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Original Article

Clinical efficacy of combined spinal-epidural anesthesia for painless delivery

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Abstract: Objective: This prospective study was designed to compare the effect of painless childbirth under combined spinal-epidural anesthesia (CSEA) and normal delivery. Methods: We enrolled 86 parturients with full-term singleton pregnancies who were admitted to the Department of Obstetrics and Gynecology in Hengyang Maternal and Child Health Care hospital from June 2018 to December 2019. Among them, 43 parturients with painless delivery were randomly selected into the CSEA group and 43 parturients with normal delivery were put into the non-CSEA group. After anesthesia in the CSEA group, the parturients of both groups at each stage of labor were clinically evaluated in terms of the analgesic efficiency, degree of motor block, delivery mode, labor duration, blood loss at 2 hours and 24 hours after delivery and Apgar scores of the newborns. Results: The analgesic efficiency was significantly higher, and the blood loss at 2 h and 24 h after delivery was much less in the CSEA group than in the non-CSEA group (all $P<0.05$). Meanwhile, the total length of labor revealed no significant difference between the two groups ($P>0.05$); however, the duration of the first stage of labor was significantly shorter, while the duration of the second stage of labor was much more prolonged in the CSEA group than in the non-CSEA group (all $P<0.05$). Otherwise, no significant differences were identified in spontaneous delivery rates and Apgar scores between the two groups (both $P>0.05$). Conclusion: CSEA can exert an obvious analgesic effect, decrease the rate of cesarean section and assisted delivery, as well as reduce the length of the first stage of labor and postoperative bleeding in the process of delivery, thus greatly alleviating maternal pain and fetal distress and promoting the health of mothers and infants. As a result, the CSEA technique is worthy of promotion and application during delivery.

Keywords: Combined spinal-epidural anesthesia, painless delivery, clinical application, efficacy

Introduction

Child birth is a natural physiological process accompanied by excessive pain sensation [1]. The delivery pain results from uterine contractions and fetal traction in the birth canal [2]. The excessive pain can lead to anxiety and fear, increased blood pressure and intrauterine fetal compression, thus posing a threat to maternal and infant health [3-5]. In recent years, the rate of cesarean section has increased annually [6]. However, it is noted that many parturients undergoing cesarean section have no corresponding indications, and some of them choose cesarean section just for fear of pain. Therefore, painless delivery technologies have emerged to ensure reduced pain sensation during spontaneous delivery [7].

Painless delivery technologies cannot only reduce delivery pain of parturients by using drugs or other medical means, but also ensure good maternal and infant health [8]. Epidural block anesthesia for labor analgesia has been gradually accepted by people due to its significant analgesic effect. However, considerable attention has been paid to the question whether or not effects of Epidural block anesthesia and combined spinal-epidural anesthesia (CSEA) were similar, especially in terms of the influence on uterine contractions, postpartum hemorrhage, incidence of fetal respiratory distress and neonatal asphyxia. Therefore, we herein investigated the clinical effect of both painless delivery modes under CSEA technique and normal delivery.

Materials and methods

General data

Forty-three parturients undergoing painless delivery (CSEA) admitted to Hengyang Maternal and Child Health Care Hospital from June 2018 to December 2019 were selected in the CSEA group, and 43 parturients undergoing normal delivery in the non-CSEA group by a random number table method.

On admission, the baseline information of parturients was collected, including age, gestational weeks and weight [9]. Ethical approval for the study was given by the Ethics Committee of Hengyang Maternal and Child Health Care Hospital, and written informed consent form was obtained from all parturients.

Inclusion and exclusion criteria

Parturients were included if they were primiparas with full-term singleton pregnancies, fetal head position, and American Society of Anesthesiologists grade I or II [10]. Additionally, parturients were excluded if they had other major system diseases (e.g., heart, kidney and liver diseases), obstetric symptoms (cephalopelvic disproportion, significantly prolonged latency during labor), long-term use of narcotic analgesic drugs, or anesthetic contraindications.

Anesthetic methods

After entering the labor room, all parturients were given a routine intravenous injection of normal saline and oxygen inhalation. Meanwhile, the parturients of both groups received the same monitoring treatment, including monitoring of vital signs (e.g., blood pressure, heart rate and blood saturation), fetal heart rate (FHR) and uterine contractions. During the process, opening of the cervix was observed in real time so that analgesic treatment could be performed for the parturients with normal uterine contractions when their cervix was 2-3 cm dilated [11].

In the CSEA group, CSEA was applied as follows. The puncture was performed at the L3-4 interspace with routine disinfection. After confirming the epidural space and correct placement of epidural catheter, a test dose of 3 mL of 1.5% lidocaine hydrochloride (Suicheng Pharmaceutical Co., Ltd., H41023668) containing 1:200,000 adrenalin hydrochloride (Grandpharma (China) Co., Ltd., China, H42021700) was injected through the epidural catheter. Then observation for 5 min was conducted to prevent accidental vascular or subarachnoid insertions of the catheter. If there were no abnormal symptoms, a 25 G beaked spinal needle (Jiangsu Yaguang Medical Appliance Co., Ltd., China, 20143082110) was inserted into the subarachnoid space along the guiding groove on the epidural needle (Jiangsu Yaguang Medical Appliance Co., Ltd., China, 20143082110). Subsequently, 2 mg of ropivacaine hydrochloride (Yichang Humanwell Pharmaceutical Co., Ltd., China, H20103636) and 3 μg of sufentanil citrate (Yichang Humanwell Pharmaceutical Co., Ltd., China, H20154171) were injected, followed by epidural catheter placement. If no blood or spinal fluid was withdrawn, the epidural catheter was connected with a patient-controlled epidural analgesia pump (Jiangsu Apon Medical Technology Co., Ltd., China; Z01914471). Then all the parturients received solution containing ropivacaine 0.1% plus fentanyl 2 μg/mL combined with sodium chloride solution 0.9% for the maintenance of epidural analgesia. The maintenance dose was 6-10 mL/h, the bolus doses for patient-controlled analgesia was 8-10 mL/time, and the locking time was 15 min. Furthermore, the administration was suspended when the cervix was fully dilated, and the pump was opened again for suture in lateral episiotomy incision after childbirth [12].

In the non-CSEA group, only simple psychological comfort was performed and no other analgesic drugs were given. After admission, the parturients were given routine obstetric ultrasound examination, as well as FHR-uterine contraction monitoring according to the degree of opening of the cervix. After reaching the requirements of predelivery, the parturients received normal psychological midwifery according to the mode of delivery.

Outcome measures

The analgesic efficiency, motor block degree, delivery mode, labor duration, bleeding loss at 2 h and 24 h after delivery and the Apgar scores of the newborn were observed and compared between the two groups.

Table 1. Indicators for parturients' pain sensation

Pain grading	Indicators
Grade 0	No pain
Grade I	Mild pain, no symptoms
Grade II	Severe pain, sleep disorders
Grade III	Worst pain, psychological symptoms

Note: Effective rate of analgesia = (number of parturients undergoing effective anesthesia/total number of parturients) * 100% (Grade 0 or I for effective analgesia).

Table 2. Bromage motor scale

Bromage Score (point)	Indication
0	Full flexion of knees and feet (none)
1	Just able to move knees (partial)
2	Able to move feet only (almost complete)
3	Unable to move feet or knees (complete)

Prenatal evaluation: The parturients' pain sensation, which is classified into 4 grades (grade 0-1 for effective anesthesia, and grade 2-3 for ineffective anesthesia; see **Table 1**), was evaluated [13]. Besides, the motor block degree of the lower limb (see **Table 2** for more details), and the delivery mode (i.e., spontaneous vaginal delivery, assisted vaginal delivery and cesarean section) were recorded [14].

Labor Evaluation: Continuous monitoring of the FHR and comparison of uterine contractions between the two groups were performed, and the duration of the first, second, and third stages of labor was recorded in both groups.

Postpartum Evaluation: The Apgar scores of the newborn infants were assessed by midwives at 1 min, 5 min, and 10 min after birth (see **Table 3**), and the mean ± standard deviation ($\bar{x}$ ± sd) of the scores was calculated according to the Apagr scores of each group [15]. An independent t-test was performed with a 95% confidence interval in both groups, and the differences were plotted according to the test results. Moreover, the blood loss at 2 hours and 24 hours after delivery was also determined [16].

Statistical analysis

All data analyses were performed with the SPSS 22.0 software. The measurement data with the normal distribution were expressed as mean ± standard deviation ($\bar{x}$ ± sd), and independent t-test was used for the comparison between the two groups. Chi-square test (χ^2 test) was adopted for the comparison of enumeration data expressed as the case/percentage (n/%). $P<0.05$ was considered statistically significant.

Results

General data

There was no significant difference in age, weight, and gestational weeks between the two groups ($P>0.05$), suggesting the two groups were comparable. See **Table 4**.

Comparison of pain grading before delivery

As is shown in **Table 5**, 93.02% parturients had grade 0 pain, 6.98% parturients had grade I pain, and none of them had grade II and grade III pain in the CSEA group. While in the non-CSEA group, 11.63% parturients with grade I pain, and 88.37% parturients with grade II and III pain. These results indicate that CSEA is an effective method of providing pain relief in all the parturients. The CSEA group had a significantly lower level of pain than the non-CSEA group ($P<0.05$), indicating CSEA exerts good analgesic effects.

Comparison of delivery mode

There were 32 cases (74.42%) of spontaneous delivery, 10 cases (23.26%) of assisted delivery and 1 case (2.33%) of cesarean section in the CSEA group, while there were 31 cases (72.09%) of spontaneous delivery, 8 cases (18.60%) of assisted delivery and 4 cases (9.30%) of cesarean section in the non-CSEA group. The spontaneous delivery rate showed no significant difference between the two groups ($P>0.05$). See **Table 6**.

Comparison of uterine contractions and FHR

No significant differences were found in the duration and interval of uterine contractions, as well as FHR between the two groups ($P>0.05$). See **Table 7**.

Comparison of labor duration

Both the first and third stages of labor were significantly shorter ($P<0.001$), and the second

Table 3. Apgar scoring system

Vital signs	Apgar score (point)		
	0	1	2
Appearance	Blue pale	Pink body and blue extremities	Pink
Grimace	Floppy	Minimal response to stimulation	Prompt response to stimulation
Activity	Absent	Flexed limbs	Active
Respiration	Absent	Slow and irregular	Vigorous cry
Pulse	Absent	<100 bpm	≥100 bpm

Table 4. General data

Group	Cases	Items ($\bar{x}$ ± sd)		
		Age (year)	Weight (kg)	Gestational weeks (week)
CSEA group	43	29.5±5.2	58.37±12.90	39.1±0.9
Non-CSEA group	43	29.3±6.5	58.38±11.20	39.0±0.8
t		0.157	0.004	0.686
P		0.875	0.997	0.495

Note: CSEA: combined spinal-epidural anesthesia.

Table 5. Comparison of pain grading before delivery

Group	Cases	Grade 0	Grade I	Grade II	Grade III	χ^2	P
CSEA group	43	40 (93.02%)	3 (6.98%)	0 (0)	0 (0)	78.502	<0.001
Non-CSEA group	43	0 (0)	5 (11.63%)	29 (67.44%)	9 (20.93%)		

Note: CSEA: combined spinal-epidural anesthesia.

Table 6. Comparison of delivery mode

Group	Cases	Spontaneous delivery	Assisted delivery	Cesarean section	χ^2	P
CSEA group	43	32 (74.42%)	10 (23.26%)	1 (2.33%)	2.038	0.361
Non-CSEA group	43	31 (72.09%)	8 (18.60%)	4 (9.30%)		

Note: CSEA: combined spinal-epidural anesthesia.

stage of labor was slightly more prolonged in the CSEA group (P=0.131) than in the non-CSEA group (P<0.001). However, the total labor length revealed no significant difference between the two groups (P>0.05). See **Table 8**.

Comparison of postpartum blood loss and neonatal Apgar scores

As **Figure 1** and **Table 9** show, no significant difference was identified in the Apgar scores between the two groups (P>0.05). Blood loss, however at 2 h and 24 h after delivery was significantly less in CSEA group than in non-CSEA group (P<0.05). Overall, these results suggests that CSEA does not have a large influence on neonatal and maternal health.

Discussion

The improvement in living standards and medical technology, as well as a fear of spontaneous delivery has lead to an increased probability of cesarean section [17]. At the same time, an increasing number of elderly parturients have higher safety requirements with the liberalization of the second-child policy [18]. Since painless delivery not only exerts a good analgesic effect and shortens portions of labor without increasing the cesarean section rate, as well as ensuring the health of parturients and newborns, it is worthy of promotion during delivery [19-21].

In our study, 86 parturients were enrolled and 43 of them received painless delivery under

Table 7. Comparison of uterine contraction and FHR

Group	Cases	Uterine contraction (min)		FHR (bmp/min)
		Interval	Duration	
CSEA group	43	2.49±0.32	0.65±0.19	136.41±28.32
Non-CSEA group	43	2.51±0.28	0.63±0.23	135.28±25.91
t		0.312	0.442	0.191
p		0.759	0.661	0.847

Note: CSEA: combined spinal-epidural anesthesia; FHR: fetal heart rate.

Table 8. Comparison of labor duration

Group	Cases	Labor ($\bar{x}$ ± sd), min)			
		Stage 1	Stage 2	Stage 3	Total stage of labor
CSEA group	43	9.82±0.88	58.21±9.83	8.42±0.15	76.45±10.86
Non-CSEA group	43	12.93±1.04	55.07±9.23	8.50±0.21	76.50±10.48
t		14.972	1.527	2.030	0.022
P		<0.001	0.131	<0.001	0.983

Note: CSEA: combined spinal-epidural anesthesia.

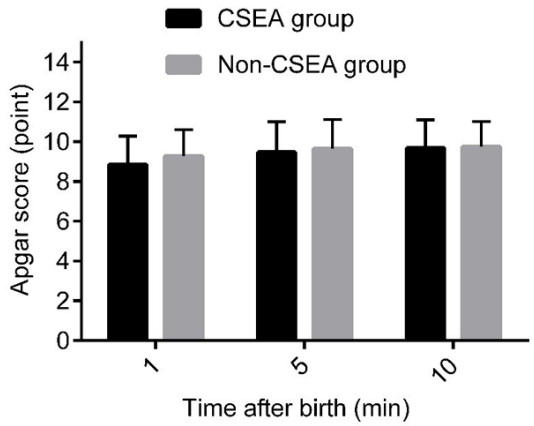

Figure 1. Comparison of Apgar scores of the newborn infants. CSEA: combined spinal-epidural anesthesia.

CSEA. The results showed that; first, CSEA had an obvious analgesic effect in the parturients and effective analgesia was achieved in all of them (no pain or slight pain). Besides, anesthesia exerted little effect on the motor block of parturients, which was consistent with the results of Choi et al., indicating that the analgesic efficacy of CSEA can be ensured [22].

Second, the spontaneous delivery rate in the CSEA group (74.42%) was higher than that in the non-CSEA group (72.09%). A review of the relevant literature revealed that CSEA not only reduced the delivery pain and increased the spontaneous delivery rate, but also alleviated the psychological burden of parturients due to pain reduction, which was more conducive to spontaneous delivery [23]. Furthermore, there was no significant difference in uterine contractions and FHR between the two groups. As to labor duration, the first stage of labor in the CSEA group was significantly shortened, and the second stage of labor was markedly prolonged, as compared to that in the non-CSEA group; however, no significant difference was found in the total length of labor between the two groups (CSEA group: 76.45±10.86; non-CSEA group: 76.50±10.48). The results demonstrate that CSEA is effective in assisted delivery in parturients before and during delivery without side effects.

Last but not least, the comparison of postpartum data revealed that the Apgar scores of neonates were the same as those with spontaneous delivery, but the parturients with CSEA had comparatively reduced blood loss. However, it was reported that painless delivery under different anesthesia methods might have different results for pregnant women and newborns [24]. In our study, the painless delivery under CSEA also had no influence on maternal and infant health, and could reduce the blood loss. Therefore, the effect of different anesthesia methods on postpartum maternal and infant health for painless delivery is worthy of in-depth study.

Table 9. Comparison of blood loss

Group	Cases	Blood loss (($\bar{x}$ ± sd), mL)	
		2 h	24 h
CSEA group	43	143.89±43.48	238.7±82.43
Non-CSEA group	43	183.08±56.49	311.55±98.31
t		3.613	3.722
P		0.012	<0.001

Note: CSEA: combined spinal-epidural anesthesia.

There are still shortcomings in this study. With the small sample size we are aware that multicenter and prospective studies with larger sample sizes are needed, and the effect of CSEA in painless labor remains to be explored in the future.

In summary, painless delivery under CSEA has significant analgesic efficacy in parturients, without side effects in parturients and newborns. Also, the CSEA technique can reduce the delivery pain and improve maternal and infant health. So, painless delivery with CSEA is worthy of being widely popularized and applied clinically.

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Disclosure of conflict of interest

None.

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