

Clinical Observations

Acupuncture in Preterm Babies during Minor Painful Procedures

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Objective: To evaluate analgesic effects of acupuncture in preterm neonates during minor painful procedures.

Methods: Ten preterm neonates requiring heel prick for blood gas analysis were enrolled in the study, which had a crossover design. Oxygen saturation, systolic and diastolic blood pressure, respiratory rate, heart rate, and crying duration were recorded before and after heel prick. Babies were given expressed breast milk before each procedure. Patients were randomly assigned to receive acupuncture or not, and the groups were crossed over on the following day, so that patients who had received acupuncture received only breast milk, and the previous breast milk only group received both acupuncture and breast milk. The neonatal infant pain scale (NIPS) was used for pain evaluation.

Results: Crying duration and NIPS pain scores during heel prick were lower in the neonates who had received acupuncture.

Conclusion: Acupuncture is an effective method for the treatment of pain in neonates.

Keywords: *acupuncture; neonatal pain; non-pharmacological treatment*

Preterm and critically ill newborns admitted to a neonatal intensive care unit (NICU) undergo repeated skin-breaking procedures that are necessary for their survival. Analgesics are usually used to minimize pain, but non-pharmacological treatments may also be beneficial, reducing the need for opioids or other analgesics and side effects of these drugs.^{1,2} Non-pharmacological methods include sucrose, non-nutritive sucking and breastfeeding. Sucrose is an efficacious medication for managing acute procedural pain in infants. Although shown to be safe in single doses, there are concerns about the safety of repeated doses of sucrose to preterm newborns.^{3,4}

Pain during medical procedures may cause physical and emotional distress in children. Pain can be assessed by behavioral observation or physiological measures.^{5,6} Physiological responses used in the assessment of acute pain include increased heart rate, increased respiratory rate, elevated blood pressure and decreased oxygen saturation.^{7,8}

Acupuncture has been used to treat a variety of diseases and symptoms. Acupuncture is a complementary method for soothing of pain and distress, and minimal stimulation of acupuncture points has also been reported to be effective.^{9,10} Acupuncture may affect the nervous system.^{11,12} It has been reported that the levels of enkephalin, endomorphin-1, beta-endorphin, and serotonin increase in plasma and brain tissue after acupuncture or electroacupuncture application.¹³⁻¹⁷ When an acupuncture needle is inserted, it stimulates pain receptors (nerve endings) and causes the secretion of endogenous opioids, which play a role in pain control.¹⁸

We aimed to test whether the analgesic effect of acupuncture may prevent behavioral and physiological responses to pain during blood sampling in infants.

METHODS

The study was conducted in the NICU at Baskent University Hospital. It was approved by the hospital Ethical Committee, and written consent was obtained from each of the families of the newborns. Babies born before the age of 37 weeks, and who did not receive any medication for sedation or analgesia, were included.

Ten premature infants (7 girls, 3 boys) with a mean gestational age of 29.9±3.07 weeks and mean birth weight of 1129±405.4 g, who required a heel prick for blood gas analysis, were enrolled in the study. The patients were initially randomly assigned to receive acupuncture or not. Groups were then crossed over on the following day, and the patients who had received acupuncture received no treatment, and vice versa. The patients were administered 2 mL/kg expressed breast milk 2 min before the procedure, as a routine of the NICU, and all patients received non-nutritive sucking with a pacifier during the procedure. All heel pricks were done by the same person. The blood sample was taken with a capillary tube (Kunststoff kapillareit, 9 × 100 mm), after cleaning the skin with 70% alcohol, lancing the lateral portion of the heel (30 gauges), and gently squeezing the heel.

Oxygen saturation, systolic and diastolic blood pressure, respiratory rate and heart rate were recorded before and during blood sampling. Crying time was defined as the

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duration of crying within the 4-min recording time. All the babies were scored according to the neonatal infant pain scale (NIPS) by a second researcher. The NIPS includes six categories of assessment: facial expression, crying, breathing patterns, arm movement, leg movement and state of arousal, with each category having two or three gradations.¹⁹

Acupuncture was performed by a competent doctor. During light needling, the skin was cleaned with alcohol and penetrated by a thin (0.22×1.5 mm) sterile disposable needle at the acupuncture point Yintang (EX-HN3). This point is located midway between the medial ends of the eyebrows. Each needle was kept in place for 30 min and then removed. Crying time, oxygen saturation, and pulse were recorded before and after application of the acupuncture needle. NIPS scoring was done during acupuncture.

The Statistical Package for the Social Sciences (SPSS), version 11.0 (SPSS Inc.), was used for analysis. Changes in oxygen saturation, systolic and diastolic blood pressure, respiratory rate, and heart rate were compared between groups (before and after heel prick) using repeated measures analysis of variance. Crying duration

and pain scores were analyzed using the nonparametric Mann-Whitney test. Oxygen saturation, systolic and diastolic blood pressure, respiratory rate and heart rate before and 3 min after needle insertion were analyzed using a paired *t* test.

RESULTS

The heart rate decreased significantly 3 min after application of acupuncture needle. The mean heart rate of the infants was 152.2 ± 19.0 before acupuncture treatment and 138.3 ± 16.8 after acupuncture treatment ($P < 0.05$). There were no significant changes in oxygen saturation, systolic or diastolic blood pressure, or respiratory rate. None of the infants cried during the placement of the acupuncture needle, and the pain score was 0.8 ± 1.1 .

The blood pressure, oxygen saturation, and respiratory rate during heel prick were not different during acupuncture compared to control. The NIPS and the mean crying duration were significantly lower after acupuncture (Table 1). Three of the 10 patients treated with acupuncture did not cry at all in response to the heel prick.

Table 1. Results detected in the control and study groups

	Control group		Study group		P value
	Before	After	Before	After	
Oxygen saturation (%)	97.4±1.5	95.0±2.4	95.1±1.5	93.2±3.8	NS
Heart rate (beats/min)	141.2±15	154.9±19.1	140.3±23.8	156.9±25.9	NS
Respiration rate (/min)	52.8±5.5	64.4±10.9	54.4±5.3	58.4±11.1	NS
Systolic blood pressure (mmHg)	70.4±12.0	79.2±15.9	74.5±12.3	76.3±18.1	NS
Diastolic blood pressure (mmHg)	39.9±9.6	46.1±13.9	39.4±10.1	45.8±10.3	NS
Crying time (seconds)	138.1±42.6		72.8±40.2		0.00
NIPS score	6.1±0.8		4.2±1.9		0.00

Notes: NS: Not Significant, NIPS: Neonatal infant pain scale.

DISCUSSION

The Yintang (EX-HN3) acupoint has sedative and analgesic effects, in addition to its anxiolytic and stress-reducing effects.²⁰⁻²² We studied the effects of acupuncture on procedural pain due to heel prick, and report that acupuncture resulted in a meaningful reduction in crying duration and pain scores in preterm newborns. Acupuncture has been practiced in China for thousands of years and has a long history of use for pediatric conditions.²³ Acupuncture is used in the treatment of pain in adults, but there are also a few studies on the use of acupuncture in infants, for conditions such as migraine headaches, cystic fibrosis and infantile colic.¹ A study including 47 pediatric patients with chronic severe pain found that acupuncture treatment was pleasant and reduced their symptoms.²⁴ Wu, et al.¹ reported that acupuncture was accepted and feasible in 20 critically ill, postoperative infants with pain. When an acupuncture needle is inserted into the skin, it stimulates pain receptors and causes the secretion of endogenous opioids,

which may play a role in pain control. Acupuncture increases the levels of endomorphin-1, beta-endorphin, enkephalin and serotonin in plasma and brain tissue, and causes analgesia and sedation.²⁵ Sucrose solutions have been used to provide analgesia in newborn infants during minor procedures.^{26,27} While a single dose of sucrose is safe and effective, preterm newborns admitted to a NICU often require repeated painful procedures. Repeated doses of sucrose have potential side effects such as necrotizing enterocolitis, hyperglycemia, and fluid overload in premature infants.²⁸ There are concerns about neurodevelopmental delay with repeated sucrose exposures. Therefore, acupuncture could be a safer alternative non-pharmacologic method that could be used for repeated minor procedures. In addition, its sedative effect can help to stabilize the preterm infant in the NICU.

None of the neonates cried during the application of the acupuncture needle. Pain scores and crying duration in response to procedural pain were also significantly lower after acupuncture. We observed a short and restful sleep

and a slight but significant decrease in heart rate. The decrease in heart rate after the acupuncture may be due to sedative effects of this method. Sedation induced by acupuncture at Baihui (GV 20) and Yintang (EX-HN3) might be associated with stimulation of the alpha (2)-adrenergic system.²¹ Acupuncture may have sedative effects on newborns, and could be a good alternative to pharmacologic sedatives, which can have side effects.

To our knowledge, this is the first published study to evaluate the role of acupuncture in preterm neonates during procedural pain in the NICU. According to our results, acupuncture is a safe, effective, and cheap method for pain relief in newborns during minor procedural pain. The efficacy of this method should be tested for other painful invasive procedures, to achieve analgesia and sedation in newborns.

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