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Addition of low-dose sufentanil to ropivacaine for reducing shivering and visceral traction pain during cesarean section

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Abstract

Objective: To investigate the efficacy of low-dose sufentanil for preventing shivering and visceral traction pain during cesarean section under spinal anesthesia.

Methods: This was a prospective, randomized, controlled study. A total of 112 full-term parturients who underwent elective caesarean delivery were randomly divided into two groups. Group R received 0.75% isobaric ropivacaine intrathecally and group RS received 0.75% isobaric ropivacaine plus 5 μg sufentanil intrathecally.

Results: There were no significant differences in the maximum sensory block time, motor block time, duration of the surgery, and heart rate, mean arterial pressure, and blood oxygen saturation before and 1, 5, and 10 minutes after spinal anesthesia, and at the end of the surgery between the two groups. Shivering was significantly more common in group R ($n = 30$) than in group RS ($n = 8$). The incidence of visceral traction pain in group R (46.43%) was significantly higher than that in group RS (14.29%). There was no significant difference in the newborns' Apgar scores between the groups.

Conclusion: Adding low-dose sufentanil to ropivacaine can significantly reduce the incidence of shivering and visceral traction pain after spinal anesthesia.

Keywords

Sufentanil, cesarean section, shivering, visceral traction pain, pregnancy, spinal anesthesia

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Introduction

Cesarean section is one of the most frequently performed surgeries in obstetrics. Shivering and visceral traction pain are common complications during cesarean section under spinal anesthesia. Visceral pain and shivering can make parturients feel less comfortable and more nervous. Of concern, these complications can increase oxygen consumption and carbon dioxide production and affect blood pressure, resulting in organ dysfunction or an arrhythmia, which can be life-threatening.[1] Therefore, decreasing the incidence of shivering and visceral traction pain during cesarean section has become a major challenge in the field. Sufentanil can be used for sedation with a low dose (2.5–5.0 μg) providing adequate analgesia for surgery.[2,3]

This study was conducted to investigate the efficacy of addition of low-dose sufentanil to ropivacaine for preventing shivering and visceral traction pain during cesarean section under spinal anesthesia.

Subjects and methods

Subjects

Healthy full-term pregnant women at 37 to 42 gestational weeks who underwent elective caesarean delivery were enrolled in the study between October 2019 and October 2020. The inclusion criteria were as follows: (1) parturients who were full-term; (2) parturients who were older than 18 years; and (3) parturients who had signed informed consent. The exclusion criteria were as follows: (1) parturients who had a history of mental illness; (2) parturients who were allergic to anesthetic drugs; (3) parturients who had a coagulation disorder; (4) parturients who had lumbar disc pathologies; (5) parturients who had severe cardiac issues; (6) parturients who had liver or renal dysfunction; (7) parturients who had severe maternal complications; and 8) parturients who were diagnosed with intrauterine retardation growth, a congenital defect, or placenta previa.

This was a prospective, randomized, controlled study. The parturients were randomly divided into two groups. Group R (control group, 56 parturients) received 0.75% isobaric ropivacaine intrathecally, and group RS (56 parturients) received 0.75% isobaric ropivacaine plus 5 μg sufentanil intrathecally. This study was conducted in accordance with the declaration of Helsinki and approved by the ethics committee of Yongchuan Hospital of Chongqing Medical University on 4 September 2019 (approval number: 2019–25). Signed consent was obtained from each patient. The study was registered at https: //www.researchregistry.com/browse-the-registry#home/ (No. researchregistry6746).

Methods

Upon entering the operating room, the parturient had an electrocardiogram performed, and heart rate (HR), mean arterial pressure (MAP), and blood oxygen saturation (SpO_2) were measured. Body temperature was monitored using the tympanic temperature method (Thermoscan IRT 3020; Braun, Kronberg, Germany). The temperature in the operating room was kept at between 22°C and 26°C and the room humidity was approximately 60%. All parturients had two large-bore intravenous (IV) catheters inserted, including one for oxytocin after the fetus was delivered and the other for intravenous administration of antibiotics after omphalotomy. The L3–4 interspace was determined. A 25-gauge Whitacre-point spinal needle (Braun spinal needle) was advanced until cerebrospinal fluid return was established. Parturients in group R received 1.7 mL of 0.75% ropivacaine hydrochloride injection (Naropin, 7.5 mg/

mL; AstraZeneca, China) diluted with 3 mL of cerebrospinal fluid. Group RS received 1.7 mL of 0.75% ropivacaine hydrochloride injection diluted with 1.2 mL of cerebrospinal fluid and 0.1 mL of sufentanil citrate injection (50 μg/mL; Yichang Humanwell Pharmaceutical Co., Ltd., China). To prevent hypotension, left displacement of the uterus (10°) was performed by tilting the operating table. After successful anesthesia, the vital signs were constantly monitored every 5 minutes. The sensory block level was tested using a cotton swab and recorded bilaterally along the midclavicular line. The surgery was started once the sensory blockade level reached T4. The modified Bromage score was used to assess motor block as follows: 1, unable to move the feet or knees; 2, able to move feet only; 3, just able to move knees; and 4, full flexion of knees and feet. Hypotension was defined as systolic blood pressure dropping below 90 mmHg and treatment with IV phenylephrine hydrochloride. Bradycardia was defined as a heart rate $<$50 beats per minute (bpm) and treatment with 0.5 mg IV atropine. During surgery, if the patient could not bear the traction pain or had severe shivering, then IV tramadol 100 mg was provided. At this point, the subject could also choose to withdraw from the experiment.

Main outcomes and measurements

The primary endpoints included the maximum sensory block time (minutes), motor block time (minutes), duration of surgery (minutes), hemodynamic changes during anesthesia, shivering and visceral traction pain during anesthesia, typical adverse reactions of pregnant women (nausea, vomiting, and pruritus), and the newborns' Apgar scores. These endpoints were recorded and analyzed.

MAP, SpO_2, and HR were recorded before and 1, 5, and 10 minutes after spinal anesthesia was performed, and at the end of the surgery. Shivering was graded using a five-item scale[4] as follows: Grade 0, no shivering; Grade 1, piloerection, peripheral vasoconstriction, and/or peripheral cyanosis without other cause, but without visible muscle activity; Grade 2, visible muscle activity confined to one muscle group; Grade 3, visible muscle activity in more than one muscle group; and Grade 4, gross muscle activity involving the whole body.

Time 1 was defined as closure of the uterus, Time 2 was when the pelvic appendages and bladder were checked by surgeons, Time 3 was peritoneal closure, and Time 4 was when the uterus was pressed to promote uterine contraction and the vagina was checked by surgeons. The parturients were asked to rate the pain level on a 10-cm linear visual analogue scale (http://www.cqvip.com/QK/86373X/201510/664519344.html),[5] which was recorded every 5 minutes following this process.

Apgar scores were recorded at 1 and 5 minutes after delivery. A normal Apgar score ranges from 7 to 10, where 4 to 6 suggests light asphyxia, and an Apgar score $<$4 indicates immediate resuscitation is required.[6]

Statistical analysis

The software program SPSS 14.7 (SPSS Inc., Chicago, IL, USA) was used. A study population of 56 parturients for each group was calculated with an α error of 0.05 and a power (1-β error) of 0.8. Continuous variables are expressed as mean $\pm$ standard deviation. Discontinuous variables are expressed as a percentage. Normality was analyzed by the Kolmogorov–Smirnov test. For two comparisons, each value was compared with the t-test when each item of data conformed to a normal distribution, while non-normally distributed continuous data were

compared using the Kruskal–Wallis test. Count data were tested by the chi-square test. A value of $P < 0.05$ was considered statistically significant.

Results

General characteristics

A total of 112 women were included in the study. There were no significant differences in demographic variables, such as age, body weight, gestational week, and the number of parturitions, between the two groups (Table 1).

Sensory block time and intraoperative vital signs in the two groups

There was no difference in the maximum sensory block time, motor block time, or duration of surgery between the two groups (Table 1). There was also no significant difference in MAP, SpO_2, or HR before, and 1, 5, and 10 minutes after spinal anesthesia, and at the end of the surgery between the two groups.

Table 1. Demographic variables of the study groups.

Variable		Group R (n = 56)	Group RS (n = 56)	*P*
Age (years)		29.32 ± 6.17	29.57 ± 7.35	0.34
Weight (kg)		68.10 ± 4.08	68.32 ± 4.12	0.50
Gestational age (weeks)		38.23 ± 1.01	38.84 ± 1.20	0.50
Childbearing history				0.25
Primipara		37	39	
Multipara		19	17	
Maximum sensory block time (minutes)	T4	3.25 ± 0.44	3.19 ± 0.53	0.11
	T8	40.52 ± 0.50	42.21 ± 0.32	0.09
Motor block time (minutes)		155.45 ± 5.38	159.42 ± 3.48	0.07
Duration of surgery (minutes)		43.25 ± 7.23	42.25 ± 8.36	0.48
Pre-anesthesia	MAP (mmHg)	92.2 ± 5.4	93.6 ± 6.1	0.63
	SpO_2 (%)	99.1 ± 0.1	99.1 ± 0.3	0.16
	HR (bpm)	85.4 ± 6.1	82.3 ± 6.2	0.50
1 minute after anesthesia	MAP (mmHg)	89.4 ± 6.1	87.2 ± 7.5	0.47
	SpO_2 (%)	99.1 ± 0.1	99.2 ± 0.2	0.35
	HR (bpm)	82.2 ± 6.2	81.3 ± 6.1	0.64
5 minutes after anesthesia	MAP (mmHg)	76.3 ± 6.1	78.1 ± 6.5	0.24
	SpO_2 (%)	99.4 ± 0.2	99.1 ± 0.3	0.37
	HR (bpm)	76.1 ± 6.0	75.1 ± 6.2	0.51
10 minutes after anesthesia	MAP (mmHg)	77.1 ± 6.0	79.3 ± 5.2	0.20
	SpO_2 (%)	99.2 ± 0.3	99.1 ± 0.2	0.10
	HR (bpm)	78.1 ± 6.4	79.1 ± 6.2	0.42
At the end of surgery	MAP (mmHg)	79.4 ± 6.3	81.1 ± 6.2	0.10
	SpO_2 (%)	99.1 ± 0.2	99.6 ± 0.3	0.10
	HR (bpm)	82.1 ± 7.2	83.1 ± 6.1	0.41

Data are mean ± standard deviation. In group R, women received 0.75% isobaric ropivacaine intrathecally; in group RS, women received 0.75% isobaric ropivacaine plus 5 μg sufentanil intrathecally. T4 represents the level of sensory obstruction below the fourth thoracic plan and T8 represents the level of sensory obstruction below the eighth thoracic plane.

MAP, mean arterial pressure; SpO_2, blood oxygen saturation; HR, heart rate; bpm, beats per minute.

Incidence and severity of shivering and visceral traction pain

Shivering was observed in significantly more women in group R (n = 30, 53.57%) than in group RS (n = 8, 14.28%) ($P = 0.003$, Table 2). The incidence of visceral traction pain in group R (46.43%) was significantly higher than that in group RS (14.29%) ($P = 0.032$).

Incidence of side effects and Apgar scores

No parturients had pruritus. The incidence of nausea and vomiting in group RS was significantly lower than that in group R ($P = 0.03$, Table 3). However, there was no significant difference in the newborns' Apgar scores between the groups.

Discussion

In the current study, we found that the combination of ropivacaine and sufentanil decreased the incidence of post-spinal anesthesia shivering and visceral traction pain, which is in accordance with previous studies.[7] This finding might be due to sufentanil preventing visceral neural transmission from producing visceral discomfort. A previous study reported that hyperbaric ropivacaine caused faster onset of sensory block at T4 and a higher median block than plain ropivacaine.[8]

No pruritus was observed in any of the parturients in this study. However, the incidence of nausea and vomiting in group RS was much lower than that in group R, which is in contrast to previous studies.[9–11] This discrepancy between studies could be

Table 2. Comparison of the incidence and severity of shivering and visceral traction pain.

Variable	Type	Group R (n = 56)	Group RS (n = 56)	χ^2	*P*
Shivering	Grade 0	26 (46.43)	48 (85.71)		
	Grade 1	21 (37.50)	8 (14.28)		
	Grade 2	9 (16.07)	0 (0.00)		
	Grade 3	0 (0.00)	0 (0.00)		
	Grades 1–3	30 (53.57)	8 (14.28)	5.3724	0.003
Visceral traction pain	No pain	30 (53.57)	48 (85.71)		
	Mild pain	14 (25.00)	8 (14.29)		
	Moderate pain	12 (21.43)	0 (0.00)		
	Severe pain	0 (0.00)	0 (0.00)		
	Incidence (%)	46.43	14.29	4.2047	0.032

Data are n (%). In group R, women received 0.75% isobaric ropivacaine intrathecally; in group RS, women received 0.75% isobaric ropivacaine plus 5 μg sufentanil intrathecally.

Table 3. Comparison of the incidence of side effects and newborn Apgar scores.

Side effects		Group R (n = 56)	Group RS (n = 56)	χ^2/T	*P*
Pruritus		0	0	<0.0001	1.00
Nausea, vomiting		16	4	4.3768	0.03
Newborn Apgar score	1 minute	9.05 ± 0.43	9.14 ± 0.34	0.1342	0.55
	5 minutes	10.00	10.00	<0.0001	1.00

Data are mean ± standard deviation or number. In group R, women received 0.75% isobaric ropivacaine intrathecally; in group RS, women received 0.75% isobaric ropivacaine plus 5 μg sufentanil intrathecally.

attributed to factors, such as the fasting time of the parturients and the severity of pulling the peritoneum when suturing. Therefore, future studies with a larger sample are required to address this discrepancy. Moreover, there were no significant differences in the 1- and 5-minute Apgar scores between groups R and RS, which indicated that addition of sufentanil can ensure fetal safety.

The combination of sufentanil and bupivacaine in anesthesia of cesarean section prolongs the duration of analgesia and motor block.[12–15] Our study showed that there was no significant difference in the maximum sensory block time, motor block time, or hemodynamics between the two groups. These findings indicated that the combination of ropivacaine and sufentanil did not prolong the duration of anesthesia and had little effect on hemodynamics. This is consistent with the results of previous studies.[16–17]

There are several limitations to this study. This was a single-center study and the sample size was limited. Additionally, we only focused on the obvious clinical symptoms and did not confirm the results by evaluating laboratory indicators.

In conclusion, low-dose sufentanil significantly reduces the incidence of post-spinal anesthesia shivering and visceral traction pain. Adding low-dose sufentanil to ropivacaine is recommended as a prophylaxis for pregnant women undergoing cesarean section.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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References

1. Qin M, Xue X. Treatment progress of shivering after cesarean section. *Med Recap* 2015; 21: 2962–2965. doi: 10.3969/j.issn.1006-2084.2015.16.029.
2. Nelson KE, Rauch T, Terebuh V, et al. A comparison of intrathecal fentanyl and sufentanil for labor analgesia. *Anesthesiology* 2002; 96: 1070–1073.
3. Bachmann-Mennenga B, Veit G, Biscoping J, et al. Epidural ropivacaine 1% with and without sufentanil addition for Caesarean section. *Acta Anaesthesiol Scand* 2005; 49: 525–531.
4. Zheng D, Wu G, Qin P, et al. Hyperbaric spinal anesthesia with ropivacaine coadministered with sufentanil for cesarean delivery: a dose-response study. *Int J Clin Exp Med* 2015; 8: 5739–5745.
5. Lin HQ, Wang SQ, Lin H, et al. Efficacy of small-dosage sufentanil for prevention of shivering and visceral traction pain during selective cesarean delivery. *Guide of China Medicine* 2015; 10: 148–149.
6. Xie LJ, Zhu JX. *Chin J Perinat Med* 2015; 18: 648–651.
7. de Figueiredo Locks G. Incidence of shivering after cesarean section under spinal anesthesia with or without intrathecal sufentanil: a randomized study. *Rev Bras Anestesiol* 2012; 62: 676–684. doi: 10.1016/S0034-7094(12)70166-6.
8. Wang X, Xia F, Feng SW, et al. Comparison of the efficacy and safety between the use of ropivacaine alone and reopivacaine with sufentanil in epidural labor analgesia. *J Clin Anesthesiol* 2016; 32: 761–764.
9. Khaw KS, Ngan Kee WD, Wong M, et al. Spinal ropivacaine for caesarean delivery: a comparison of hyberbaric and plain solutions. *Anesth Analg* 2002; 94: 680–685.
10. Xu GH, Gao M, Sheng QY, et al. Opioid receptor A118G polymorphism does not affect the consumption of sufentanil and

ropivacaine by patient-controlled epidural analgesia after cesarean section. *Ther Drug Monit* 2015; 37: 53–57.
11. Berti M, Danelli G, Antonino FA, et al. 0.2% ropivacaine with or without sufentanil for patient-controlled epidural analgesia after anterior cruciate ligament repair. *Minerva Anestesiol* 2005; 71: 93–100.
12. Chen X, Qian X, Fu F, et al. Intrathecal sufentanil decreases the median effective dose (ED50) of intrathecal hyperbaric ropivacaine for cesarean delivery. *Acta Anaesthesiol Scand* 2010; 54: 284–290.
13. Farzi F, Mirmansouri A, Naderi Nabi B, et al. Comparing the Effect of Adding Fentanyl, Sufentanil, and Placebo with Intrathecal Bupivacaine on Duration of Analgesia and Complications of Spinal Anesthesia in Patients Undergoing Cesarean Section. *Anesth Pain Med* 2017; 7: e12738.
14. Dourado AD, Lins Filho RL, Fernandes RA, et al. Associação de sufentanil a dose reduzida de bupivacaína hiperbárica em raquianestesia para cesariana: ensaio clínico randomizado [Sufentanil in combination with low-dose hyperbaric bupivacaine in spinal anesthesia for cesarean section: a randomized clinical trial]. *Rev Bras Anestesiol* 2016; 66: 622–627.
15. Wolfler A, Salvo I, Sortino G, et al. Epidural analgesia with ropivacaine and sufentanil is associated with transient fetal heart rate changes. *Minerva Anestesiol* 2010; 76: 340–345.
16. Abdollahpour A, Azadi R, Bandari R, et al. Effects of Adding Midazolam and Sufentanil to Intrathecal Bupivacaine on Analgesia Quality and Postoperative Complications in Elective Cesarean Section. *Anesth Pain Med* 2015; 5: e23565.
17. Braga Ade F, Braga FS, Hirata ES, et al. Association of lipophilic opioids and hyperbaric bupivacaine in spinal anesthesia for elective cesarean section. Randomized controlled study. *Acta Cir Bras* 2014; 29: 752–758.