupressure, compared to abdominal massage and changing position, had a more significant effect on the alleviation of colic pain. In addition, in the randomized controlled trial study by Ozkan *et al*.,[20] the average pain score in the acupressure and foot massage groups was significantly lower than the control group. In these two studies, pressure

Table 1: Comparison of the individual characteristics between the Hegu pressure massage, Kunlun-Taixi pressure massage, control, and placebo groups

Group / Variables	Mean (SD)/*n* (%)				Test statistic	df	*p*
	Hegu massage	Kunlun-Taixi massage	Control	Placebo			
Gestational age (week)	34.96 (1.36)	35.16 (0.98)	34.36 (1.60)	35.2 (1.27)	1852.68	3	0.07*
Birth weight (g)	2223.8 (289.13)	2207.2 (258.73)	2234.20 (265.99)	2222.4 (216.39)	0.04	3	0.98*
Body weight (g)	2148.4 (291.48)	2161.2 (264.09)	2202.4 (260.7)	2168.4 (220.50)	0.19	3	0.98*
1st minute Apgar score	8.24 (0.43)	8.2 (0.40)	8.48 (0.40)	8.28 (0.51)	2.31	3	0.08*
Hospitalization Length (day)	7.84 (2.83)	7.24 (2.72)	8.08 (2.64)	6.6 (0.57)	1.92	3	0.13*
Age after birth (day)	8.4 (2.85)	7.84 (2.32)	8.12 (2.61)	7 (0)	1.79	3	0.15*
Birth Method							
Cesarean section	20 (80.00)	18 (72.00)	18 (72.00)	16 (64.00)	1.58	3	0.66**
Normal vaginal delivery	5 (20.00)	7 (28.00)	7 (28.00)	9 (36.00)			
Gender							
Girl	11 (44.00)	12 (48.00)	12 (48.00)	8 (32.00)	1.75	3	0.62**
Boy	14 (56.00)	13 (52.00)	13 (52.00)	17 (68.00)			
Nutrition type							
Breast milk	11 (44.00)	10 (40.00)	10 (40.00)	17 (68.00)	12.29	3	0.08**
Formula	5 (20.00)	6 (24.00)	11 (44.00)	4 (16.00)			
Mix	9 (36.00)	9 (36.00)	4 (16.00)	4 (16.00)			

*ANOVA, **Chi-square

Table 2: Comparison of the average of pain score in premature newborns in the groups before, during, and after intramuscular injection of vitamin K

Groups	Pain before Mean (SD)	Pain during Mean (SD)	Pain after Mean (SD)	*F*	df	*p***
Hegu massage	0.75 (0.74)	5.92 (1.99)	5.52 (2.21)	139.10	2	>0.001
Kunlun-Taixi massage	0.59 (0.40)	5.94 (1.75)	5.66 (2.00)	169.59	2	>0.001
Control	0.90 (0.84)	6.66 (1.455)	6.62 (1.64)	277.56	2	>0.001
Placebo	0.540 (0.49)	6.56 (1.61)	5.42 (1.96)	229.87	2	>0.001
F	1.94	1.32	1.96			
df	3	3	3			
P	0.128	0.271	0.124			

*ANOVA, **Repeated measures ANOVA

on the Kunlun and Taixi points was used to stimulate these points and perform acupressure, but in the present study, pressure massage was used to stimulate the points; perhaps this is the reason for the difference in the results. Therefore, it is recommended to investigate the effect of pressure on these points on the pain relief of premature newborns in future studies.

One of the strengths of this study was using an easy, risk-free, and cost-free non-pharmacological method to relieve the pain of premature newborns, which was designed as a randomized controlled study. The other strengths of this study were having a control group and a placebo. It is suggested that the effects of this easy, safe, and inexpensive non-pharmacological method be further investigated for the reduction of pain in minor procedures in premature newborns.

Of the limitations of this study, we can point out the individual differences of newborns in terms of the threshold of pain intensity and their response to external stimuli and environmental noise, which may affect their responsiveness to pain. Moreover, this study was conducted on newborns with a gestational age of 32–36 weeks, so the results cannot be generalized to all other newborns.

In summary, this study did not show any significant difference between the effects of the pressure massage of Hegu and Kunlun-Taixi points on the pain of intramuscular injection in premature newborns.

Conclusion

This study showed that although the intensity of pain during and after the intramuscular injection of vitamin K injection was lower in the intervention groups compared to the control and placebo groups, this difference was not statistically significant. Therefore, more studies are necessary to recommend the use of acupressure by nurses before painful interventions such as intramuscular injection. It is suggested that in future studies the massage be performed for a more extended period, along with other pain relief methods for premature newborns.

Acknowledgements

This article results from a master's thesis project in pediatric nursing approved (code: 1397-1-99-1853(by the vice chancellor of research and technology of Lorestan University of Medical Sciences. We are grateful for the cooperation of Khorramabad Nursing and Midwifery College staff and Rahimi Teaching Hospital of Khorramabad.

Financial support and sponsorship

Lorestan University of Medical Sciences

Conflicts of interest

Nothing to declare.

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