Feasibility study on continuous spinal analgesia in all stages of labor

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To the Editor: Most researchers in China are concerned that the whole labor process of traditional continuous epidural analgesia (CEA) will hinder the maternal force in the second stage of labor. In contrast, a local anesthetic drug can be used for a relatively long time. Excessive intraspinal administration may inhibit the contraction of the uterine smooth muscle,[1] which may lead to a longer labor stage, increased oxytocin use, and increased rates of forceps delivery, cesarean section, and neonatal asphyxia. Therefore, some obstetricians and midwives in China choose to stop epidural labor analgesia when the cervix opens to 7 to 8 cm or at complete cervical dilation. Thus, most parturients cannot enjoy ideal full-term labor analgesia.

Continuous spinal analgesia (CSA) produces and maintains spinal analgesia by intermittent or continuous injection of a small dose of local anesthetic using a subarachnoid catheter.[2] During the whole labor process, CSA can have the advantages of micro-administration, rapid-onset and satisfactory analgesia, mild motor block, and potential to convert to surgical anesthesia for operative vaginal or cesarean deliveries.[3] Compared to CEA, CSA prevents the risk of total spinal anesthesia and local anesthetic drug block and toxicity of local anesthetics. Ideal analgesia can be achieved by CSA. This study aimed to investigate the effectiveness and safety of CSA in labor and compare CSA and CEA with respect to the labor process, maternal outcome, analgesic effect, and effects on the fetus and newborn.

This study was approved by the Ethical Committee of Beijing Obstetrics and Gynecology Hospital. We obtained all appropriate consent forms. In the form, the parturients had given the consent for her images and other clinical information to be reported in the journal. We conducted a randomized, single-blind trial involving 84 nulliparous women without pregnancy complications. They were randomly divided into two groups ($n = 42$ each): CSA (group S) and CEA (group E). Both catheters were placed at the L3-4 interspace. When uterine contractions were regular and the cervix opened to 2 to 3 cm, analgesia was performed in the first stage of labor. Group S received a loading dose of a 5 mL solution of 0.03% ropivacaine with 0.8 μg/mL sufentanil, followed by patient-controlled intrathecal analgesia (basal infusion of 0.025% ropivacaine with 0.5 μg/mL sufentanil at a rate of 2 mL/h; demand bolus, 2 mL; lockout interval, 15 min) when the pain was relieved (visual analog scale [VAS] score ≤4). In group E, the epidural catheter with the test dose (1.5% lidocaine 3 mL) was inserted and observed for 3 to 5 min. If the catheter was not inserted into the blood vessel or subarachnoid space, epidural analgesia was initiated with 10 to 15 mL solution of 0.1% ropivacaine with 0.5 μg/mL sufentanil, followed by patient-controlled epidural analgesia (basal infusion of 0.1% ropivacaine with 0.5 μg/mL sufentanil at a rate of 3 mL/h; demand bolus, 7 mL; lockout interval, 15 min) when the pain was relieved (VAS score ≤4). All infusion was stopped at 120 min after delivery. VAS scores were maintained at ≤4.

As shown in Table 1, compared to T_0, the VAS scores of T_1–T_9 decreased. Compared to group E, the VAS scores of T_1–T_3 in group S were lower ($P < 0.05$) and the analgesic onset time in group S was shorter ($P < 0.05$). During the whole delivery process, the total dose of ropivacaine (8.0 ± 2.9 mg) and sufentanil (17.0 ± 5.9 μg) in group S was much lower than that in group E (ropivacaine, 61.9 ± 20.1 mg; sufentanil, 31.0 ± 10.1 μg), and the difference was statistically significant ($P < 0.05$). The results of this study showed that the analgesic effect time was significantly faster in group S than in group E, but there was no significant difference in the analgesic effect between the two groups after 30 min of pumping, indicating that the onset time of CSA was faster than that

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Table 1: VAS scores, onset time, and total drug dose between the nulliparous women of two groups ($n = 42$ each).

Items	Group S (CSA)	Group E (CEA)	P
T_0 (N_1) VAS scores	8.6 ± 1.1	8.7 ± 1.0	0.778
T_1 (N_1) VAS scores	$4.2 \pm 1.5^{*,\dagger}$	$6.0 \pm 1.6^{\dagger}$	<0.01
T_2 (N_1) VAS scores	$2.3 \pm 1.2^{*,\dagger}$	$3.3 \pm 1.0^{\dagger}$	<0.01
T_3 (N_1) VAS scores	$1.6 \pm 1.1^{*,\dagger}$	$2.6 \pm 1.1^{\dagger}$	<0.01
T_4 (N_2) VAS scores	$1.6 \pm 1.3^{\dagger}$	$2.0 \pm 1.0^{\dagger}$	0.129
T_5 (N_3) VAS scores	$1.9 \pm 1.4^{\dagger}$	$1.8 \pm 1.1^{\dagger}$	0.858
T_6 (N_4) VAS scores	$3.0 \pm 1.8^{\dagger}$	$2.9 \pm 1.4^{\dagger}$	0.783
T_7 (N_1) VAS scores	$4.9 \pm 1.1^{\dagger}$	$4.7 \pm 1.4^{\dagger}$	0.454
T_8 (N_1) VAS scores	$4.0 \pm 2.0^{\dagger}$	$4.3 \pm 1.9^{\dagger}$	0.388
T_9 (N_1) VAS scores	$0.1 \pm 0.4^{\dagger}$	$0.1 \pm 0.3^{\dagger}$	0.539
Onset time (min) (N_1)	4.4 ± 1.6	10.8 ± 2.5	<0.01
Sufentanil (μg) (N_1)	17.0 ± 5.9	31.0 ± 10.1	<0.01
Ropivacaine (mg) (N_1)	8.0 ± 2.9	61.9 ± 20.1	<0.01

All data were shown as mean ± standard deviation. N_1: (n (S) = 40, n(E) = 39), N_2: (n(S) = 39, n(E) = 38), N_3: (n(S) = 38, n(E) = 38), N_4: (n(S) = 34, n(E) = 37). Group S (CSA): continuous spinal analgesia group; Group E (CEA): continuous epidural analgesia group. Before analgesia (T_0), after the injection of 3 min (T_1), after installing the analgesia pump (T_2), 10 min (T_3), 30 min (T_4), 60 min (T_5), 120 min (T_6), at full dilation (T_7), fetal delivery (T_8), post-partum 120 min (T_9). $^{*}P < 0.01$, compared to group E. $^{\dagger}P < 0.01$, compared to T_0.

of CEA; both methods were proven effective in alleviating pain.

Post-dural puncture headache (PDPH) and neurological complications limited the popularity of CSA with regard to safety.[4] In our study, one woman in group S had a headache in the occipital area 1 day after delivery. The headache disappeared when the patient was lying down. This woman was advised to lie down for a longer period, and fluid supplements were administered. The symptoms were relieved on the third day after delivery. There are several risk factors for PDPH, including patient's age, body mass index and size of the puncture needle. In our study, a 21-G Sprotte® spinal anesthesia needle, which has a special cannula tip shaped in the form of an ogive, was used in group S. It penetrated the dura mater and thereby caused comparatively less tissue damage. This guarantees that the fibers of the dura mater will seal the catheter tightly and perfectly, thus reducing the risk of PDPH.

There are no recent reports on the clinical applications of CSA.[5] No serious neurological complications, such as cauda equina syndrome and spinal cord injury, were noted in our study. Therefore, we should treat cauda equina syndrome objectively. CSA should not be considered as a high-risk anesthesia method with serious complications. Besides, low-level puncture and catheterization, avoidance of high-concentration local anesthetic administration, acceleration of injection speed, use of reciprocating injection methods to fully combine drugs and cerebrospinal fluid, and measures such as strict supervision and monitoring can also reduce the incidence of cauda equina syndrome. Compared with that in group E, the incidence of pruritus in group S increased ($P < 0.05$). Although some parturients have pruritus, they are basically tolerable, and the itching symptoms disappear within 30 min after analgesia. This may be related to the single large dose of sufentanil at the onset of analgesia. In subsequent studies, we will take measures to reduce the dose of sufentanil to strengthen the quality of research.

In this study, two patients in group S underwent cesarean delivery due to intrapartum fever. In group E, two patients underwent cesarean delivery due to labor stagnation and intrapartum fever, respectively. For four patients with fever, the body temperature was reduced to normal on the first post-operative day. Analysis of the specific causes showed that, theoretically, intra-spinal analgesia can effectively reduce severe pain during childbirth and the adverse reactions caused by pain, but the incidence of fever was higher in parturients who received intra-spinal analgesia than in those who underwent other labor analgesic methods; the mechanism of post-partum fever during labor analgesia is unclear. Studies reported that this may be related to maternal thermoregulatory disorder after spinal analgesia, anesthetic effect, increased interleukin (IL)-6 level, and increased IL-8 level. Of the two women in group S and three women in group E who underwent cesarean delivery, conversion from labor analgesia to surgical anesthesia was successful in all of them. However, the onset time of anesthesia in group S was faster than that in group E. CSA can achieve rapid conversion from labor analgesia to cesarean section anesthesia. In group E, the final anesthetic effect lasted throughout the operation, but the onset was slow and the overall dose (0.5% ropivacaine + 1% lidocaine, 15 mL) was higher.

The risk of PDPH and neurocomplications are the primary reasons why CSA is infrequently used; however, the relative risk of these treatable side effects should be weighed against the many advantages of the technique in some specific obstetric anesthesia cases.

Therefore, our study demonstrated that, compared to the traditional CEA, CSA can provide satisfactory analgesia and mild motor block and the potential to convert to surgical anesthesia in cesarean deliveries. CSA in all stages of labor is effective and safe and provides a new method for obstetric analgesia.

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Conflicts of interest

None.

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