



# Effects of electroacupuncture on reducing labor pain and complications in the labor analgesia process of combined spinal–epidural analgesia with patient-controlled epidural analgesia

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## Abstract

**Purpose** To compare the pain scores and rates of complications in the labor analgesia process between the two groups.

**Methods** There were 127 participants being recruited in this research, and randomly divided into 2 groups according to the anesthetic technique: CSEA with PCEA with EA group (group 1), CSEA with PCEA group (group 2). Group 1 was first operated CSEA and PCEA, then EA at Hegu (LI4), Neiguan (PC6), Zusanli (ST36) and Sanyinjiao (SP6) by HANS-200A device for 25 min. Group 2 was only treated by CSEA and PCEA. The main outcome was the VAS for labor pain. Meanwhile the complications, use of oxytocin, durations of three stages, delivery mode, cord blood pH and neonatus Apgar score in this study were considered as secondary outcomes.

**Results** After labor analgesia, the VAS scores of group 1 at the five point-in-times were all lower than that of group 2. The rates of fever and urinary retention of group 1 were lower compared with group 2. Group 1 had less usage of oxytocin and shorter durations of cervical dilation from 3 to 10 cm and third stage than group 2.

**Conclusions** EA can help to reduce labor pain in CSEA with PCEA labor analgesia process, and may be able to reduce the complications.

**Keywords** Electroacupuncture · Labor analgesia · Complications · VAS · Combined spinal–epidural analgesia · Patient-controlled epidural analgesia

## Introduction

Under normal circumstances, natural birth is the best delivery mode for the mothers and newborns [1]. Therefore, promoting natural birth is the eternal theme in gynecology and obstetrics. However, more and more puerperae in China choose cesarean section because of the fear of severe pain in labor. Thus labor analgesia is extremely needed in hospitals [2].

Many large general hospitals and maternity hospitals in China have promoted the application of labor analgesia. Combined spinal–epidural analgesia (CSEA) with patient-controlled epidural analgesia (PCEA) is most effective and widely used at present [3, 4]. The efficacy of this labor analgesic method has been accepted, but the complications of fever, urinary retention, pruritus, nausea and vomiting, transient fetal bradycardia, prolonged labor it causes cannot be overlooked [5–7]. What's more, the CSEA may increase the frequency of emergency cesarean section [8].

Acupuncture is one of the most important therapies of traditional Chinese medicine. It can be used to treat many kinds of diseases, which includes various acute and chronic pain. Acupuncture can also reduce labor pain [9]. A lot of research results [10, 11] indicate that acupuncture is well-received by obstetrician and maternal because of its safety and no side effects. Another research result [12] suggested that electroacupuncture (EA) was a non-pharmacologic method when stimulated EX-B2 and SP6 acupoints, which

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could not only reduce the labor pain, but also shorten the active phase of labor.

However, the analgesia effect of acupuncture is not ideal [13]. Sometimes, acupuncture may just be used as a complementary and alternative therapy in labor pain management [14, 15]. In this study, the labor pain and complications were compared among the two groups. The results could reflect the effect of EA on reducing labor pain and complications in the labor analgesia process of CSEA with PCEA.

## Methods

### Participants

Women who delivered in Department of Obstetrics and Gynecology of the Third Affiliated Hospital of Sun Yat-Sen University from July 2017 to February 2018 participated in the study. The criteria for the participants were as follows. The inclusion criteria: (1) primipara; (2) singleton fetus with cephalic presentation; (3) gestational weeks from 37 to 41<sup>+6</sup>; (4) age from 20 to 35; (5) attempting a vaginal delivery; (6) without any other obstetrical or non-obstetrical complications; (7) regular contractions with cervical dilation 2–3 cm; (8) signed informed consent. The exclusion criteria: (1) unable to fulfill the treatments; (2) serious adverse reactions; (3) precipitated labor; (4) incomplete clinical data; (5) loss to follow-up.

### Apparatus and treatments

Totally 127 participants were recruited and assigned to study group and control group randomly. 120 numbers were picked from the random numbers table, and randomly allocated into 2 groups. Cards were made with the subject's serial number, random number and group on it, then sealed according to the serial number. When the participants chose labor analgesia, they were told to take the corresponding envelopes and cards.

Women in group 1 received CSEA with PCEA with EA for labor analgesia. They were positioned in the left lateral decubitus position. After successful epidural puncture at the L3–4 intervertebral space, a 25-gauge spinal needle was inserted. With the free flow of cerebro-spinal fluid, injected 4.5 µg of sufentanil citrate into the subarachnoid space. Epidural catheter was placed into the epidural space. PCEA pump was then attached to the epidural catheter. There is 120 ml mixed fluid in the pump, with 45 mg sufentanil citrate and 75 mg ropivacaine. The patient controlled dose was set as 8 ml with 15 min locking time, while continuous dose

was 6 ml/h. The PCEA pump was kept open until 2 h after delivery.

After successfully operating the CSEA and PCEA, the women were helped to lie on their back. Then the fetal surveillance apparatus was connected and lay on one's side. The fetal heart rate, contractions intensity and frequency, blood pressure, heart rate and body temperature were observed for half an hour until they were at a steady level.

Acupuncture at Hegu (LI4) and Neiguan (PC6) into the skin 0.5–1 cun with 0.25 × 25 mm needles was done. Then EA device (HANS-200A) was connected. Two electrodes were attached on the ipsilateral acupoints (Fig. 1). After 20-min stimulation, acupuncture at Zusanli (ST36) and Sanyinjiao (SP6) into the skin 1–1.5 cun with 0.30 × 40 mm needles was done. The EA device, with two electrodes attached on the ipsilateral acupoints, was connected (Fig. 2). After 5 min stimulation, the EA operation was ended.

The EA device was set as sparse-dense wave (2 Hz sparse wave and 50 Hz dense wave, alternately) and 0.1–1 mA intensity. This operation was repeated every 2 h if it was still in first stage in labor.

LI4 is located on the back of the hand, the midpoint of the radial side of the second metacarpal. PC6 is located on the midpoint of the volar wrist stripes on the 2 B-cun, between the two tendons. ST36 is located on the anterior tibial muscle, 3 B-cun straight below the outside knee eye. SP6 is located on medial margin of the tibia,



**Fig. 1** Electroacupuncture at Hegu (LI 4) and Neiguan (PC 6)



**Fig. 2** Electroacupuncture at Zusanli (ST 36) and Sanyinjiao (SP 6)

3 B-cun above medial malleolus pointed. In traditional Chinese medicine theory, B-cun is a measurement unit in acupuncture, which is determined by the skeletal structure of the body to be measured. And the results are different between people. The acupuncture is done by the same acupuncturist.

Women in group 2 only received CSEA with PCEA.

The VAS of labor pain considered as primary outcomes of this study. The VAS scores were recorded by the same trained midwife before and 10, 30, 60, 120 min after the labor analgesia and at the time of 10 cm cervical dilation.

Complications, duration of cervical dilation from 3 to 10 cm, second and third stage of labor, use of oxytocin, delivery mode, cord blood pH and neonatus Apgar score at 1, 5 and 10 min were secondary outcomes.

## Data analysis

The data were analyzed by using Stata 13.0 software. Nominal variables were evaluated by Chi-square test or Fisher's exact test. Continuous variables outcomes were expressed as mean  $\pm$  standard deviation, and evaluated by *t* test. Skewness distribution data were expressed as median  $\pm$  quartile range, and evaluated by non-parameter test.  $P < 0.05$  was defined as statistically significant level.

## Ethics

This research was approved by the Ethic Committee of the Third Affiliated Hospital of Sun Yat-Sen University. Each participant gave verbal and written consent.

## Results

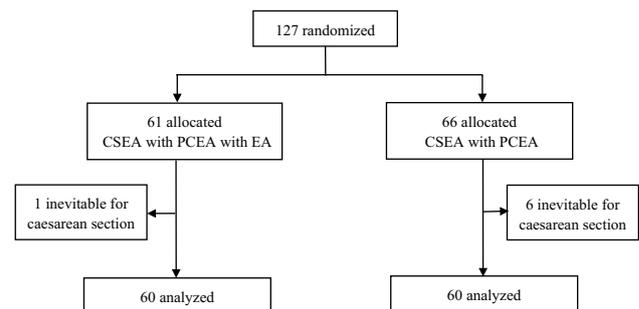
There were 127 participants in this research in total being randomly divided into 2 groups. 61 in group 1 received CSEA with PCEA with EA, 66 in group 2 only received CSEA with PCEA. 7 participants were considered ineligible due to cesarean section delivery. The flow chart is depicted in Fig. 3.

The main characteristics are summarized in Table 1. There was no significant difference in age, gestational weeks, fundal height, abdominal girth, blood pressure, heart rate, fetal heart rate between the two groups ( $P > 0.05$ ).

The VAS scores are summarized in Table 2. There was no significant difference in VAS scores before labor analgesia between the two groups ( $P > 0.05$ ). After 10, 30, 60 and 120 min intervention and at the time of 10 cm cervical dilation, the VAS scores of group 1 were all lower than that of group 2 ( $P < 0.05$ ). The VAS scores in two groups at all the five point-in-times were lower than that before labor analgesia ( $P < 0.05$ ).

The complications, use of oxytocin and delivery mode are summarized in Table 3. The rates of fever and urinary retention in group 1 were lower than group 2 ( $P < 0.05$ ). There was no significant difference in skin itch and rest complications between the two groups ( $P > 0.05$ ). The rate of oxytocin use in group 1 was lower than group 2 ( $P < 0.05$ ). There was no significant difference in rate of instrumental delivery and cesarean section between the two groups ( $P > 0.05$ ).

The durations and neonatal outcomes are summarized in Table 4. The durations of cervical dilation from 3 cm to 10 cm and third stage in group 1 was shorter than group 2 ( $P < 0.05$ ). There was no significant difference in duration of second stage between the two groups ( $P > 0.05$ ).



**Fig. 3** Flow chart

**Table 1** Main characteristics

Characteristics	Group 1 (N=60)	Group 2 (N=60)	P value
Age (years, mean ± SD)	27.62 ± 2.86	27.72 ± 2.60	0.84
Gestational weeks (days, mean ± SD)	274.55 ± 7.77	275.60 ± 7.59	0.46
Fundal height (cm, mean ± SD)	33.60 ± 1.50	33.88 ± 1.72	0.34
Abdominal girth (cm, mean ± SD)	95.52 ± 2.39	95.35 ± 3.36	0.75
Blood pressure			
SBP (mean ± SD)	118.37 ± 10.45	117.60 ± 9.44	0.67
DBP (mean ± SD)	73.95 ± 8.32	74.33 ± 6.54	0.78
Heart rate (mean ± SD)	81.85 ± 7.38	81.20 ± 7.65	0.64
Fetal heart rate (mean ± SD)	140.73 ± 6.30	140.72 ± 6.06	0.99

**Table 2** VAS scores

VAS scores (M ± QR)	Group 1 (N=60)	Group 2 (N=60)
0 min	7.00 ± 1.75	7.00 ± 1.00
10 min	1.00 ± 2.00 <sup>ab</sup>	2.00 ± 1.00 <sup>a</sup>
30 min	0.00 ± 0.00 <sup>ab</sup>	1.00 ± 2.00 <sup>a</sup>
60 min	0.00 ± 0.00 <sup>ab</sup>	1.00 ± 2.00 <sup>a</sup>
120 min	0.00 ± 0.00 <sup>ab</sup>	2.00 ± 2.00 <sup>a</sup>
Cer 10 cm	5.00 ± 3.00 <sup>ab</sup>	6.00 ± 3.00 <sup>a</sup>

Compared with 0 min, paired *t* test, <sup>a</sup>*P* < 0.05

Compared with group 2, two-sample *t* test, <sup>b</sup>*P* < 0.05

**Table 3** Complications, use of oxytocin and delivery mode

	Group 1 (N=60)	Group 2 (N=60)	P value
Complications (%)			
Fever	22 (36.7%)	40 (66.7%)	0.00
Urinary retention	12 (20.0%)	38 (63.3%)	0.00
Skin itch	3 (5.0%)	4 (6.7%)	0.70
Rests	1 (1.7%)	3 (5.0%)	0.31
Use of oxytocin (%)	10 (16.7%)	30 (50.0%)	0.00
Instrumental delivery (%)	6 (10.0%)	10 (16.7%)	0.35
Cesarean section (%)	1 (1.64%)	6 (9.1%)	0.07

**Table 4** Duration and neonatal outcome

Characteristics	Group 1 (N=60)	Group 2 (N=60)	P value
Duration (min, (M ± QR))			
Cer 3–10 cm	260.00 ± 236.25	362.50 ± 355.00	0.00
Second stage	81.50 ± 127.50	92.50 ± 81.00	0.90
Third stage	6.00 ± 3.75	8.00 ± 4.75	0.02
Cord blood pH (M ± QR)	7.23 ± 0.11	7.24 ± 0.12	0.26
Apgar score (M ± QR)			
1 min	10.00 ± 10.00	10.00 ± 10.00	0.44
5 min	10.00 ± 10.00	10.00 ± 10.00	1.00
10 min	10.00 ± 10.00	10.00 ± 10.00	1.00

There was no significant difference in cord blood pH and neonatus Apgar score at 1, 5, 10 min between the two groups (*P* > 0.05).

## Discussion

There are various measurements addressing different components pain. Research results [16, 17] indicated that the VAS seems to be most suitable for measuring intensity of pain day after the surgery based on its methodologically sound, conceptually simple, easy to administer and unobtrusive to the respondent. In this research, VAS was used as an appropriate tool for assessing labor pain.

The method of CSEA with PCEA can largely relieve labor pain. Most puerperas in this study reported that they just felt a little pain with the VAS scores no more than 3 after taking this labor analgesia method. When combined with CSEA and PCEA, EA could help to reduce labor pain by 1–2 points. The mechanism of EA in reducing labor pain can be elaborated from several different perspectives. First and foremost, EA is able to dredge the channels and collaterals, enhance Qi and blood circulation, which can promote body to restore normal functions and relieve pain. In addition, the analgesic effect has a lot to do with the release of endorphins and related neuroactive substances and the block of pain signal upward to brain after EA stimulation [18, 19].

The rate of urinary retention increase generally in CSEA with PCEA labor analgesia process on account of the inhibition of lumbosacral spinal cord nerve and increased tension of bladder sphincter [20]. EA regulates and stimulates the excitability of visceral nerve that innervates bladder, which improves the coordination function of related muscle [21]. Thus the normal urination function can be restored. The rationale of EA reducing fever rate has not been clearly defined. More research is needed to study this issue.

PCEA could initially suppress uterine electromyography, which is shown as decreased contraction force, shortened contraction duration and prolonged contraction interval [22]. It has something to do with the block of sympathetic nerve

regulation on contractions and reduction of endogenous oxytocin [23]. However, EA can promote and strengthen the contractions, which may reduce the use of oxytocin and shorten the duration of labor process [24, 25]. EA with 2 Hz sparse wave and 50 Hz dense wave alternately was more effective than other EA parameters for increasing the force, prolonging the duration and shortening the interval of uterine contraction [26, 27].

There were still some weaknesses of this study. It was almost impossible to conduct double-blind protocol due to the participants' awareness of the two methods. In addition, acupuncture is a traditional therapy and widely accepted in China, which may lead to psychological effect in the labor process. Sham acupuncture or international research is needed to strengthen the evidence.

EA is considered inconvenient given the acupuncture needles and connected instrument. However, it is worthy of clinical application considering its strength like cheap, safe and easy to operate.

## Conclusions

The results of this research showed that the combination of CSEA, PCEA and EA for labor analgesia can achieve some effect to a certain extent. Compared with only application of CSEA and PCEA, this combination can enhance analgesic effect and reduce complications. EA is a nonpharmacologic method, which is simple, easy to operate and low cost without any adverse effects. The application of acupuncture has certain limitations, but it deserves further study. Traditional Chinese medicine and Western medicine have their own advantages. In the near future, the combination of traditional Chinese and Western medicine is a major trend in most hospitals in China. However, further large sample size randomized research is needed to verify the method in labor analgesia.

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## Compliance with ethical standards

**Conflict of interest statement** We declare that we have no conflict of interest with other people or organizations that can inappropriately influence our work; there is no professional or other personal interest of

any nature or kind in any product, service or company that could be construed as influencing the position presented in. We have full control of all primary data and we agree to allow the journal to review our data if requested.

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