



# Comparison of Spinal Versus Epidural Analgesia for Vaginal Delivery: A Randomized Double Blinded Clinical Trial

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## Abstract

**Background:** Recently, one of the problems in developing countries is pregnant women who insist on cesarean section for fear of painful vaginal delivery. There are various methods to reduce labor pain, including medical and non-medical methods. Neuraxial analgesia is classified as one of the best ways to reduce labor pain. Epidural analgesia is a classic and popular procedure to decrease labor pain. Nevertheless, other methods, such as spinal or combined spinal-epidural analgesia, is more effective compared with the epidural.

**Objectives:** In this study, we investigated a single intrathecal versus epidural injection in pregnant women during childbirth.

**Methods:** In our research, after obtaining informed consent, the patients were randomly assigned to two equal groups: epidural and spinal. Each group contained 50 parturient women in advanced labor. In the epidural group, 2.5 mL isobaric bupivacaine 0.5%, sufentanil (0.2 mcg/mL), and 7 mL saline 0.9% were injected by an 18-gauge Tuohy needle at the L4-5 or L5-S1 intervertebral space, and in the spinal group, 0.5 mL isobaric bupivacaine 0.5%, 2.5 mcg sufentanil, and 0.5 mL saline 0.9% were injected by a 25-gauge pencil-point Quincke needle at the L4-5 or L5-S1 intervertebral spaces. For pain intensity, the visual analog scale (VAS) was used at serial intervals, and other variables, such as the onset and duration of analgesia, hypotension, neonatal APGAR score, fetal heart rate (FHR) changes, and other variables were examined.

**Results:** The mean time to onset analgesic effect was 4.6 min in the spinal group compared with 12.5 minutes in the epidural ( $P < 0.001$ ). Duration of analgesia was 121 minutes in the spinal group compared with 104 min in the epidural group ( $P < 0.001$ ). The time to reach the maximum block was 8.4 min in the spinal group vs. 22.2 min in the epidural group ( $P < 0.001$ ). The duration of the second and third gestation stages was the same in both groups.

**Conclusions:** Spinal analgesia is short and easy to perform and does not require advanced equipment and technical experience. Spinal analgesia can be a good option for labor analgesia and leads to achieving a lower pain score than epidural analgesia.

**Keywords:** Spinal, Epidural, Labour Analgesia, Pain, Sensory Block

## 1. Background

Recently, one of the problems in developing countries is pregnant women who insist on cesarean section due to the fear of painful vaginal delivery. Childbirth is known as one of the most painful emotional experiences to deal with severe pain during a woman's life (1). Labour pain has several physiologic and emotional consequences for the mother and even fetus, like the leftward shift of oxyhemoglobin dissociation curve and fetus low oxygen delivery afterward (2). There are various methods to reduce labor pain, including medical and non-medical methods. Other non-medical methods are physiological delivery, delivery in water, childbirth in the presence of the family, mas-

sage, Lamaze technique, relaxation, hypnotism, aromatic therapy, shiatsu, subdermal, intradermal sterile water injection, etc. to ameliorate delivery. Unfortunately, these methods require more time and facilities (3-7). Other medical methods are Entonox, epidural or spinal analgesia, intravenous infusion, or using intramuscular drugs, like meperidine, promethazine, remifentanyl, and ketamine (8-15). Another way to reduce pain in the second stage of labor that can be effective is to use transvaginal local anesthetic cream (16). In developing countries, the vast majority of pregnant women want to have labor analgesia, but less than 40% can get analgesia (17).

Several medical analgesic methods have been pro-

posed, and neuraxial techniques are considered as the most acceptable and practical ways to reduce labor pain (18). Epidural analgesia is one of the best medical methods to reduce labor pain (19). The epidural method does not need advanced technical and clinical considerations (20).

## 2. Objectives

We compared spinal and epidural analgesia because the spinal method requires fewer facilities and less technical experience, and it can be a good option for analgesia at any stage of labor as an analgesic technique.

## 3. Methods

This study was a double-blinded randomized clinical trial approved by the Ethics Committee of Kermanshah University of Medical Science (code: KUMS.REC.1394.464), and receipt of the clinical trial registration code (code: IRCT2016042927667N1). The inclusion criteria were patients in the advanced labor stage referred to our center, nulliparous or multiparous American Society of Anesthesiologists (ASA) physical status II, and those interested in painless delivery. Exclusion criteria included patient refusal, drug abuse, intracranial hypertension, spinal or epidural failure, coagulopathy, or local infection, and patients who needed an emergency cesarean section. Participants' informed consent was obtained. The sample size was estimated to be 100 women in advanced labor (50 in each group) obtained using a test power of 90%.

Our 100 healthy pregnant women were randomly categorized as 50 patients as the spinal group and 50 patients as the epidural group that were randomly selected by a computer-based list. There were primigravid and multigravid pregnant women in both groups. When the patients were in an advanced stage with no contraindication, we infused 750 mL ringer lactate as an isotonic solution.

Patients in the spinal group received spinal block by insertion of 25-gauge pencil-point Quincke needle (Dr. Japan Co, Ltd) from the midline L3-L4 or L4-L5 intervertebral space to reach the intrathecal space, and after a dural puncture and acceptable cerebrospinal fluid perfusion, 2.5 mg isobaric bupivacaine 0.5% (AstraZeneca), 5 mcg sufentanil (Abureyhan Co.), and 0.5 mL saline were infused. In the epidural group, epidural analgesia was performed using an 18-gauge Tuohy needle (PAJUNK GmbH) using the loss of resistance technique with recognition of the standard place. The epidural catheter was inserted through the needle into the cranial direction, 4 cm at the L4-5 or L5-S1 intervertebral space, in a sitting position. After the absence of any blood or cerebrospinal fluid (CSF) aspiration, 3 ml lidocaine 1% was instilled via the catheter as the test dose, and

then 10 mL isobaric bupivacaine 0.1% and 2 mcg sufentanil were injected. Especially for the spinal group, we placed patients at zero bed angle for 15 minutes in the left lateral position. Pulse oximetry, noninvasive blood pressure, electrocardiography, and fetal heart monitoring were continually evaluated. In all stages, side effects, such as a drop in blood pressure of more than 25% compared with the baseline were recorded. Analgesic failure, like the failure of spinal or epidural analgesia, led to the exclusion of the patient from the study.

This research assessed different variables to compare spinal and epidural methods. Dilation of the cervix was an indicator for infusion and starting analgesia in primigravid patients (5 - 6 cm) and multigravida cases (4 - 5 cm). Sensory block was continuously evaluated after injection, after onset, and after complete sensory block every 5 min until 15 min, and then after VAS intervals until the end of the operation. The sensory block and pinprick test were assessed for both lower limbs. Evaluation of sensory distribution was assessed by a verbal rating scale: 100% (normal sensation) 0 (no sensation). The motor block was evaluated by modified Bromage scores: Bromage 0 (full flexion of knee and feet), Bromage 1 (just able to move knee), Bromage 2 (able to move the feet), and Bromage 3 (unable to move the knees and feet). Duration of stages 2 and 3 was defined as the time between full dilation of the cervix and delivery of the placenta.

The onset time for the sensory block was the time between the injection and the complete absence of pinprick response in both lower limbs. The duration of the sensory block was defined as the time interval between the complete sensory block (complete absence of pinprick response) and the first postoperative pain.

The maximum sensory block duration was defined as the time between the end of the block and the complete sensory block. Regression of 2 dermatomes was assessed as decreasing sensory level from 10th to 12th thoracic dermatome. The motor block was defined as any paralysis, Bromage 3 (unable to move knees and feet), and complete recovery Bromage 0 (full flexion of knee and feet). The variables of this study were continuously monitored by the operator in both groups. The pain score for labor analgesia was based on a standard VAS (VAS = 0 - 10). The VAS was assessed at the intervals of 5, 10, 30, 40, 60, 90, 120, and 150 min after injection in both groups.

Statistical analysis of the present study was performed using independent student *t*-test and chi-square tests by SPSS V18. The *t*-test was used to compare our two groups regarding quantitative variables. The chi-square and Fisher's exact tests were used for qualitative variables. A P-value of less than < 05% was considered significant.

#### 4. Results

In our research, 100 pregnant women were randomly categorized into two equal 50 patients. Participants were fairly aged between 17 and 41 years. Two patients had epidural punctures that CSF was seen, and both were excluded from the study. Tables 1 and 2 present demographic and other quantitative variables of the patients. Regarding age, weight, height, and gestation, no significant differences were reported ( $P > 0.05$ ).

Duration of the second and third stages of labor was not significantly different between the two groups ( $P > 0.05$ ), but the onset of analgesia was completely different. The mean time to achieve analgesic effect was 4.6 minutes after injection in the spinal group and 12.5 min in the epidural group ( $P < 0.001$ ). The duration of analgesia was 121 minutes in the spinal group and 104 min in the epidural group ( $P < 0.001$ ). The time to reach the maximum block in the spinal group was 8.4 minutes, and in the epidural group, it was 22.2 minutes ( $P < 0.001$ ). Time from injection to two dermatomal regressions was 72.3 min in the spinal group and 62.2 min in the epidural group ( $P < 0.001$ ). The quality of analgesia was 79.2% in the spinal group and 70.5% in the epidural group ( $P < 0.001$ ). The average of analgesia was not meaningfully different in both groups ( $P > 0.05$ ) (Table 2).

Regarding the VAS, the scores of the spinal group were significantly lower compared with the epidural group (Table 3).

Complications, like pruritus, vacuum extraction, oxytocin augmentation infusion, vomiting, and neonate APGAR score and FHR variation were approximately the same in both groups ( $P > 0.05$ ). The epidural group was found with a decrease of more than 25% in blood pressure compared with baseline than the spinal group ( $P < 0.05$ ) (Table 4). In the spinal group, 10 patients were re-punctured due to prolonged delivery time, and in the epidural group, 16 patients received an additional bolus of analgesic dose, such as loading dose from the catheter ( $P > 0.05$ ). No additional side effects were reported in these patients. The average time and cost in the spinal group were significantly lower than in the epidural group.

#### 5. Discussion

Pain management for labour analgesia can be done through several methods, such as inhalational, parenteral (i.v. and i.m.), regional, and neuraxial (spinal and epidural) techniques. Intravenous route as a bolus or continuous infusion of analgesics such as meperidine, remifentanyl, dexmedetomidine, ketamine, etc, can be used as a single or

multimodal analgesia (20-24). Regional techniques categorized as spare nerve block (25) or neuraxial block are the most acceptable and practical ways to reduce labor pain (18). Epidural analgesia is one of the best practical methods to reduce labor pain (19). However, it needs special considerations compared with other analgesic methods for labor analgesia (26).

We compared spinal vs. epidural analgesia in labor. In most variables, the single-shot spinal analgesia was the same or even better than the epidural analgesia. The effectiveness, convenience, and cost-effectiveness of the spinal method were indicators of its introduction as a suitable option for analgesia. During the first stage of labor, the pain was originated from visceral sources. In the second stage, it combined both visceral and somatic pathways. Analgesia can reduce pain in both stages and even involves levels above the tenth lumbar dermatome.

For pretreatment, intravenous isotonic fluids have been the best options. Several surveys have been proposed as the best options; for example, Fathi et al. (27) proposed superior effects of ringer lactate vs. hetastarch or any other fluids for spinal anesthesia. We used 750 ml of Ringer's lactate 30 min before the puncture, and no side effects or hemodynamic instability events were reported. Opioid administration is frequently used by intravenous or neuraxial methods, but they need special considerations (28, 29). Intrathecal injection of local anesthetic and opioids can decrease labor pain efficiently (30-33). In line with this observation, the onset and duration of analgesia in the spinal group were significantly faster and longer. Manouchehrian et al. (34) reported that fentanyl and sufentanil as opioids could have different effects on the onset, duration, quality of analgesia, and the maximum time of neuraxial block. There was no significant difference between their analgesic effects. Fentanyl had a faster onset of analgesia and higher satisfaction, whereas sufentanil had a longer analgesia duration (34). In our research, we only used sufentanil, and no comparison was recorded.

Intrathecal sufentanil seems to cause faster and longer analgesia than bupivacaine; however, both of them have the same level of analgesia (35). In our study, we used low doses of bupivacaine and sufentanil simultaneously, and the onset of analgesia was effectively faster.

Bucklin et al. (36) assessed 133 pregnant women and showed that 15 to 20 min after intrathecal injection of sufentanil and bupivacaine, patients experienced the same scores as epidural analgesia. In our study, patients in the spinal group reported higher satisfaction scores than epidural patients. Several studies have shown that multiparous patients preferred spinal analgesia to epidural analgesia for subsequent delivery (36). Intrathecal fen-

**Table 1.** Patient's Demographic Characteristics

Characteristic	Epidural Group, Mean $\pm$ SD	Spinal Group, Mean $\pm$ SD	P-Value
Age, y	30.6 $\pm$ 10.8	28.4 $\pm$ 15.4	> 0.05
Weight, kg	77.6 $\pm$ 7.0	77.2 $\pm$ 7.1	> 0.05
Height, cm	159.3 $\pm$ 5.6	158.5 $\pm$ 4.7	> 0.05
Gestation, wk	37.5 $\pm$ 1.7	36.9 $\pm$ 2.3	> 0.05

**Table 2.** Anesthetic Effect of a Single Dose Spinal Versus Epidural Injection

Parameters	Epidural Group, Mean $\pm$ SD	Spinal Group, Mean $\pm$ SD	P-Value
Duration of stages 2 and 3, min	64.3 $\pm$ 9.6	63 $\pm$ 9.2	> 0.05
Onset of analgesia, min	12.5 $\pm$ 0.9	4.6 $\pm$ 1.4	> 0.05
Duration of analgesia, min	104.1 $\pm$ 6.9	121 $\pm$ 5.7	> 0.05
Maximum sensory block duration, min	22.2 $\pm$ 2.1	8.4 $\pm$ 1.2	> 0.05
Two dermatomes regression, min	62.2 $\pm$ 6.1	72.3 $\pm$ 15.2	> 0.05
Average of analgesia, min	128.6 $\pm$ 11.6	132.6 $\pm$ 7.9	> 0.05
Quality of analgesia, %	70.5 $\pm$ 12.9	79.2 $\pm$ 10	> 0.05

**Table 3.** Analgesic Effect of a Single Dose of Spinal vs. Epidural Injection

VAS Time Interval, min	Epidural Group, Mean $\pm$ SD	Spinal Group, Mean $\pm$ SD	P-Value
5	4.4 $\pm$ 0.76	2.1 $\pm$ 0.5	< 0.05
10	3.7 $\pm$ 1.7	2.5 $\pm$ 1.3	< 0.05
30	3.0 $\pm$ 1.3	2.1 $\pm$ 1.1	< 0.05
40	5.1 $\pm$ 1.6	2.3 $\pm$ 1.1	< 0.05
60	4.4 $\pm$ 1.5	2.3 $\pm$ 1.5	< 0.05
90	4.5 $\pm$ 1.2	2.9 $\pm$ 1.5	< 0.05
120	6.1 $\pm$ 1.5	3.9 $\pm$ 1.4	< 0.05
150	5.8 $\pm$ 2.3	3.9 $\pm$ 1.4	< 0.05

**Table 4.** Adverse Effect (n)

Adverse Effect	Epidural Group	Spinal Group	$\chi^2$ Test	P-Value
Pruritus	7	14	2.9	0.8
Vacuum	8	5	0.7	0.3
Oxytocin	21	21	0	1
Repeat infusion or block	16	10	0.7	0.3
Vomiting	3	6	1	0.29
FHR variation	0	2	3	0.22
Hypotension	16	1	3	0.5
Motor block	3	2	0	1.00

tanyl can improve cervical dilatation and is associated with less nausea and better fetal APGAR scores than intravenous opioids (37). In our study, nausea and vomiting were the same or slightly higher in the spinal group, and APGAR scores were almost the same in both groups.

Epidural analgesia has different effects, such as increased FHR and mal-position of the fetus, instrumental delivery, and maternal fever (38). In our study, only a drop in blood pressure in the epidural group was significantly higher than the spinal group, and the other variables were

almost identical in both groups.

Mardirosoff et al. (39) reported a link between fetal bradycardia and intrathecal opioid injection. In our research, only two cases of the spinal group had FHR variation. In these cases, it was only a variable deceleration and improved by general maneuvers, such as dextrose infusion. If patients with spinal analgesia need an immediate cesarean section, there is no contraindication to spinal or even epidural anesthesia (40).

In this study, 5 patients from the spinal group and 7 patients from the epidural group were scheduled for emergent cesarean section due to labour arrest and placental abruption, and there was no significant difference between the groups. In the spinal group, only 10 women needed repeated blocks once, and in the epidural group, 16 women received reinfusion of analgesia. No additional differences or side effects have been reported in these patients.

Abdel Barr et al. (41) compared the two spinal and epidural groups. In the spinal group, 3.75 mg hyperbaric bupivacaine and 25 mcg fentanyl with 0.75 mL saline, and for the epidural group, 4 ml hyperbaric bupivacaine with 4 mL saline and 1 mL (50 mcg) fentanyl were infused. Pain relief was recorded by the VAS and verbal expression, and other variables were recorded at the end of the study. They believed that spinal analgesia was better than epidural analgesia and it can be a good alternative for the epidural block. Spinal analgesia is easier to perform, cost-effective, and can provide effective analgesia than epidural analgesia (41), which is consistent with our research. However, in this study, they did not report any renewed doses for the prolonged spinal or epidural blocks.

Kuczkowski and Chandra (42) evaluated 62 pregnant women with spinal analgesia during delivery. They received 2.5 mg bupivacaine, 0.25 mg morphine, and 45 µg clonidine via a small 25-gauge needle. They assessed satisfaction with analgesia and other side effects. Also, 81% of the patients expressed higher satisfaction, and approximately 11% were satisfied with this method (42). In our research, satisfaction with spinal and epidural analgesia was 79.2% and 70.5%, respectively.

Mazur-Sunko (43) compared spinal and epidural analgesia and suggested spinal analgesia as a suitable option for the epidural method because of the rapid onset and similar side effects, which is in line with our findings.

Minty et al. (44) evaluated unique spinal and other pain-relieving techniques. Yeh et al. (45) evaluated the efficacy of morphine in combination with bupivacaine and fentanyl to cause spinal analgesia. The analgesic effects were long-lasting, and the other criteria were not different from the epidural method (45), which is similar to the results of our study.

Due to time constraints of single-shot spinal analgesia, it is not possible to make a maternal indication to start analgesia at the beginning of labor, which seems to be the main limitation of the spinal method.

### 5.1. Conclusions

Spinal analgesia for labor pain can be a logical and safe method, which in addition to rapid recovery in postpartum and safety, it provides acceptable pain relief for parturient.

### Footnotes

**Authors' Contribution:** Analysis and interpretation of data: FI, AA, and SL. Study concept and design and acquisition of data: AA and SL. Analysis and interpretation of data: ASH and AA. Drafting of the manuscript and critical revision of the manuscript for important intellectual content: FI. Statistical analysis: ASH. Administrative, technical, and material support and Study supervision: FI, AA, JA, and SL.

**Clinical Trial Registration Code:** The clinical trial registration code was IRCT2016042927667N1.

**Conflict of Interests:** The authors declared no conflict of interests.

**Ethical Approval:** The research was approved by the Ethic Committee of the Kermanshah University of Medical Sciences approval number (code: KUMS.REC.1394.464).

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**Informed Consent:** Informed consent was taken from the patients.

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