

## ACUPRESSURE AT BL60 AND K3 POINTS BEFORE HEEL LANCING IN PRETERM INFANTS

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**Context:** Acupressure is an ancient Chinese healing art. In this pain-relieving method, the fingers are used to press key acupuncture points on the skin surface that stimulates the body's regulatory processes.

**Objective:** The aim of this study was to investigate the effect of acupressure at Kun Lun (UB60) and Taixi (K3) points for pain management in preterm infants prior to heel lancing for blood collection.

**Design:** This was a prospective, randomized controlled study.

**Setting:** The study setting was the neonatal intensive care unit at Baskent University Hospital in Turkey.

**Patients:** A total of 32 preterm infants between 28 and 36 weeks' gestational age were randomly assigned to one of two groups: an acupressure group ( $n = 16$ ) or a control group ( $n = 16$ ).

**Intervention:** In the acupressure group, immediately before the heel prick, acupressure was applied for three minutes at UB60 and K3 points.

**Main Outcome Measures:** A behavioral pain score was determined using the Premature Infant Pain Profile (PIPP) scale.

**Results:** There were no significant differences between the groups with respect to gestational age, birth weight, sex, mode of delivery, age at time of procedure, weight at time of procedure, or PIPP score. Mean duration of procedure and mean duration of crying were both shorter in the acupressure group (both  $P = .001$ ).

**Conclusions:** Applying acupressure at the BL60 and K3 points before heel lancing was associated with shorter procedural time and shorter duration of crying in preterm infants.

**Key words:** Acupressure, procedural pain, heel lancing, preterm infant

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### INTRODUCTION

Infants who are born prematurely or seriously ill are commonly exposed to painful procedures as part of their prolonged stay in the neonatal intensive care unit (NICU).<sup>1</sup> Non-pharmacological strategies are important for managing pain in the neonates because pharmacologic analgesic agents tend to have low efficacy and have potential side effects in this age group.<sup>2-4</sup> A number of non-pharmacological therapies have been identified as beneficial for managing pain in

newborns, and more research is needed to find effective ways of reducing pain in preterm infants. Oral sucrose has been extensively studied as a therapy to reduce pain in newborn infants, but there is still a knowledge gap regarding the appropriate dose, safety, and efficacy of long-term repeated doses of oral sucrose, especially in preterm infants.<sup>5</sup>

Acupressure is an ancient Chinese healing art that has been practiced for over 2000 years.

In this pain-relieving method, the fingers are used to press key acupuncture points on the skin surface that stimulates the body's regulatory processes. In traditional medical terms, pressure applied to acupoints stimulates the channel system relieving muscle spasm, improving blood circulation, warming an area, and calming nerves.<sup>6</sup> In modern term, acupuncture for pain therapy is mediated by secreted endorphins, enkephalin, and serotonin.<sup>7</sup>

Increased levels of these substances in plasma and brain tissue cause analgesia and sedation. Similarly, applying acupressure at acupoints may activate nociceptors, specialized peripheral sensory neurons that are sensitive to painful or damaging stimuli or to pressure on the skin.<sup>8</sup> During the pain impulse, stimulation of neurons in the mesencephalon activates

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the analgesic system. Acupressure triggers the release of endorphins, norepinephrine, enkephalin, and serotonin using similar transmission pathways, resulting in pre-synaptic inhibition of pain.<sup>9</sup>

Many studies have demonstrated the effectiveness of acupressure for relieving pain in adults. Numerous systematic reviews were published between 1996 and 2013.<sup>10-14</sup>

Research has shown that acupressure at the Sanyingjiao point (SP6) is effective for treating dysmenorrhea and labor pain.<sup>14-16</sup>

Significant reductions of traumatic pain, headache, and anxiety have been documented after acupressure at the Hegu (LI4), Kun Lun (BL60), and Baihui (GV20) points.<sup>17,18</sup>

To date, there are a few studies that have evaluated the use of acupressure in children. Wang et al.<sup>19</sup> applied acupressure at the Yin-Tang (Extra-1) point in a group of pediatric patients 30 minutes before the patients underwent general anesthesia for gastrointestinal endoscopic procedures. They observed decreased pre-procedural anxiety and reduced intra-procedural propofol requirements. Chen et al.<sup>20</sup> and Yeh et al.<sup>21</sup> investigated the effect of ear acupressure on visual health in school children, and observed significant improvements in visual acuity, refractive error, and behavior related to visual health.

In another study, Chen et al.<sup>22</sup> found that acupressure and meridian massage was a safe therapy for preterm infants and had a significant positive effect on weight gain in premature infants.

No study to date has examined acupressure as a treatment for procedural pain in preterm newborns hospitalized in a NICU. The Kun Lun (BL60) and Taixi (K3) acupuncture points are nociceptor-rich areas at the ankle near the site where heel lancing is done for routine newborn blood screening. Our aim was to investigate the effect of acupressure at these two points simultaneously for pain management in preterm infants prior to heel lancing for blood collection.

## METHODS

The study was carried out in the NICU at Baskent University Hospital in Turkey. The hospital's Ethical Research Committee approved the study protocol, and written informed consent was obtained from the parents of the infants who participated.

A total of 32 preterm infants between 28 and 36 weeks' gestational age were enrolled. All were receiving intensive care in incubators and were in stable condition. Newborns with major malformations or severe congenital anomalies, and those who had received previous treatment with analgesics or sedatives were excluded.

The babies were randomly assigned to one of the two groups: an acupressure group ( $n = 16$ ) or a control group ( $n = 16$ ). The same experienced nurse performed heel lancing in all 32 cases to collect blood for routine screening. Each baby was fed at least 30 minutes prior to the procedure.

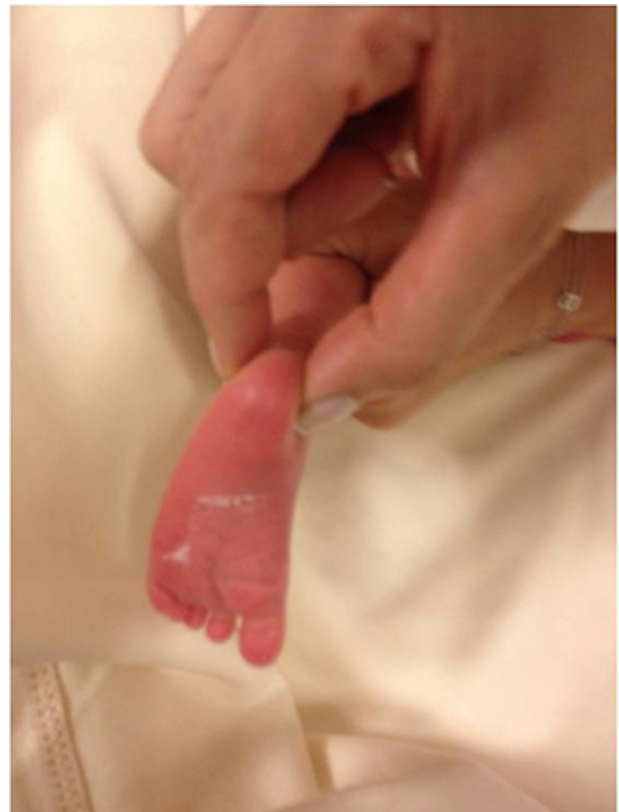
In the acupressure group, immediately before the heel prick, acupressure was applied for three minutes simultaneously at BL60 (a depression between the tip of the external malleolus and the calcaneal [Achilles] tendon) and K3 (the

medial aspect of the foot, posterior to the medial malleolus and in the depression between the tip of the medial malleolus and the Achilles tendon). The points were kneaded a bit too thick, firmly and stimulated in a gentle manner that did not cause pain and distress to the infant (Figure 1). Acupressure was applied by a well trained physician.

In the control group, babies received routine care before and after the procedure.

Each baby's behavioral state during heel lancing was recorded by video camera. A behavioral pain score was determined using the Premature Infant Pain Profile (PIPP) scale,<sup>23</sup> a multidimensional measure that was developed to assess acute pain in preterm and term infants. Total scores on the PIPP scale range from 0 to 21, with higher scores indicating greater pain behavior. Scores of six or less represent absence of or minimal pain. In this method, the neonate is observed for 15 seconds and the following seven indicators are noted: gestational age, behavioral state during the procedure, heart rate increase from baseline, oxygen saturation change from baseline, length of time the infant exhibits brow bulge, eye squeeze, and naso-labial furrow. Oxygen saturation, heart rate, and blood pressure were recorded during the heel lancing procedure as physiological parameters in the PIPP scale. Duration of crying and duration of procedure were also recorded.

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS version 17.0; SPSS Inc., Chicago, IL). Results were expressed as number of observations,



**Figure 1.** Application of a cupressure at the BL60 and K3 points.

**Table 1.** Demographic and Clinical Characteristics of the Two Study Groups That Underwent Heel Lancing (Data Presented as Mean  $\pm$  Standard Deviation Where Appropriate)

|   | Acupressure Group ( <i>n</i> = 16) | Control Group ( <i>n</i> = 16) | <i>P</i> Value          |
|---|------------------------------------|--------------------------------|-------------------------|
| Gestational weeks                         | 32.25 $\pm$ 1.87                   | 32.18 $\pm$ 2.61               | .93                     |
| Birth weight (g)                          | 1961.87 $\pm$ 487.22               | 1780.62 $\pm$ 564.72           | .33                     |
| Age at time of procedure (postnatal days) | 7.37 $\pm$ 4.92                    | 10.12 $\pm$ 7.02               | .20                     |
| Weight at time of procedure (g)           | 1863.12 $\pm$ 421.97               | 1816.87 $\pm$ 479.31           | .77                     |
| Apgar score at one minute                 | 6.75 $\pm$ 1.43                    | 6.50 $\pm$ 1.71                | .65                     |
| Apgar score at five minutes               | 8.12 $\pm$ 1.02                    | 8.25 $\pm$ 0.93                | .72                     |
| Sex (F/M)                                 | 10/6                               | 10/6                           | .99                     |
| Mode of delivery (cesarean/vaginal)       | 16/0                               | 15/1                           | .31                     |
| Duration of procedure(s)                  | 123.57 $\pm$ 60.40                 | 184.56 $\pm$ 43.09             | <b>.00<sup>a</sup></b>  |
| Duration of crying(s)                     | 103.93 $\pm$ 72.87                 | 190.31 $\pm$ 43.83             | <b>.001<sup>a</sup></b> |
| PIPP score                                | 9.13 $\pm$ 1.99                    | 9.56 $\pm$ 1.71                | .52                     |

F, female; M, male; PIPP, Premature Infant Pain Profile.

<sup>a</sup>*P* < .01.

mean  $\pm$  standard deviation, and/or median and minimum-maximum values, as appropriate. Levene's test (homogeneity) and the Shapiro–Wilk test (normality) were used to decide which statistical methods to apply to compare the study groups' findings. Results for variables that were normally distributed and had homogeneous variances were compared using Student's *t* test. For variables that did not meet the assumptions for parametric testing, group results were compared using the Mann–Whitney *U* test. *P* < .01 were considered statistically significant.

## RESULTS

The demographic and clinical features of the acupressure and control groups are summarized in Table 1. There were no significant differences between the groups with respect to gestational age, birth weight, sex, mode of delivery, age at time of procedure, weight at time of procedure, or PIPP score. Mean duration of procedure and mean duration of crying were both shorter in the acupressure group (both *P* = .001).

## DISCUSSION

Our main findings were that the newborns who received acupressure prior to heel lancing had shorter procedure time and shorter duration of crying than the controls, but the groups' mean PIPP scores were not statistically different.

Applying acupressure activates the analgesic system, resulting in release of serotonin. Serotonin has a vasomodulating effect; it binds with endothelial 5-HT<sub>2A</sub> receptors and can cause either vasoconstriction or vasodilation, depending on which endothelial receptors are stimulated. Serotonin induces vasodilation via the nitric oxide pathway, and increases capillary permeability.<sup>24–27</sup> We found that procedure time for heel lancing was shorter after applying acupressure, and this may be linked with serotonin's vasodilatory and capillary permeability effects.

Li et al.<sup>28</sup> observed that acupressure caused significant increase in lower limb blood flow while acupressure was

applied to patients with occlusive peripheral arterial disease. Acupressure stimulates peripheral sensory nerve endings and causes the release of vasoactive neuropeptides, such as calcitonin gene-related peptide, and substance P.<sup>29</sup> These mediators induce local vasodilation, thus increasing skin blood flow. Distinct from serotonin effects, increased blood supply around the malleolus as a result of acupressure might also have contributed to the shorter procedure time we observed in the acupressure group.

Mars et al.<sup>30</sup> demonstrated that compressed air massage causes a concurrent rise in skin blood flow in subjects who have asymptomatic peripheral vascular disease. This effect can be seen due to reflex vasodilatation and might have also contributed to the shorter procedure time for heel lancing that we observed with acupressure in newborns.

Our acupressure group had shorter duration of crying during the procedure than the control group. Crying behavior is widely considered to be an indicator of pain, even though it is not specific for pain occurrence.<sup>5</sup> Crying time may not only be associated with occurrence of pain, but also duration of pain. Shorter duration of procedure time or crying time may be associated with shorter duration of pain, and this may result in shorter memory of pain. Babies who experience this may exhibit decreased sensitization to pain that persists into childhood, and possibly throughout the individual's lifetime.<sup>31–34</sup>

## CONCLUSIONS

Acupressure prior to heel lancing in preterm infants is a simple, quick and safe non-pharmacological therapy. This method is easy to use and is well tolerated by newborns and even preterm babies. We found that applying acupressure at the BL60 and K3 points before heel lancing was safe and associated with shorter procedural time and shorter duration of crying in preterm infants. Our results suggest that acupressure could be a promising non-pharmacological treatment modality for reducing pain in newborns. More extensive investigation of different acupoints should be done to assess

the effects of acupressure methods on repeated procedural pain in preterm infants in the NICU.

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