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The Impact of Intrapartum Fever During Combined Spinal-Epidural Analgesia on Maternal and Neonatal Outcomes

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Abstract

Background: Epidural analgesia is recognized as the gold standard for labor analgesia; however, its associated complication—epidural-related maternal fever (ERMF)—has become a focus of clinical concern. ERMF not only increases maternal infectious evaluations and antibiotic use but may also adversely affect neonatal outcomes. Combined spinal-epidural analgesia (CSEA), with its rapid onset and reduced requirement for local anesthetics, is considered to potentially reduce the risk of ERMF.

Objective: This study aimed to investigate the impact of ERMF on maternal and neonatal outcomes among parturients receiving CSEA for labor analgesia.

Methods: This retrospective study included 100 full-term primiparas who delivered at the Zhaoqing Branch of the Third Affiliated Hospital of Sun Yat-sen University between January and June 2025, all of whom received CSEA for labor analgesia. Based on whether fever occurred during labor (axillary temperature ≥37.5 ℃), participants were categorized into a fever group (n=50) and an afebrile group (n=50). Maternal demographic data, labor parameters, laboratory indices, and neonatal outcomes were collected and compared between groups.

Results: Compared with the afebrile group, the fever group had a significantly prolonged second stage of labor ($P<0.05$), increased intrapartum blood loss, and higher oxytocin usage ($P<0.05$). Postpartum leukocyte counts and neutrophil ratios were elevated in the fever group ($P<0.05$), whereas no significant differences were observed at admission. Regarding neonatal outcomes, no significant differences were found in birth weight, length, or Apgar scores ($P>0.05$); however, the fever group demonstrated higher umbilical arterial lactate levels, lower base excess ($P<0.05$), and a significantly increased NICU admission rate ($P<0.05$).

Conclusions: ERMF is not uncommon among parturients receiving CSEA for labor analgesia. Its occurrence may contribute to prolonged second-stage labor, increased maternal blood loss, greater oxytocin requirement, and unfavorable short-term neonatal outcomes. Clinicians should strengthen the prevention and management of ERMF while ensuring adequate analgesia to optimize maternal and neonatal outcomes.

Keywords: labor analgesia, epidural-related maternal fever (ERMF), combined spinal-epidural analgesia (CSEA), labor process, maternal and neonatal outcomes

1. Introduction

Labor pain is an unavoidable physiological phenomenon during spontaneous vaginal delivery, and intense uterine contractions not only induce maternal anxiety, fear, and physical exhaustion, but are also closely associated with a range of adverse maternal and neonatal outcomes [1]. Epidural analgesia has been recommended by international guidelines as the “gold standard” for labor pain relief, owing to its superior analgesic efficacy and controllability [2]. However, the widespread application of epidural techniques has also raised concerns, such as increased labor interventions due to motor blockade and the risk of maternal hypotension [3]. In recent years, the most widely discussed complication has been epidural-related maternal fever (ERMF). ERMF not only increases the medical burden of maternal antibiotic exposure and infectious evaluations, but is also strongly linked to adverse neonatal outcomes [4]. To balance analgesic effectiveness with the risk of complications, combined spinal-epidural

analgesia (CSEA), an important modification of the epidural technique, has attracted growing attention. This approach provides rapid onset of analgesia and reduces the total dose of local anesthetics, theoretically lowering the risk of ERMF [5]. Therefore, the present prospective cohort study aimed to investigate the effect of modified CSEA on the incidence of ERMF and to comprehensively evaluate its clinical value in terms of labor progression, maternal and neonatal outcomes, and analgesic quality.

2. Methods

2.1 Participant

This retrospective study was conducted in the Department of Obstetrics, Zhaoqing Hospital, The Third Affiliated Hospital of Sun Yat-sen University, from January 2025 to June 2025. A total of 100 full-term primiparas were enrolled. Participants were categorized into the observation group (afebrile group, n = 50) and the control group (febrile group, n = 50) according to the occurrence of fever during labor analgesia, with fever defined as an axillary temperature ≥37.5 °C. The inclusion criteria were as follows: (1) maternal age between 20 and 40 years; (2) singleton cephalic pregnancy with gestational age ≥37 weeks; and (3) no contraindications to vaginal delivery or neuraxial anesthesia. The exclusion criteria were as follows: (1) coagulation disorders (international normalized ratio [INR] >1.5 or platelet count <100 × 10^9/L); (2) severe cardiac, pulmonary, hepatic, or renal diseases, or pregnancy-induced hypertension; (3) elective cesarean delivery without trial of labor; and (4) antenatal fever ≥38 °C or evidence of infection (e.g., prolonged rupture of membranes >24 h, elevated C-reactive protein). Written informed consent was obtained from all participants.

2.2 Labor Analgesia Modalities

Standardized combined spinal-epidural analgesia (CSEA) was administered for labor analgesia. When the cervical dilatation reached 2 cm, the parturient was placed in the lateral position, and the L3–4 interspace was punctured under aseptic conditions. After confirming unobstructed cerebrospinal fluid return, 1 mL of sufentanil citrate injection (Yichang Humanwell Pharmaceutical, batch number 21A09171A2) was slowly injected into the subarachnoid space at a rate of 0.2 mL/s. An epidural catheter was then advanced cranially, fixed with a 4-cm length retained in the epidural space, and connected to an electronic patient-controlled analgesia (PCA) pump. The PCA regimen consisted of a total volume of 120 mL containing 75 mg of ropivacaine and 45 μg of sufentanil, with parameters set as follows: background infusion rate 6 mL/h, bolus dose 8 mL, and lockout interval 15 min. The PCA pump was removed 2 hours postpartum.

2.3 Outcome Measures

This study systematically collected maternal baseline characteristics and perinatal data, including maternal demographics (age, height, weight, body mass index [BMI], and gestational age), maximum intrapartum temperature, labor parameters (duration of each stage of labor, amniotic fluid characteristics, mode of delivery, intrapartum blood loss, and oxytocin use), laboratory indices (white blood cell count and neutrophil percentage at admission and postpartum), as well as neonatal outcomes (birth weight, length, Apgar scores at 1, 5, and 10 minutes, umbilical arterial blood gas analysis, and admission to the neonatal intensive care unit [NICU]).

2.4 Statistical Analysis

Statistical analyses were performed using SPSS version 23.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Shapiro–Wilk test. Normally distributed data with homogeneity of variance were expressed as mean ± standard deviation ($\bar{x} \pm s$) and compared between groups using the independent-samples t-test. Non-normally distributed data were expressed as median (interquartile range) [M (P25, P75)] and analyzed using the Mann–Whitney U test. Categorical variables were expressed as numbers and percentages [n (%)] and compared using the χ^2 test or Fisher's exact test, as appropriate. A two-sided P value <0.05 was considered statistically significant.

3. Results

3.1 Comparison of General Characteristics Between the Two Groups

A total of 100 parturients who received combined spinal-epidural analgesia for labor were included in this study. According to the occurrence of intrapartum fever after analgesia, they were divided into the afebrile group (n=50) and the febrile group (n=50). Comparison of baseline characteristics showed no significant differences between the two groups in terms of age, height, weight, body mass index (BMI), or gestational age (all P>0.05), as shown in Table 1.

Table 1. Baseline maternal characteristics between the afebrile and febrile groups (mean ± SD)

Variables	Afebrile group (n = 50)	Febrile group (n = 50)	t value	P value
Age (years)	29.72 ± 4.09	28.92 ± 3.51	1.049	0.297
Height (cm)	159.16 ± 5.27	158.16 ± 5.40	0.938	0.351
Weight (kg)	66.57 ± 9.11	65.61 ± 8.87	0.531	0.596
BMI (kg/m²)	26.29 ± 3.45	26.20 ± 3.02	0.140	0.889
Gestational age (weeks)	39.49 ± 0.88	39.41 ± 0.96	0.420	0.675

Data are presented as mean ± SD for normally distributed variables. SD, standard deviation; BMI, body mass index.

3.2 Comparison of Maternal Outcomes Between the Two Groups

During labor, intrapartum temperature was significantly higher in the febrile group than in the afebrile group ($P<0.05$). Regarding labor progress, no significant differences were observed in the durations of the first and third stages of labor ($P>0.05$), whereas the second stage was significantly prolonged in the febrile group ($P<0.05$). In terms of maternal outcomes, intrapartum blood loss and oxytocin usage were both significantly higher in the febrile group compared with the afebrile group ($P<0.05$), while no significant differences were found in the incidence of meconium-stained amniotic fluid or the rate of assisted delivery ($P>0.05$). For laboratory parameters, postpartum white blood cell counts and neutrophil percentages were significantly elevated in the febrile group ($P<0.05$); however, no significant differences were observed at admission between the two groups ($P>0.05$). Details are presented in Table 2.

Table 2. Intrapartum parameters and laboratory indices between the afebrile and febrile groups

Variables	Afebrile group (n = 50)	Febrile group (n = 50)	Z/t/χ^2	P value
Intrapartum temperature (°C)	37 (36.88, 37.3)	37.6 (37.5, 37.9)	-8.659	0.000
First stage (h)	9.97 ± 4.59	10.78 ± 3.57	-0.980	0.329
Second stage (h)	0.77 ± 0.59	1.17 ± 0.81	-2.808	0.006
Third stage (h)	0.16 ± 0.05	0.17 ± 0.07	-0.447	0.656
Meconium-stained amniotic fluid rate	7 (14)	10 (20)	0.638	0.424
Assisted vaginal delivery rate	1 (2)	1 (2)	-	1.000
Blood loss during labor (mL)	146.40 ± 86.75	189.80 ± 105.96	-2.241	0.027
Oxytocin use	27 (54)	37 (74)	4.340	0.037
WBC at admission (×10⁹/L)	9.07 (7.79, 10.76)	9.94 (8.48, 11.02)	-1.138	0.255
Neutrophils at admission	0.738 (0.705, 0.783)	0.736 (0.702, 0.794)	-0.193	0.847
WBC postpartum (×10⁹/L)	13.32 (11.42, 14.99)	15.53 (13.47, 17.73)	-3.209	0.001
Neutrophils postpartum	0.77 (0.73, 0.81)	0.80 (0.76, 0.84)	-2.096	0.036

Data are presented as mean ± SD for normally distributed variables, median (IQR) for non-normally distributed variables, and n (%) for categorical variables. SD, standard deviation; IQR, interquartile range; WBC, white blood cell.

3.3 Comparison of Neonatal Outcomes Between the Two Groups

No significant differences were observed between the two groups in neonatal birth weight, length, Apgar scores, or umbilical arterial pH levels ($P>0.05$). However, neonates in the febrile group had significantly higher umbilical arterial lactate levels and lower base excess values compared with those in the afebrile group (both $P<0.05$). In addition, the NICU admission rate was significantly higher in the febrile group ($P<0.05$). Details are shown in Table 3.

Table 3. Neonatal outcomes between the afebrile and febrile groups

Variables	Afebrile group (n = 50)	Febrile group (n = 50)	t/χ^2	P value
Neonatal birth weight (kg)	3.09 ± 0.35	3.07 ± 0.31	0.378	0.707
Neonatal length (cm)	49.80 ± 1.88	49.50 ± 1.47	0.887	0.377

Apgar score at 1 min ≤7	0 (0)	1 (2)	-	1.000
Umbilical artery pH (mean ± SD)	7.28 ± 0.07	7.27 ± 0.08	0.809	0.421
Umbilical artery lactate (mean ± SD)	3.99 ± 1.55	4.80 ± 1.67	-2.530	0.013
Umbilical artery base excess (mean ± SD)	-3.17 ± 3.11	-4.42 ± 2.63	2.164	0.033
NICU admission (n, %)	8 (16)	17 (34)	4.320	0.038

Data are presented as mean ± SD for normally distributed variables, median (IQR) for non-normally distributed variables, and n (%) for categorical variables. SD, standard deviation; IQR, interquartile range; NICU, neonatal intensive care unit. All neonates had Apgar scores > 7 at 5 and 10 min.

4. Discussion

The findings of this study indicated that epidural-related maternal fever (ERMF) occurred in a subset of parturients receiving combined spinal-epidural analgesia (CSEA) for labor analgesia. Compared with the afebrile group, parturients in the febrile group showed a significantly prolonged second stage of labor, increased intrapartum blood loss, and higher oxytocin usage, along with elevated postpartum white blood cell counts and neutrophil percentages, suggesting that maternal fever may be closely associated with the activation of inflammatory responses. In addition, although no significant differences were observed in neonatal birth weight, length, or Apgar scores between the two groups, neonates born to febrile mothers exhibited higher lactate levels, lower base excess values, and an increased rate of NICU admission, indicating that maternal fever may adversely affect neonatal short-term adaptation.

At present, epidural analgesia has been widely recognized as the “gold standard” for labor analgesia; however, epidural-related maternal fever (ERMF) has emerged as a major clinical concern in recent years. Previous studies have suggested that ERMF is not infection-induced but rather represents a sterile inflammatory response. The underlying mechanisms may involve the effects of local anesthetics on leukocyte function and suppression of antipyretic factors (such as interleukin-1 receptor antagonist), thereby triggering a cytokine cascade and dysregulation of the thermoregulatory center [6–7]. In the present study, significantly elevated postpartum white blood cell counts and neutrophil percentages were observed in the febrile group, further supporting the hypothesis that inflammatory mechanisms may contribute to the development of ERMF. With respect to labor progression, the second stage of labor was significantly prolonged in the febrile group, a finding that has also been reported in multiple studies. Evidence indicates that parturients receiving epidural analgesia experience prolonged second-stage labor, along with increased oxytocin use and a higher frequency of obstetric interventions [8–9]. In our study, the increased blood loss and higher oxytocin usage observed in the febrile group may also be attributable to the extended second stage of labor. This may be associated with greater maternal physical exhaustion, reduced uterine contraction efficiency, or more frequent clinical interventions, suggesting that ERMF may increase the risk of labor-related complications through prolongation of labor.

Regarding neonatal outcomes, this study found that neonates in the febrile group had higher lactate levels, lower base excess values, and a significantly increased rate of NICU admission. These findings suggest that maternal ERMF may trigger neonatal metabolic stress, thereby impairing short-term adaptation. Previous studies have also demonstrated that maternal fever increases the likelihood of neonatal infection evaluations, antibiotic administration, and NICU admission [10]. Our results are generally consistent with these reports, highlighting the need for enhanced monitoring and timely intervention of both maternal temperature and neonatal conditions during CSEA labor analgesia.

The strengths of this study lie in the use of a standardized CSEA protocol, which minimized heterogeneity in anesthesia methods, and the comprehensive evaluation of both maternal and neonatal outcomes. However, several limitations should be acknowledged. First, as a single-center retrospective study with a limited sample size, the generalizability of the findings is restricted. Second, the lack of long-term follow-up precludes assessment of the potential impact of ERMF on neonatal long-term outcomes, such as neurobehavioral development and growth. Third, the present study did not further explore the underlying molecular mechanisms of ERMF. Future studies should consider conducting multicenter, large-sample, prospective randomized controlled trials, combined with basic experimental research, to elucidate the inflammatory mechanisms of ERMF and develop effective preventive strategies.

In conclusion, ERMF is not uncommon among parturients receiving CSEA for labor analgesia. Its occurrence may contribute to prolonged second-stage labor, increased maternal blood loss, and greater oxytocin requirements, while also exerting adverse effects on short-term neonatal outcomes. Clinicians should therefore strengthen the

monitoring and management of ERMF while ensuring adequate analgesia, in order to optimize maternal and neonatal outcomes.

Conflict of interest statement

The authors have no conflict of interest to declare.

Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to patient privacy concerns, but are available from the corresponding author on reasonable request.

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References

[1] Brownridge, P. (1995). The nature and consequences of childbirth pain. *European Journal of Obstetrics & Gynecology and Reproductive Biology, 59*(Suppl), S9-S15. https://doi.org/10.1016/0028-2243(95)02058-Z

[2] Callahan, E. C., Lee, W., Aleshi, P., & George, R. B. (2023). Modern labor epidural analgesia: implications for labor outcomes and maternal-fetal health. *American Journal of Obstetrics and Gynecology, 228*(5 Suppl), S1260-S1269. https://doi.org/10.1016/j.ajog.2022.06.017

[3] Leighton, B. L., & Halpern, S. H. (2002). The effects of epidural analgesia on labor, maternal, and neonatal outcomes: a systematic review. *American Journal of Obstetrics & Gynecology, 186*(5 Suppl Nature), S69-S77. https://doi.org/10.1067/mob.2002.121813

[4] Mullington, C. J., & Malhotra, S. (2021). Hyperthermia after epidural analgesia in obstetrics. *BJA Education, 21*(1), 26-31. https://doi.org/10.1016/j.bjae.2020.08.004

[5] Yao, Z., Zhou, J., Li, S., & Zhou, W. (2022). The effects of combined spinal-epidural analgesia and epidural anesthesia on maternal intrapartum temperature: a randomized controlled trial. *BMC Anesthesiology, 22*(1), 352. https://doi.org/10.1186/s12871-022-01898-w

[6] Patel, S., Ciechanowicz, S., Blumenfeld, Y. J., & Sultan, P. (2023). Epidural-related maternal fever: incidence, pathophysiology, outcomes, and management. *American Journal of Obstetrics & Gynecology, 228*(5 Suppl), S1283-S1304.e1. https://doi.org/10.1016/j.ajog.2022.06.026

[7] Kinishi, Y., Koyama, Y., Yuba, T., Fujino, Y., & Shimada, S. (2024). Fever in childbirth: a mini-review of epidural-related maternal fever. *Frontiers in Neuroscience, 18*, 1389132. https://doi.org/10.3389/fnins.2024.1389132

[8] Leighton, B. L., & Halpern, S. H. (2002). Epidural analgesia: effects on labor progress and maternal and neonatal outcome. *Seminars in Perinatology, 26*(2), 122-135. https://doi.org/10.1053/sper.2002.32201

[9] Antonakou, A., & Papoutsis, D. (2016). The effect of epidural analgesia on the delivery outcome of induced labour: A retrospective case series. Obstetrics and Gynecology International, 2016, 5740534. https://doi.org/10.1155/2016/5740534

[10] Zhang, Z., Deng, C. M., Ma, J. H., Li, S., Lei, B., & Ding, T. (2023). Effects of neuraxial labor analgesia on intrapartum maternal fever in full-term pregnancy and its influence on birth outcomes. *Frontiers in Medicine (Lausanne), 10*, 1208570. https://doi.org/10.3389/fmed.2023.1208570