



Administering intrathecal sufentanil during the second stage of labor: impact on duration

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Background: The second stage of labor, or fetal expulsion phase, can be prolonged and uncomfortable, prompting research into methods for managing both its duration and associated discomfort. This study aimed to investigate how intrathecal administration of sufentanil affects the duration of the second stage of labor and its potential to alleviate pain, with particular attention to the potential use of vacuum-assisted delivery.

Methods: In this observational study, 200 pregnant women were randomly divided into two groups ($n = 100$). The first group underwent labor pain reduction using intrathecal sufentanil (3 ml), while the second group received no intervention. Various factors, including use of delivery tools (vacuum or forceps), birth weight, and Apgar score, were examined during the second stage of labor.

Results: The results indicated no significant differences between the groups in terms of age, weight, height, parity, gravidity, gestational age, or body mass index. However, there was a notable difference in the duration of the second stage of labor between the groups ($P < 0.05$). Vacuum-assisted delivery was used in both groups, but the intervention with sufentanil did not significantly alter the frequency of its application.

Conclusion: Based on the findings, the use of sufentanil may help reduce labor discomfort and shorten the duration of the second stage of labor, but the role of vacuum-assisted delivery remains unaffected by the pain management technique.

Keywords: delivery, intrathecal, pain, second stage of labor, spinal anesthesia, sufentanil

Introduction

Labor pain management is a critical aspect of obstetric care, as unmitigated pain can lead to hormonal changes that may adversely affect uterine function and blood flow to the fetus^[1,2]. Pain relief methods during labor are generally divided into non-pharmacological approaches, such as exercise, support, and breathing techniques, and pharmacological options, including regional analgesia^[3]. Although epidural analgesia is widely considered the gold standard for labor pain relief in many countries^[4], other techniques such as spinal and spinal-epidural anesthesia are also utilized, particularly

HIGHLIGHTS

- Physical labor is often regarded as a disagreeable process, prompting numerous suggestions to alleviate its discomfort.
- Among the various methods proposed, one approach to mitigating labor pain involves the administration of sufentanil intrathecally.
- It is recommended to utilize sufentanil in order to reduce labor discomfort during vaginal delivery.

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in Iran, where single-dose spinal injections are often preferred due to their simplicity and effectiveness^[5,6].

In recent years, the potential of intrathecal opioids, particularly sufentanil, has garnered interest due to its long-lasting analgesic effects with minimal dosage and resources required^[7]. Despite the known presence of opioid receptors in the spinal cord's substantia gelatinosa, there is limited research specifically examining the efficacy and safety of intrathecal sufentanil for labor, especially in the second stage^[8].

The key element in facilitating the departure of the fetus is providing the mother with regional analgesia to alleviate pain while maintaining her awareness. The most commonly utilized approach for regional analgesia includes techniques such as spinal, epidural, and spinal-epidural^[9,10]. However, in many countries, epidural analgesia is considered the most effective method for reducing labor pain^[11,12].

In Iran, general and spinal anesthetic techniques are more commonly preferred. This method involves a single intrathecal injection into the cerebrospinal fluid. The advantages of this approach include the use of fewer medications and personnel^[13].

This procedure offers additional advantages that can be highly beneficial during the second stage of labor, including the ability to work rapidly, provide sedation, and achieve a high success rate^[14,15].

Although opioid receptors are present in the substantia gelatinosa, their presence does not hinder the intrathecal injection of opioids, as this area serves as the site of action for the effects of intrathecal opioid injections^[16]. The rationale for choosing sufentanil as the study target over other opioids is based on its unique properties in providing effective, long-lasting labor analgesia when used intrathecally^[17].

During pregnancy, women generally experience three phases, with the first phase characterized by frequent and painful contractions that lead to full dilation of the cervix. The second stage commences when the uterus is fully dilated and concludes with the actual childbirth. The third phase commences with childbirth and concludes with the ejection of the placenta^[18]. When it comes to spinal analgesia, the duration of labor plays a vital role. For nulliparous women, the first and second phases typically last around nine hours, while for multiparous women, the duration is approximately six hours in the absence of regional analgesia^[19,20]. The duration of the second stage of labor was categorized into hourly intervals: 0–1 hour, 1–2 hours, 2–3 hours, and 3 hours or more^[21]. The objectives of this study were to assess the impact of intrathecal sufentanil injection during the second stage of labor on the amount of suction utilized.

Material and method

In this observational study, for participation, mothers were required to have a cephalic presentation, confirmed by obstetricians, with no contraindications for vaginal delivery. Blood tests were conducted to confirm appropriate platelet count, hemoglobin, and hematocrit levels. Additionally, criteria such as the absence of active bleeding, organ failure, extremity paralysis, coagulation disorders, or any prior history of anesthesia complications were prerequisites for inclusion. A total of 200 eligible pregnant women were identified based on these criteria.

Random selection process

We utilized a block randomization method to assign participants randomly to two groups, each consisting of 100 individuals. Block randomization helps ensure equal distribution by creating blocks of participants with an equal number of treatment and control assignments in each block. Each block was randomly selected, and treatment assignments within the blocks were made based on these random selections.

Group assignments and procedures

The participants were randomly assigned to either the sufentanil (S) intervention group or the control (C) group. In the S group, labor pain was managed using intrathecal sufentanil, while no analgesic intervention was provided to the C group, serving as the control. Before spinal analgesia, participants received lactated Ringer's solution (500–1000 ml) and were positioned upright. Analgesia was administered when cervical dilation reached 6 cm, following a sterilization process and injection via the L2–L3 intervertebral space.

Table 1

Maternal, pregnancy and second stages of labor characteristics in study groups

Variable	Spinal analgesia (n = 100)	Control (n = 100)
Age	24.5 ± 4.3	26.5 ± 5.6
Weight	73.7 ± 11.06	74.7 ± 13.4
Height	154.41 ± 32.2	160.2 ± 16.8
Gravity	1.4 ± 0.6	1.4 ± 0.6
Parity	0.3 ± 0.4	0.3 ± 0.4
Gestational age	274.5 ± 8.7	270.5 ± 24.9
Second stages of labor	48.3 ± 44.8	38.3 ± 23.1
Vacuum	1.9 ± 0.2	1.9 ± 0.1
BMI	27.2 ± 6.7	28.5 ± 4.9

Data are expressed as mean standard deviation (means ± SD).

Sample size and calculation method

$$n = \frac{(z_{\alpha/2} + z_{\beta})^2 \times (p_1 \times (1 - p_1) + p_2 \times (1 - p_2))}{(p_1 - p_2)}$$

Patients were randomly assigned to either the sufentanil (S) group or the control (C) group. We utilized block randomization, wherein blocks were randomly selected, and the initial treatments were allocated based on the chosen blocks.

This study was approved by the research ethics board of Alborz University of Medical Sciences.

Unique identifying number is Research Registry:9221.

The methods were reported in accordance with STROCSS 2021 Guideline^[22].

Statistical analysis

The data via the independent *t*-test to compare the significant differences among the treatments ($P < 0.05$) was applied by use of SPSS version 18 (SPSS Inc., 176 Chicago, IL, USA). All data are presented as mean ± standard deviation (SD) unless indicated otherwise.

Results

The study found no statistically significant differences between the two groups in maternal characteristics, including age, weight, height, parity, gravity, BMI, vacuum usage, or the presence of underlying diseases. Additionally, gestational age and participation in pregnancy preparation courses were similar across groups (Table 1). Neonatal outcomes, including Apgar scores at 1 and 5 minutes and birth weight, also showed no significant differences between groups (Table 2). However, there was a significant difference in the duration of the second stage of labor, with the sufentanil group experiencing a shorter labor time ($P < 0.05$).

Discussion

In the study, the use of intrathecal sufentanil administration did not yield significant differences in the primary characteristics of labor pain during delivery compared to other analgesic methods^[3]. However, the duration of the second stage of labor showed a notable increase in the group receiving intrathecal sufentanil, indicating a potential impact on labor progression^[7].

Table 2
Neonatal characteristics in study groups

Variable	Spinal analgesia (n = 100)	Control (n = 100)
Apgar at 1 min	8.8 ± 0.4	8.7 ± 0.4
Apgar at 5 min	9.8 ± 0.4	9.7 ± 0.4
Birth weight	3175.9 ± 384.67	3184.5 ± 363.89

Data are expressed as mean standard deviation (means ± SD).

This observation aligns with previous research demonstrating prolonged labor duration associated with certain analgesic interventions, such as epidural anesthesia^[9].

Intrathecal administration represents an effective and straight anesthesia technique^[23,24]. With proper training provided to mothers and the alleviation of their fears, this method holds significant potential for effectively reducing pain^[24,25].

Sufentanil and fentanyl are commonly utilized as analgesics in spinal anesthesia during labor. Incorporating small doses of short-acting opioids like fentanyl or sufentanil not only enhances pain relief but also helps maintain motor function, thus improving overall efficacy^[24].

In the current study, the use of intrathecal sufentanil administration did not significantly alter the primary characteristics of labor pain during delivery. While the impact of labor pain management through epidural anesthesia has been extensively researched and documented, there remains a disparity regarding the association between spinal anesthesia and the duration of the second stage of labor. Nonetheless, several studies have indicated that epidural analgesia is associated with prolonged delivery duration^[26].

In this study, the administration of sufentanil intrathecally resulted in a significant increase in the duration of the second stage of labor. A comparable study conducted previously administered 45 µg of sufentanil to reduce pain in laboring women.

In the study, sufentanil was administered intrathecally as part of combined spinal–epidural analgesia. The research demonstrated effective analgesia during the second stage of labor. In another study involving 44 pregnant women, intrathecal fentanyl administration was used for labor analgesia, with participants aged between 20 and 31 years.

The findings indicated a longer duration of labor in the intervention group, which aligns with previous research^[27]. This outcome is consistent with the present study's findings. In another investigation, 60 pregnant women were chosen and randomly allocated to either the sufentanil group or the control group.

In the sufentanil group, 10 µg of sufentanil were injected into the intrathecal space. The study revealed that the duration of the second stage of labor in the sufentanil and control groups was 37 and 33 minutes, respectively. Interestingly, the duration of labor in both groups did not exhibit statistical significance, which contrasts with the findings of the current study. However, vital signs of the mothers, fetal heart rate (FHR), and Apgar scores did not exhibit significant differences between the two groups, mirroring our study results^[28].

Another study aimed to assess the analgesic effect of fentanyl during labor and its impact on newborns when administered via intrathecal injection to pregnant women preparing for natural delivery. The control group in this study did not receive any form of analgesic intervention.

In conclusion, the number of analgesic intervals and the Apgar scores of newborns at the first and fifth minutes were compared between the two groups^[29]. There were statistically significant differences observed in the average delivery time between the experimental and control groups, with 211 and 181 minutes, respectively, as reported in a previous study, aligning with the findings of the present study.

Nelson et al. (2002) investigated the use of sufentanil and fentanyl for pain reduction in pregnant women. They studied pain relief, side effects, maternal hemodynamic status at the block level, duration of labor, and fetal heart rate (FHR) variables in two groups. The duration of analgesia was found to be significantly higher in the sufentanil group compared to the fentanyl group (104 vs. 79 minutes)^[17].

However, demographic characteristics, hemodynamic status, duration of labor, delivery type, motor block, leg weakness, itching, nausea, pinprick numbness level, visual analog scale (VAS), fetal bradycardia, and Apgar scores were comparable between both groups. These findings suggest that the relative potency of sufentanil compared to fentanyl was 4.4 to 1^[30].

Sufentanil analgesia also results in a prolonged duration with no additional side effects. Opioids are the most utilized medications for pain relief, typically administered via injection. It's important to note that all opioids cross the placenta and can affect fetal heart rate^[31].

The onset of action of lipophilic opioids such as fentanyl and sufentanil via intrathecal administration is rapid, leading to respiratory depression originating from the cerebrospinal fluid. Another study found that the use of fentanyl during the second stage of labor resulted in increased pain reduction and improved patient satisfaction postpartum^[32].

In this study, no significant differences were found in age, parity, or body mass index, which is consistent with the findings of the present study. However, there was a lack of information concerning maternal and neonatal aspects during the second stage of labor, which resulted in a prolonged duration, as noted in previous studies^[20,33].

Researchers have indicated that the administration of epidural anesthesia during the second stage of labor prolongs its duration. Previous studies have demonstrated a significant increase in the duration of the second stage of labor with the use of epidural anesthesia^[34].

In our investigation, the incidence of vacuum extraction did not show a statistically significant difference between the two groups. Junichi et al. (2012) reported a vacuum extraction rate of 6.5% in pregnant women receiving spinal anesthesia compared to 2.9% in the control group, which contrasts with the findings of our study where vacuum extraction occurred in 1.9% of cases in both groups. The objective of employing intrathecal administration is to alleviate pain with minimal adverse effects on both the mother and newborn. As outlined in the findings, various maternal and neonatal variables such as weight, height, age, gravidity, parity, gestational age, BMI, birth weight, and Apgar scores at the first and fifth minutes showed no statistically significant differences between the two groups in our study. This aligns with the findings of Rimaitis et al., reflecting a similar pattern of results^[35].

This indicates a high level of similarity and minimal discrepancies between the trial groups. In a separate study, 60 healthy pregnant women received epidural analgesia with the administration of epidural sufentanil. Parameters related to both mothers and newborns, including age, height, weight, birth

weight, gestational age, and Apgar scores at 1 and 5 minutes, exhibited no significant differences between the trial groups^[36].

This finding mirrors our study. Similarities in analgesia and epidural analgesia complications have been noted across various studies with similar compositions. Recently, there has been growing consideration for the continuous use of spinal analgesia techniques for labor pain relief, attributed to advancements in these methods^[22].

Although the reduction in the duration of the second stage of labor is statistically significant, it may also hold clinical significance by potentially lowering the risk of maternal fatigue and associated complications, as well as reducing the likelihood of operative interventions during delivery.

Conclusions

This study suggests that intrathecal sufentanil can be effective in reducing pain during the second stage of labor without causing major adverse effects. However, while no significant complications were observed in our study, it is important to consider that neuraxial analgesia, including sufentanil administration, can sometimes be associated with a prolonged second stage of labor. Therefore, while sufentanil may offer pain relief benefits, clinicians should remain cautious and monitor labor progression to ensure safe and balanced management for each patient.

Ethical approval

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation Alborz University of Medical Sciences (IR.ABZUMS.REC.1401.000), and with the Declaration of Helsinki 1975, as revised in 2013. This study was approved by the Research Ethics Board of Alborz University of Medical Sciences.

Consent

Informed consent was obtained from the patient for publication parents/legal guardian for publication and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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Authors' contributions

M.H. and M.A.: conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript. S.M.P. and B.M.: Designed the data collection instruments, collected data, carried out the initial analyses, and reviewed and revised the manuscript. M.R., F.B. and M.M.H.: Coordinated and supervised data collection, and critically reviewed the manuscript for important intellectual content.

Conflict of interest disclosure

The authors deny any conflict of interest in any terms or by any means during the study.

Research registration unique identifying number (UIN)

This study was approved by the Research Ethics Board of Alborz University of Medical Sciences (IR.ABZUMS.REC.1388.000). Unique identifying number is: researchregistry:9221.

Guarantor

Dr. Banafsheh Mashak.

Provenance and peer review

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Data availability statement

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

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