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Promotion and Application of Combined Spinal-Epidural Block Analgesia Technique with Ropivacaine and Sufentanil for Labor Analgesia in Ngari Prefecture

Dolkar Tenzin[1], Xinlu Wang[1], Yuqin Lu[1], Tsedpal Tenzin[1], Drolma Ngawang[1], Yan'an Jiang[2]*, Yulong Song[2]

[1]Operation and Anesthesia Department, Ngari Prefecture People's Hospital, Ngari Prefecture 859000, Xizang Autonomous Region, China
[2]Department of Anesthesiology, Shaanxi Provincial People's Hospital, Xi'an710068, Shaanxi, China

**Corresponding author: Yan'an Jiang, yanan635@163.com*

Abstract: *Objective*: To observe the promotion and application of combined spinal-epidural analgesia with ropivacaine and sufentanil in plateau areas. *Methods*: Sixty primiparous women who gave birth in our hospital from March 2023 to March 2025 were selected and randomly divided into a control group (Group A) and an analgesia group (Group B) using the random number method. Group A underwent routine obstetric natural childbirth, while Group B received combined spinal-epidural analgesia. VAS scores, changes in labor duration, postpartum hemorrhage, delivery methods (including instrumental delivery), and neonatal Apgar scores were observed in both groups. *Results*: There was no statistically significant difference in VAS scores between the two groups before analgesia ($P > 0.05$). However, there were statistically significant differences in VAS scores at various time points after analgesia ($P < 0.05$). The first stage of labor in Group B (210 ± 45 min) was shorter than that in Group A (252±44 min), with a statistically significant difference ($P < 0.05$). Similarly, the second (38 ± 11 min vs. 50 ± 14 min) and third (9 ± 4 min vs. 16 ± 5 min) stages of labor were also shorter in Group B compared to Group A, with statistically significant differences ($P < 0.05$). The cesarean section rate was lower in Group B (6.7%) compared to Group A (10.0%), with a statistically significant difference ($P < 0.05$). There were no statistically significant differences in postpartum hemorrhage or neonatal Apgar scores at 1, 5, and 10 minutes after birth between the two groups ($P > 0.05$). *Conclusion*: The combined use of ropivacaine and sufentanil in combined spinal-epidural anesthesia can significantly alleviate the pain experienced by parturients during childbirth in plateau regions, shorten the duration of labor, and have no effect on the neonatal Apgar score. This method is worthy of promotion in plateau regions.

Keywords: Labor analgesia; Ropivacaine; Sufentanil; Combined epidural anesthesia; Plateau areas

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1. Introduction

In the Ngari Prefecture, due to the high altitude and low oxygen concentration, the implementation of analgesia during childbirth requires more consideration of the environment and physiological changes in parturients [1]. As a drug combination, ropivacaine combined with sufentanil has been widely used in many domestic hospitals and has shown good analgesic effects [2]. This study aims to verify the feasibility and effectiveness of ropivacaine combined with sufentanil in plateau regions, providing a suitable option for analgesia during childbirth for parturients in these regions.

2. Materials and methods

2.1. General information

Sixty primiparas who gave birth in the obstetrics department of Ngari Prefecture People's Hospital from March 2023 to March 2025 were selected. All parturients were long-term residents of the plateau, had naturally conceived pregnancies, and had an S_PO_2 of approximately 85% on a daily basis. They were classified as ASA grade I–II, with a height range of 150–165cm and a weight range of 50-80kg. All were single pregnancies between 37 and 42 weeks of gestation. There were no contraindications for natural childbirth, and the fetal heartbeat and movement were normal. There were no contraindications for intravertebral anesthesia, coagulation disorders, history of allergy to related anesthetic drugs, history of cesarean section, cognitive impairments, or mental abnormalities. Parturients voluntarily chose analgesia during childbirth and signed an informed consent form. This study was approved by the hospital ethics committee.

2.2. Methods

A total of 60 parturients were randomly divided into two groups: the control group (Group A, n = 30) received routine obstetric care with doula-supported labor and verbal comfort. The labor analgesia group (Group B, n = 30) underwent combined spinal-epidural analgesia for labor pain relief. The parturients underwent routine intrathecal puncture, and 5 μg of sufentanil was injected into the subarachnoid space. Then, an epidural catheter was placed 3-4cm towards the cephalic side and fixed. After changing to a supine position, 3 mL of 1% lidocaine hydrochloride injection (Hubei Jinyao Pharmaceutical Co., Ltd., National Medical Approval Number H20133209) was administered as a test dose 30 minutes later. If no adverse reactions occurred, the analgesia pump was connected for patient-controlled epidural analgesia. The pump was stopped after perineal suturing. The epidural pump contained a mixture of 0.45 μg/mL sufentanil citrate injection (Yichang Renfu Pharmaceutical Co., Ltd., Batch Number AB40400911) and 0.09% ropivacaine hydrochloride injection (Jiangsu Hengrui Medicine Co., Ltd., National Medical Approval Number H20060137) totaling 100 mL, with a background infusion rate of 10 mL/h, PCA of 5 mL, and a lockout time of 15 minutes. If the parturient experienced inadequate analgesia, an additional 5ml of the analgesia pump mixture was administered into the epidural space, which could be repeated up to 2 times as needed. Both groups received nasal cannula oxygen inhalation and monitoring of blood pressure, heart rate, pulse oxygen saturation, and fetal heart rate changes. In case of any fetal abnormalities, immediate conversion to cesarean section was performed to ensure the safety of both the mother and the baby.

2.3. Observation indicators

(1) Visual Analog Scale (VAS) was used to evaluate the pain relief effect of the parturients. VAS scores were recorded at various time points: T_0, T_1 = 15 min, T_2 = 30 min, T_3 = 60 min, T_4 = 2 h, T_5 = 3 h, T_6 = 4 h, T_7

= 5 h for both Group A and Group B.

(2) The durations of the first, second, and third stages of labor were recorded.

(3) The mode of delivery, presence of vaginal instrumental assistance, emergency conversion to cesarean section, and postpartum hemorrhage volume were documented for both groups.

(4) Neonatal Apgar score (skin color, heart rate, reflex response to heel stimulation or nasal insertion, muscle tone, respiration): Observe and record the Apgar score of newborns at 1 minute, 5 minutes, and 10 minutes after birth.

2.4. Statistical methods

SPSS 20.0 was used. The ASA classification of general information for the two groups of mothers was analyzed using the Mann-Whitney U test (Wilcoxon rank-sum test), and the remaining general information was analyzed using the t-test. The pain score data satisfied a normal distribution and were analyzed using repeated measures ANOVA, with comparisons made using mean ± standard deviation (SD). For labor duration data, independent sample t-tests were performed for both intergroup and intragroup comparisons. Count data were expressed as rates (%), and $P < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of general patient characteristics

There were no statistically significant differences in general information such as age, height, weight, gestational week, ASA classification, and cervical dilation between the two groups of mothers ($P > 0.05$, **Table 1**).

Table 1. Comparison of general information between the two groups of mothers

Item	Control group A ($n = 30$)	Labor analgesia group B ($n = 30$)
ASA classification (I/II)	12/18	13/17
Age (years), mean ± SD	23 ± 1.1	22 ± 0.9
Height (cm)	155 ± 1.3	156 ± 1.1
Weight (kg)	55 ± 1.8	56 ± 2.2
Gestational age (weeks)	37.3 ± 1.3	37.4 ± 1.1
Cervical dilation (cm)	3 ± 1.1	3 ± 1.0

3.2. Comparison of VAS scores at different time points between the two groups of mothers

There was no statistically significant difference in VAS scores before labor analgesia between the two groups ($P > 0.05$). However, there were statistically significant differences in VAS scores at various time points after labor analgesia between the two groups ($P < 0.05$, see **Table 2**).

Table 2. Comparison of VAS scores at different time points between the two groups of mothers

Time point	Control group A (n = 30)	Labor analgesia group B (n = 30)
	VAS score	VAS score
T_0 (Before analgesia)	5.4 ± 1.1	5.1 ± 0.9
T_1 (15 min)	4.4 ± 1.5	1.3 ± 0.5
T_2 (30 min)	5.5 ± 2.1	1.1 ± 0.6
T_3 (60 min)	5.9 ± 2.2	1.4 ± 0.3
T_4 (2 h)	6.4 ± 2.0	2.6 ± 0.6
T_5 (3 h)	7.4 ± 1.9	2.4 ± 0.1
T_6 (4 h)	8.4 ± 1.0	2.1 ± 0.3
T_7 (5 h)	3.6 ± 2.4	1.2 ± 0.6

3.3. Comparison of labor durations between the two groups of mothers

The duration of the first stage of labor in Group B (210 ± 45 minutes) was shorter than that in Group A (252 ± 44 minutes), and the difference was statistically significant ($P < 0.05$). The duration of the second stage of labor in Group B (38 ± 11 minutes) was shorter than that in Group A (50 ± 14 minutes), and the difference was statistically significant ($P < 0.05$). The duration of the third stage of labor in Group B (9 ± 4 minutes) was shorter than that in Group A (16 ± 5 minutes), and the difference was statistically significant ($P < 0.05$, see **Table 3**).

Table 3. Comparison of the durations of the first, second, and third stages of labor between the two groups of mothers

Group	First stage (min)	Second stage (min)	Third stage (min)
Group A (n = 30)	252 ± 44	50 ± 14	16 ± 5
Group B (n = 30)	210 ± 45	38 ± 11	9 ± 4

3.4. Comparison of delivery methods between the two groups of mothers

The natural delivery rate of Group A (90.0%) was lower than that of Group B (93.3%), and the difference was statistically significant ($P < 0.05$). The instrumental delivery rate of Group A (14.8%) was higher than that of Group B (7.1%), and the difference was statistically significant ($P < 0.05$). The cesarean section rate of Group A (10.0%) was higher than that of Group B (6.7%), and the difference was statistically significant ($P < 0.05$, see **Table 4**).

Table 4. Comparison of delivery methods between the two groups of mothers (example, %)

Group	Spontaneous vaginal delivery	Instrument-assisted delivery	Cesarean section
Group A (n = 30)	27 (90.0)	4 (14.8)	3 (10.0)
Group B (n = 30)	28 (93.3)	2 (7.1)	2 (6.7)

3.5. Comparison of neonatal Apgar scores and postpartum hemorrhage between the two groups

There was no statistically significant difference in the Apgar scores of newborns at 1 minute, 5 minutes, and

10 minutes after birth between the two groups (P >0.05); there was no statistically significant difference in the comparison of postpartum hemorrhage (P >0.05, **Table 5**). It suggests that labor analgesia does not lower the neonatal Apgar score and does not increase the amount of postpartum hemorrhage.

Table 5. Comparison of neonatal Apgar scores and postpartum hemorrhage between the two groups

Group	1 min (Score, Median, IQR)	5 min (Score, Median, IQR)	10 min (Score, Median, IQR)	Blood loss (mL)
Group A (n = 30)	10 (10, 10)	10 (10, 10)	10 (10, 10)	331 ± 28
Group B (n = 30)	10 (10, 10)	10 (10, 10)	10 (10, 10)	326 ± 19

4. Discussion

The innovation of this study lies in the introduction of the labor analgesia regimen combining ropivacaine and sufentanil for the first time in the Ngari Prefecture. Due to its unique geographical environment and climatic conditions, this region has a high altitude of 4300 meters and a thin oxygen concentration, with a normal oxygen saturation of only about 85%, posing special challenges to the implementation of medical technology [1]. Many domestic hospitals are conducting labor analgesia, and the analgesic drugs and anesthesia operation techniques are very mature. Combined spinal-epidural block labor analgesia can be applied in the early stage of labor [3], which can shorten the labor process and reduce the cesarean section rate, and has no adverse effects on mothers and newborns. It has become one of the ideal methods of labor analgesia at present [4–6]. Most of these studies are concentrated in plain areas, and there is still a lack of in-depth research on the application effects in special environments, such as plateau hypoxic areas.

There was no statistically significant difference in general information between the two groups of mothers. Regarding VAS scores, mothers in the labor analgesia group who received ropivacaine combined with sufentanil had significantly lower VAS scores compared to the control group [7]. Mothers in the labor analgesia group generally reported a significant reduction in pain levels, and effectively alleviated discomfort and fear during the delivery process [9].

From the perspective of labor duration, mothers in the labor analgesia group had significantly shorter labor durations compared to the control group [6,8]. This may be related to the reduced pain experienced by mothers in the labor analgesia group during delivery, enabling them to more effectively cooperate with medical staff during childbirth. The shortened labor duration not only reduces the mother's pain but also lowers the risks associated with the delivery process.

Regarding the mode of delivery, the rate of spontaneous vaginal births was significantly higher in the labor analgesia group compared to the control group [6]. This may be associated with the reduced pain experienced by mothers after receiving ropivacaine combined with sufentanil, making the delivery process smoother. Simultaneously, this suggests that this analgesic method can reduce the rate of cesarean sections and improve the safety of childbirth.

In this study, Apgar scores were also assessed for newborns in both groups. The results showed no significant difference in Apgar scores between the labor analgesia group and the control group, with all scores falling within the normal range [10]. This indicates that ropivacaine combined with sufentanil has no significant impact on the safety of newborns.

Through a comprehensive evaluation of analgesic effects, this study found that ropivacaine combined with

sufentanil exhibits significant analgesic efficacy in labor analgesia at high altitudes. It can shorten labor duration, increase the rate of spontaneous vaginal births, and has no significant impact on the safety of newborns. These findings provide new insights and methods for the development of labor analgesia techniques in high-altitude regions, and have important clinical significance and application value.

5. Conclusion

In conclusion, the combined spinal-epidural anesthesia utilizing ropivacaine and sufentanil demonstrates significant efficacy for childbirth in plateau regions. This regimen not only provides effective analgesia and shortens labor duration but also maintains neonatal safety as evidenced by stable Apgar scores. Therefore, its clinical adoption is highly recommended in these settings.

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Disclosure statement

The authors declare no conflict of interest.

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