Effectiveness of acupuncture versus spinal-epidural anesthesia on labor pain: a randomized controlled trial

Wu Lingling, Liu Xiaohui, Yin Yuzhu, Sun Ke, Wu Ling, Yi Wei, Li Shangrong, Hou Hongying

Abstract

OBJECTIVE: To evaluate the effectiveness of acupuncture analgesia (AA) compared with combined spinal-epidural anesthesia (CSEA) for labor pain relief and labor outcomes.

METHODS: We evaluated 131 primiparous women who received respiratory guidance during maternal uterine contractions and received either AA (n = 43), CSEA (n = 45), or no additional treatment (control, n = 43). The groups were compared regarding visual analog scale (VAS) scores for abdominal and back pain, and labor outcomes.

RESULTS: The abdominal VAS scores of the AA and CSEA groups were significantly lower than that of the control group. In addition, the VAS scores of the CSEA group were significantly lower than that of the AA group at 10 and 60 min after intervention. The back pain VAS scores of the AA and CSEA groups were significantly lower than that of the control group at 5, 10, and 60 min after intervention. The duration of the active phase of labor in the CSEA group was significantly longer than that of the AA and control groups. The rates of oxytocin use (4.70%), urinary retention (4.70%), and postpartum hemorrhage [(273.7 ± 53.6) mL] in the AA group were significantly lower than in the CSEA group [46.70%, 24.20%, and (320.0 ± 85.6) mL, respectively].

CONCLUSION: Both AA and CSEA were effective for labor pain relief; CSEA provided more effective pain relief, while AA was associated with a shorter duration of labor and fewer adverse effects. and each has its advantages and disadvantages.

Keywords: Anesthesia, obstetrical; Acupuncture anesthesia; Electroacupuncture; Anesthesia, conduction; Labor pain; Randomized controlled trial

INTRODUCTION

Labor pain is severe and acute, and can be associated with adverse effects to the mother and fetus such as acidosis and fetal hypoxia.1 Due to the patients’ fear of labor pain, the rate of elective cesarean section has dramatically risen,7 and the rate is over 50% in some re-
gions of China. Thus, an available and safe source of pain relief is necessary and of considerable significance to parturient women. This is especially true for primiparous women, for whom the pain is often more severe than in multiparous women.

There are many pharmacological methods commonly used to reduce labor pain. Combined spinal-epidural anesthesia (CSEA) offers both a reliable spinal anesthesia and prolonged analgesic titration provided by continuous epidural anesthesia. CSEA relieve the pain by blocking afferent and efferent sympathetic nerve stimulation; this reduces maternal stress and oxygen consumption, and decreases fetal distress. However, CSEA may prolong the duration of labor, particularly the active phase and second stage. Other adverse effects associated with CSEA include maternal vomiting, hypotension, pruritus, uterine atony, fever, and urinary retention. Alternatives to CSEA or complementary methods for labor analgesia include non-pharmacological methods such as breathing techniques, massage therapy, and acupuncture analgesia (AA).

One alternative method commonly used to reduce labor pain is acupuncture, which involves puncturing the skin with thin needles at acupoints. Acupuncture is based on the theory of Traditional Chinese Medicine, according to which the functioning of the body is under the control of Qi flowing through meridians. Although numerous acupoints can be selected as acupunctures sites for labor analgesia, the main acupoints used in most studies are Hegu (LI 4), Sanyinjiao (SP 6), and Zusanli (ST 36). In acupuncture, the needles are rotated back and forth until the De Qi sensation is achieved. Although numerous studies have evaluated the effectiveness of acupuncture for labor pain relief, the results have been contradictory. Some researchers reported that acupuncture could relieve labor pain, while others found no difference in pain reduction relative to sham acupuncture or standard care. A recent study revealed that acupuncture did not reduce labor pain, but significantly fewer women who received acupuncture combined with electrical stimulation (electroacupuncture) used epidural analgesia compared with those given manual acupuncture or standard care alone. In addition, subcutaneous injections of sterile water into acupoints (i.e., acupoint injection) reportedly reduced the intensity of labor pain more effectively than acupuncture alone.

The current study compared AA with CSEA and a non-treated control group with regard to the effectiveness of labor pain relief.

**MATERIALS AND METHODS**

The Ethics Committee at the Third Affiliated Hospital of Sun Yat-sen University approved the present study. The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki. All patients provided written informed consent.

**Patients**

The 131 patients were primiparous females admitted to the Department of Obstetrics and Gynecology of the Third Affiliated Hospital of Sun Yat-sen University from April 2012 to March 2014. Included patients were all aged 21 to 31 years, with a normal singleton pregnancy and a fetus in cephalic presentation at a gestational age of 37 to 42 weeks, at 3-cm cervical dilation of labor, and without any obstetrical complications for vaginal delivery. We excluded those with scar diathesis, cesarean section, history of electroacupuncture for pain reduction, or any sign of fetal distress.

Each enrolled patient was randomly allocated to one of three groups: AA, CSEA, or control. Randomized selection was carried out by the midwife according to a random number table. The numbers 1 to 150 were randomly allocated into three envelopes that corresponded to the respective groups (AA, CSEA, and control). Each enrolled participant was then assigned a random number according to the order of delivery. After opening the envelope, the doctor talked with each participant (in all three groups) and explained the treatment that they would receive in this study. Nineteen participants were excluded from the study because they did not consent to the treatment allocation before delivery, required another method of pain relief during labor, or the active phase was less than 60 min. The final number of participants was 131 (43 in the AA group, 45 in the CSEA group, and 43 in the control group). In addition, all patients received respiratory guidance during maternal uterine contractions.

**Interventions**

Acupuncture needles (0.32 mm × 25-40 mm) were purchased from Suzhou Huanqiu Acupuncture Medical Appliance (Suzhou, China) and the electroacupuncture device was purchased from Shanghai Huayi (G-6805 = 2A, Shanghai, China).

Before acupuncture administration, the clinicians washed their hands, and cleaned them and the acupoints with 75% alcohol. No inserted part of the needle body was touched during the treatment. Only one needle was used at each acupoint.

We located the acupoints by first determining the individualized cun, or Chinese inch, measurement for each patient. Patients were asked to keep their index finger, middle finger, ring finger, and little finger together, and we then measured the width of these four fingers as their own individual 3 cun at the level of transverse striation at the proximal interphalangeal joint of the middle finger. We measured the patients’ bodies and located their individualized acupoints on the basis of the abovementioned cun measurement.

According to the National Standard of the People’s Republic of China (GB12346-90), acupoint Hegu (LI 4)
is located on the back of the hand, between the first and second metacarpal and at the midpoint of the second metacarpal on the radial side. Acupoint Sanyinjiao (SP 6) is located on the inner side of the legs, 3 cun proximal to the medial malleolus tip, posterior to the inner tibial margin. The Zusanli (ST 36) acupoint is located on the anterolateral side of the crus, 3 cun distal to Dubi (ST 35), and about 1 finger width (middle finger) from the leading edge of the tibia. Acupoint Dachangshu (BL 25) is located on the back, 1.5 cun to the side of the fourth lumbar spinous process. Acupoint Guanyuanshu (BL 26) is located on the back, 1.5 cun to the side of the fifth lumbar spinous process. For the AA group, when the cervical dilation reached 3 cm, four electrodes were attached to bilateral Dachangshu (BL 25) and Guanyuanshu (BL 26). Transcutaneous acupoint electrical stimulation was used to maintain labor pain relief, with a dense and dispersed waveform, a frequency of 50 Hz, and a maximum intensity depending on the tolerance of the individual patient. After routine disinfection of the skin, the needle-through-needle method was used to inject local anesthetic fluid. An epidural catheter was removed 2 h after delivery.

RESULTS

The present study included 131 patients. There were no significant differences among the three groups in terms of mean age, body mass index, gestation, fundal height, or abdominal perimeter (all P > 0.05; Table 1).

Abdominal labor pain

The VAS scores for abdominal labor pain in the three groups were similar at the beginning of the intervention for labor pain relief (0 min). At all the indicated timepoints after intervention, the mean VAS scores for abdominal pain in the AA and CSEA groups were significantly lower than those in the control group (all P < 0.05). In addition, the VAS scores of the CSEA group were significantly lower than those in the AA group at 10 and 60 min after intervention (both P < 0.05). The VAS scores of the control group were stable (0 (zero) represented no pain and 10 represented the greatest degree of pain imaginable.) VAS scores were recorded immediately (at the beginning of the intervention), at 5, 10, and 60 min after intervention, at the end of the first phase, and at the second phase of labor in the AA and CSEA groups. The control group were provided only with routine respiratory guidance during maternal uterine contractions, without any other labor pain relief.

Monitoring outcomes

The primary outcome was the patients’ self-assessment of labor pain. The visual analog scale (VAS) was used as the main tool for assessing pain relief efficacy, in which 0 (zero) represented no pain and 10 represented the greatest degree of pain imaginable. VAS scores were recorded immediately (at the beginning of the intervention), at 5, 10, and 60 min after intervention, at the end of the first phase, and at the second phase of labor in the AA and CSEA groups. The control group were assessed for labor pain using the VAS at the corresponding timepoints.

Secondary outcomes were: oxytocin use; the duration of the first, second, and third stages of labor; and the neonatal Apgar score (< 7 was considered as neonatal asphyxia). We also monitored and compared the adverse outcomes associated with treatments during and after childbirth such as pruritus, nausea, vomiting, fever, urinary retention during and after delivery, and hemorrhage in the first 24 h postpartum.

Statistical analysis

The data were analyzed using SPSS 17.0 (SPSS Statistics for Windows, version 17.0; SPSS Inc., Chicago, IL, USA). The continuous variables were presented as the mean ± standard deviation (x ± s), and were analyzed by analysis of variance. Count data were analyzed using the chi-squared test for pairwise comparisons. P < 0.05 was defined as the level of statistical significance.
at all timepoints, except at the end of the second stage of labor. However, the VAS scores of the AA and CSEA groups after intervention were significantly lower than before intervention (both \( P < 0.05 \)), indicating that both the AA and CSEA treatments were effective in relieving labor pain (Table 1).

**Back labor pain**
The VAS scores for back labor pain were similar in all three groups before intervention. The VAS scores of the AA and CSEA groups were significantly lower than those of the control group at 5, 10, and 60 min after intervention (all \( P < 0.05 \)). The VAS scores of the AA group were significantly lower than those in the CSEA and control groups at the end of the first and second stages of labor. The VAS scores of the AA and CSEA groups after intervention were significantly lower than before intervention (both \( P < 0.05 \); Table 1).

**Duration of labor**
The duration of the active phase of the first stage of labor was similar in the AA and control groups, while the duration of the active phase in the CSEA group was significantly longer than that in the AA and control groups (both \( P < 0.05 \)). All three groups had similar durations of the second and third stages of labor (Table 1).

**Adverse outcomes**
The proportion of patients who used oxytocin during labor was significantly lower in the AA group than in the control group (both \( P < 0.05 \)) or the CSEA group (both \( P < 0.05 \)). Urinary retention was experienced by significantly fewer patients in the AA group compared with the CSEA group (both \( P < 0.05 \)). The mean volume of postpartum hemorrhage in the AA group was significantly less than in the CSEA group (both \( P < 0.05 \); Table 1). One pa-

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**Table 1** Demographics and clinical data for the three treatment groups (\( \bar{x} \pm s \))

<table>
<thead>
<tr>
<th>Item</th>
<th>AA</th>
<th>CSEA</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases (n)</td>
<td>43</td>
<td>45</td>
<td>43</td>
</tr>
<tr>
<td>Age (years)</td>
<td>25.0±3.2</td>
<td>25.8±3.3</td>
<td>25.8±3.1</td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>22.2±1.5</td>
<td>21.8±1.6</td>
<td>21.3±1.4</td>
</tr>
<tr>
<td>Gestation (d)</td>
<td>281.8±7.4</td>
<td>281.2±7.5</td>
<td>279.2±5.4</td>
</tr>
<tr>
<td>Fundal height (cm)</td>
<td>33.7±1.4</td>
<td>33.7±1.4</td>
<td>33.5±1.4</td>
</tr>
<tr>
<td>AP (cm)</td>
<td>96.1±6.0</td>
<td>96.5±5.2</td>
<td>97.1±5.6</td>
</tr>
<tr>
<td>Abdominal pain (VAS, scores)</td>
<td>7.8±2.1</td>
<td>8.4±1.8</td>
<td>8.0±2.2</td>
</tr>
<tr>
<td>0 min (baseline)</td>
<td>3.3±2.1</td>
<td>4.2±2.6</td>
<td>8.1±2.2</td>
</tr>
<tr>
<td>5 min</td>
<td>3.7±2.4</td>
<td>2.5±2.1</td>
<td>8.1±2.2</td>
</tr>
<tr>
<td>10 min</td>
<td>4.4±2.5</td>
<td>2.2±1.8</td>
<td>8.0±2.6</td>
</tr>
<tr>
<td>60 min</td>
<td>3.6±2.9</td>
<td>3.6±2.1</td>
<td>6.6±3.1</td>
</tr>
<tr>
<td>First stage end</td>
<td>1.1±1.0</td>
<td>1.1±1.0</td>
<td>3.0±2.2</td>
</tr>
<tr>
<td>Second stage end</td>
<td>0.9±0.8</td>
<td>0.9±0.4</td>
<td>0.8±0.4</td>
</tr>
<tr>
<td>Back pain (VAS, scores)</td>
<td>6.5±2.8</td>
<td>6.7±2.4</td>
<td>6.6±2.6</td>
</tr>
<tr>
<td>0 min (baseline)</td>
<td>3.8±2.1</td>
<td>3.2±3.1</td>
<td>6.6±2.6</td>
</tr>
<tr>
<td>5 min</td>
<td>3.2±1.6</td>
<td>2.6±2.4</td>
<td>6.8±2.7</td>
</tr>
<tr>
<td>10 min</td>
<td>2.6±1.9</td>
<td>1.8±1.5</td>
<td>7.2±2.6</td>
</tr>
<tr>
<td>60 min</td>
<td>2.0±1.4</td>
<td>3.8±2.7</td>
<td>4.5±3.0</td>
</tr>
<tr>
<td>First stage end</td>
<td>1.0±0.9</td>
<td>1.9±1.4</td>
<td>2.4±1.0</td>
</tr>
<tr>
<td>Second stage end</td>
<td>0.9±0.6</td>
<td>0.9±0.4</td>
<td>0.8±0.4</td>
</tr>
<tr>
<td>Labor (h)</td>
<td>3.0±1.0</td>
<td>4.5±2.3</td>
<td>3.3±1.4</td>
</tr>
<tr>
<td>Active phase</td>
<td>0.9±0.6</td>
<td>0.9±0.4</td>
<td>0.8±0.4</td>
</tr>
<tr>
<td>Third stage</td>
<td>0.2±0.1</td>
<td>0.2±0.0</td>
<td>0.2±0.1</td>
</tr>
<tr>
<td>Oxytocin use [n (%)]</td>
<td>2 (4.70)</td>
<td>21 (46.70)</td>
<td>10 (23.30)</td>
</tr>
<tr>
<td>Urinary retention [n (%)]</td>
<td>2 (4.70)</td>
<td>11 (24.40)</td>
<td>7 (16.30)</td>
</tr>
<tr>
<td>Neonatal asphyxia [n (%)]</td>
<td>4 (9.30)</td>
<td>5 (11.10)</td>
<td>4 (9.30)</td>
</tr>
<tr>
<td>Postpartum hemorrhage (mL)</td>
<td>273.7±53.6</td>
<td>320.0±85.6</td>
<td>296.7±80.2</td>
</tr>
</tbody>
</table>

Notes: AA group treated with acupuncture analgesia during labor (n = 43); CSEA group treated with combined spinal-epidural anesthesia during labor (n = 45); control group received no analgesia during labor (n = 43). BMI: body mass index; AP: abdominal perimeter; VAS: visual analog scale. *P < 0.05, compared with the control group; †P < 0.05, compared with the CSEA group; ‡P < 0.05, compared with the VAS score for abdominal pain or back pain before intervention (0 min).
tient in the AA group experienced mild numbness of the index finger of her right hand after receiving acupuncture, which resolved 1 week later without any treatment. Adverse effects experienced by the CSEA group included pruritus (n = 5), nausea and vomiting (n = 6), fever (n = 3), and hypotension (n = 2). Three patients in the control group experienced nausea and vomiting.

DISCUSSION

The present study evaluated the effectiveness of AA for labor pain relief, relative to CSEA or non-treatment. AA effectively relieved labor pain during childbirth relative to the effect of CSEA; the appropriate selection of acupoints and the manipulation technique probably played crucial roles in the effectiveness of the intervention.

Labor pain is mainly caused by uterine contractions and cervical dilation, predominantly in the first and second stages of labor, and significantly fading in the third stage. The two types of pain experienced during delivery are abdominal and back pain. Thus, in the present study, the relief of abdominal and back pain, subjectively reported by each patient as a VAS score, was taken as the principle measure of effectiveness of these interventions.

The gate control theory proposes that all pain sensations are conducted to the brain through nerve fibers. Acupuncture can block the transmission of a pain signal to the brain by affecting the conduction along the spinothalamic tract and simultaneously stimulating the thalamus and pituitary to release analgesics such as β-endorphin. There are three widely used acupuncture methods: ordinary acupuncture, acupoint injection, and transcutaneous acupoint electrical stimulation. By puncturing and retaining one or more acupuncture needles in a definite acupoint, ordinary acupuncture can activate the endogenous pain relief system to achieve an analgesic effect. Acupoint injection doubles the effects of ordinary acupuncture and an injected drug by blocking the nerve conduction of a pain stimulus and simultaneously activating the endogenous pain relief system; this results in rapid onset of prolonged pain relief. Transcutaneous acupoint electrical stimulation is an easily performed method without trauma, which stimulates the release of different endogenous opioid peptides.

In the present study, patients in the AA group (who received acupuncture, acupoint injection, and transcutaneous acupoint electrical stimulation) reported significantly less abdominal and back labor pain than did the patients who were given no labor pain relief (the control group). We consider that the effectiveness of the combined acupuncture methods for labor pain relief was closely associated with the selected acupoints [Zusanli (ST 36), Hegu (LI 4), Sanyinjiao (SP 6), Dachangshu (BL 25), and Guanyuanshu (BL 26)] and acupuncture manipulation techniques applied during delivery. In the present study, the lumbaracral acupoints Dachangshu (BL 25) and Guanyuanshu (BL 26) were selected for transcutaneous electrical stimulation. Low-frequency stimulation of these acupoints can relieve waist and back pain, with a local treatment effect (that is, the acupuncture at an acupoint has a treatment effect on symptoms close to the acupoint). In the present study, those who received AA experienced better back pain relief than those who received CSEA, potentially due to this local effect of transcutaneous electrical stimulation at the lumbaracral acupoints.

According to the principles of Traditional Chinese Medicine, the acupoint Zusanli (ST 36) (which was used in the present study) is a He-Sea acupoint of Yangming, the stomach meridian of the foot. Acupuncture at Zusanli (ST 36) can produce peripheral inflammation, which increases the threshold of pain by regulating the mRNA expression of interleukin-1 receptor in the periaqueductal gray region, resulting in an analgesic effect during delivery. Acupoint injection of sterile water into Zusanli (ST 36) induces strong mechanical stimulation because of its low permeability and slow diffusion in the local region, which partially blocks the nerve conduction of the pain signal, leading to labor pain relief. Acupuncture at Hegu (LI 4) is a Yuan-primary point of the Yangming meridian of the hand, with effects on Qi, blood circulation, Qi regulation, and oxytocin. Acupuncture at Hegu (LI 4) produces a marked, lasting, and stable sedative and analgesic effect in parturient females. The acupoint Sanyinjiao (SP 6) is the junction point of the Taiyin, Shaoyin, and Jueyin meridians of the foot. Acupuncture at Sanyinjiao (SP 6) affects Qi from these three Yin meridians, which flows up to the maternal abdomen and increases the threshold of pain, with good analgesic and muscle relaxation effects.

In the present study, labor pain relief was evident 5 min after the intervention in patients who received acupuncture, and this lasted until the end of the second stage of labor, even though the intervention was terminated at the time of full cervical dilation. This indicates that such acupuncture could provide lasting effects in relieving labor pain. As the duration of the second stage of labor was about 1 h in the present study, further studies are needed to determine whether the after-effects of acupuncture could meet the requirements for labor pain relief in patients with a more prolonged second stage of labor.

The duration of labor was similar in the AA group and the control group, which indicates that applying acupuncture for pain relief during childbirth did not affect the duration of labor. However, the active phase of the first stage of labor was significantly prolonged in those treated with CSEA compared with the AA and control.
groups, probably due to the anesthetics used in CSEA, which can cause uterine inertia.\textsuperscript{19} CSEA treatment did not affect the duration of the second stage of labor, which was not consistent with another study.\textsuperscript{23} This is probably because oxytocin was used in a timely manner in the present study; furthermore, the sufentanil used during CSEA has an epidural analgesic effect that is five times as intense as the fentanyl used in the other study,\textsuperscript{44} and the lesser dose of sufentanil effectively relieved pain. The low dose of ropivacaine used during CSEA in the present study also reduced the blocking of the motor nerves, but did not affect the maternal bearing down reflex during childbirth. These factors may have worked together to prevent a longer second stage of labor in those who received CSEA treatment in the present study.

The number of patients who used oxytocin and the stage of labor in those who received CSEA treatment may have worked together to prevent a longer second bearing down reflex during childbirth. These factors of the motor nerves, but did not affect the maternal electric current. The low dose of ropivacaine used during CSEA has an epidural analgesic effect that probably because oxytocin was used in a timely manner in the present study.

In conclusion, the analgesic effect in the CSEA group was better than that in the AA group; however, more patients in the CSEA group experienced adverse effects such as pruritus, nausea, or vomiting during labor in the AA group, with the exception of one patient who experienced numbness of the forefinger of the right hand that resolved 1 week later without treatment.

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