e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2022; 12(11); 149-156

Original Research Article

Intrathecal Dexmedetomidine-Fentanyl for Labor Analgesia: A Comparative Prospective Study

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Received: 18-09-2022 / Revised: 20-10-2022 / Accepted: 12-11-2022
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Conflict of interest: Nil

Abstract

Background: Women have reported the agony they experience during childbirth as being severe and frequent, and they often have few or no choices for pain management, particularly in developing nations. In many low resource settings, sedatives and parenteral opioids are the most often recommended medications for women in labor. It has been demonstrated that his approach to pain treatment has little to no impact on labor discomfort. One of the main aims of maternity care is to relieve pain during labor. Combining spinal and epidural analgesia is a well-known method for reducing labor pain with no risk to the mother or fetus. For sustained postoperative analgesia, dexmedetomidine and bupivacaine have been administered intrathecally. It is a highly selective alpha 2 adrenoreceptor agonist with analgesic effects. It is highly lipophilic and barely crosses the placenta, according to recent evaluations.

Aim: To compare the effects of intrathecal dexmedetomidine and fentanyl to dexmedetomidine or fentanyl alone on mother and newborn outcomes during labor.

Material and Method: The department of anesthesia conducted this comparative prospective observational study. All participants gave their informed and written agreement to be included in the study and to have their data used for the current research project. 100 pregnant women who were full term and admitted to the obstetric department for safe confinement made up the participants. The study was conducted in a designated labor room of the obstetrics division of a teaching hospital with tertiary care. A multipara monitor, ultrasound, anesthetic workstation, and resuscitation supplies are available in the delivery room. The pregnant moms have described the benefits and process of labor analgesia. For every patient to be included in the trial, the approval of an obstetrician was required.

Results: 120 parturients in all met the inclusion requirements, 110 of them gave their consent and were subsequently recruited in the study after the inclusion criteria were applied. According to the exclusion criteria, ten patients were disqualified. once the predetermined sample size of 100 patients has been reached. The study of the block quality showed that Group A experienced analgesia sooner than Group B. Statistics showed that the differences were substantial. In Group A, the analgesia lasted longer as well. According to the examination of motor block, Group A has more motor block than Group B has. According to the analysis of side effects, pruritus, hypotension, bradycardia, shivering, and nausea were the most frequent side effects.

Conclusion: Contrary to dexmedetomidine or fentanyl used alone, intrathecal dexmedetomidine prolongs the duration of analgesia and reduces the prevalence of side effects. A secure and reliable technique for labor analgesia is the use of an intrathecal adjuvant walking epidural. With intrathecal dexmedetomidine, the block's intensity and duration are greater. The likelihood of a normal vaginal birth is increased with fentanyl. Dexmedetomidine should not be used as an

intrathecal adjuvant for labor analgesia; fentanyl should. Compared to fentanyl, it offers an acceptable level of labor analgesia with a longer analgesic duration.

Keywords: Analgesia, Dexmedetomidine, Fentanyl, Labor, Neonatal, labor analgesia.

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Introduction

One of the physically unpleasant conditions that women go through throughout their lifetimes is labor. On a scale of 1 to 10, labor pain typically receives a score of at least 7, placing it second or third among all painful conditions [1,2]. Clinicians have been using techniques to lessen the severity of labor pain ever since the Middle Ages. The "etherization of labor" by James Young Simpson, who successfully gave labor analgesia to a woman with a malformed pelvis, marked the start of the contemporary era of labor analgesia [3].

The mother and fetus experience a variety of negative physical and psychological effects as a result of the terrible labor pain. Intense uterine contractions that cause hyperventilation and high catecholamine levels cause hypoxemia in the mother and fetus. The widely used method of combined spinal epidural (CSE) analgesia reduces labor pain with little harm to the mother or fetus [4]. The mother and fetus experience a variety of negative physical and psychological effects as a result of the terrible labor pain.

Hyperventilation and increased catecholamine levels brought on by labor pain and unpleasant uterine contractions cause hypoxemia in the mother and fetus [5,6]. Two advantages of pain relief are calming the patient and lowering the release of stress hormones. Painkillers not only make the patient more comfortable, but they also lessen the release of stress hormones, which can exhaust the parturient's reserves and starve the fetus of nourishment and oxygen [7,8].

The widely used method of combined spinal epidural (CSE) analgesia reduces labor pain with little harm to the mother or fetus. The use of intrathecal opioids for labor analgesia is growing in popularity, yet there is scant data to back it up Fentanyl is a strong and short-acting synthetic narcotic that is a derivative of phenyl piperidine. Fentanyl is regarded as an excellent alternative for labor pain management due to its short half-life. In order to reduce motor block during labor, fentanyl and bupivacaine have been utilized widely. However, adding opioids to local anesthetics has the drawbacks of itching and respiratory depression.

In order to reduce motor block during labor, fentanyl and bupivacaine have been utilized widely. However, respiratory depression and itching are downsides of combining opioids with local anesthetics. Due to its inherent analgesic properties, dexmedetomidine, an incredibly potent and selective alpha 2 adrenergic agonist, has been used in combination with spinal bupivacaine to prolong postoperative analgesia [10]. Dexmedetomidine does not penetrate the placenta considerably because of its high placental retention, according to recent assessments of its use during pregnancy [11].

Dexmedetomidine has been used intravenously and epidurally in labor in numerous studies without causing any negative effects on the mother or fetus [12,13]. Dexmedetomidine is a highly selective alpha 2 adrenergic agonist that has been used intrathecally to extend postoperative analgesia. It also possesses intrinsic analgesic characteristics [14,15]. The fetus shouldn't alter much because there isn't much placental transfer. Dexmedetomidine offers the benefit of lowering blood pressure because it controls catecholamine release. Dexmedetomidine occasionally causes bradycardia and

hypotension in the mother, which could be harmful [16]. Intrathecally or intravenously administering dexmedetomidine during pregnancy is still considered off-label. Dexmedetomidine has a sympatholytic action that can lessen the stress response to surgery and an analgesic-sparing effect that considerably reduces the need for opioids [17,18].

Material and Methods

The department of anesthesia conducted this comparative prospective observational study. All participants gave their informed and written agreement to be included in the study and to have their data used for the current research project. 100 pregnant women who were full term and admitted to the obstetric department for safe confinement made up the participants. The study was conducted in a designated labor room of the obstetrics division of a teaching hospital with tertiary care.

A multipara monitor, ultrasound, anesthetic workstation, and resuscitation supplies are available in the delivery room. The pregnant moms have described the benefits and process of labor analgesia. For every patient to be included in the trial, the approval of an obstetrician was required. After discussing the effects of the medications used for labor analgesia, the patient provided written and informed consent to participate in the observational study.

Using computer-generated randomization, all participants who met the inclusion requirements were divided into two groups (A and B). Under aseptic conditions, a combined spinal-epidural method using an 18G Tuohy needle and a 27G spinal needle in the left lateral position was used to provide labor analgesia. The following medications and dosages were given:

1. Group A: Bupivacaine 2.5 mg (0.5 mL diluted to 2 mL) + 20 µg dexmedetomidine in 1 mL saline intrathecally (total volume: 3 mL)
2. Group B: Bupivacaine 2.5 mg (0.5 mL diluted to 2 mL) + fentanyl (15 µg) in 1 mL saline intrathecally (total volume: 3 mL).

The syringes were disguised, and the medical staff—who are unaware of the composition—performed the drug administration and following patient monitoring. On the patient's request, epidural top-up was given in both groups through the catheter. The medication was bupivacaine 0.125%.

Liver information Non-invasive measurements were made of the blood pressure, pulse rate, oxygen saturation, and respiration rate. The doctor displayed the fetal heart rate, cervical dilation, and stage and progress of labor. When the patient was experiencing active labor, the administration of intrathecal analgesia should have started.

The period of time prior to the intrathecal medication injection was referred to as the baseline. When a VAS less than 3 was recorded after intrathecal injection, analgesia had begun. After that, VAS was measured once per minute for 10 minutes, then every 10 minutes until it achieved a value of 3. The period from the intrathecal injection until the VAS reached more than 3 and required further analgesia through the epidural catheter was used to define the duration of analgesia.

Following the intrathecal injection, the mother's heart rate and non-invasive blood pressure were monitored every five minutes. Hypotension, defined as a 20% or greater drop in blood pressure from baseline, and bradycardia, defined as a heart rate under 60, were both treated right away with intravenous fluids, ephedrine, or atropine, as necessary. A cardiotocograph was used to detect and treat fetal bradycardia, which was initially managed by giving the mother oxygen while positioning her on her side to prevent aortocaval compression. There were also reported adverse effects include itching, nausea, and respiratory depression. Ondansetron 4 mg was used to

treat nausea and vomiting, while IV diphenhydramine 50 mg and oral loratadine 10 mg were used to alleviate pruritus. The delivery methods were noted. Neonatal outcomes such as pH of the umbilical cord blood and neonatal Apgar score were noted.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) version 20.0 (IBM, Chicago, IL) was used to conduct the statistical analysis. Data is given as mean, standard deviation, or numbers as necessary. The independent two-sample t-test was used to examine patient characteristics (age, weight, height, parity, and gestational age), the onset and duration of analgesia, and pH of the umbilical artery. The Fisher's exact test or the Chi-square test, if applicable, was used to analyze other parameters.

Result

120 parturient in all met the inclusion requirements, 110 of them gave their consent and were subsequently recruited in the study after the inclusion criteria were applied. According to the exclusion criteria, ten patients were disqualified. once the predetermined sample size of 100 patients has been reached. Table 1 displays the demographic and baseline data, which were statistically comparable.

Table 1: Demographic and baseline parameters among participants

Parameters	Mean±SD	
	Group A (n=50)	Group B (n=50)
Age (years)	23.80±2.76	24.66±1.86
Weight (kg)	61.27±5.52	55.05±6.86
Height (cm)	152.85±3.18	153.50±3.93
Heart rate (bpm)	106.12±5.12	102.80±6.51
SBP (mmHg)	113.38±3.33	112.29±6.32
DBP (mmHg)	70.18±5.81	71.12±6.73
MAP (mmHg)	81.22±3.52	83.10±6.42
SpO_2 (%)	94.31±0.64	92.33±0.69
VAS score	7.87±0.86	6.72±1.02

Table 2: Mode of delivery among participants

Mode of delivery	Group A (N=50)	Group B (N=50)
Normal (n=65)	30	35
Instrumental vaginal delivery (n=8)	5	3
Cesarean delivery (n=27)	15	12

A total of 100 patients (50 in Group A and 50 in Group B) experienced adequate analgesia, and 65 underwent vaginal delivery (Group A: 30; Group B: 35). This results in an overall success rate of 61.66%; however, Group B had a much greater success rate. In Group A, there were more cesarean deliveries and vaginal deliveries requiring forceps.

Table 3: Quality of block among the participants

Parameter	Mean±SD	
	Group A (N=50)	Group B (N=50)
Onset time (s)	57.22±15.20	85.50±23.30
Duration of analgesia (min)(VAS score <3)	117.11±21.17	102.21±15.81
Degree of the motor block as on the Bromage Scale	3.10±0.88	3.77±0.83
Top-up required in first 6 h	6.20±1.33	10.32±3.34

The study of the block quality showed that Group A experienced analgesia sooner than Group B. Statistics showed that the differences were substantial. In Group A, the analgesia lasted longer as well. According to the examination of motor block, Group A has more motor block than Group B has.

Table 4: Incidence of maternal and fetal side effects in both the groups

Parameter	Mean±SD	
	Group A (N=50)	Group B (N=50)
Pruritus	0	21
Hypotension	5	3
Bradycardia	4	2
Nausea	1	3
Vomiting	0	1

Pruritus was shown to be the most frequent side effect (although it was only noticed in Group B), followed by hypotension, bradycardia, shivering, and nausea, according to the analysis of negative effects. There were no abnormalities in the umbilical artery and uterine blood flow, according to fetal ultrasonography and Doppler study. With a lower pulsatility index, Group A saw less variation in heart rate. Both procedures were safe, as shown by the study of fetal data, and all neonates in both groups were confirmed to be safe and healthy after 6 weeks of birth.

Discussion

Myths and disputes have always surrounded labor pain relief. Therefore, providing efficient and secure analgesia during childbirth has continued to be difficult. Over time, labor analgesia has changed to reduce motor blockage, allow for walking epidurals, and prevent labor from being prolonged. Along with local anesthetics, lipophilic opioids like fentanyl have been utilized for labor analgesia widely intrathecally and epidurally.

Dexmedetomidine is a selective alpha 2 adrenoreceptor agonist that has been used as an adjuvant in spinal and epidural anesthesia. It offers a number of benefits over local anesthetics alone, including a longer duration of analgesia and no negative neurological effects [19,20]. However, in order to successfully perform a normal vaginal delivery, the severity of the block must be balanced during labor analgesia to prevent any motor block. Adjuvants have long been utilized in spinal anesthesia in clinical practice, and they are increasingly becoming more common in labor spinal analgesia [21].

In their meta-analysis, Niu *et al* [14]. shown that intrathecal dexmedetomidine increased postoperative analgesia, prolonged the duration of spinal anesthesia, and did not increase the frequency of adverse events or hypotension. When Wong *et al* [22]. looked at the effectiveness of different fentanyl doses as an adjuvant for labor spinal analgesia, they came to the conclusion that 15 μg was a safe and effective amount. This serves as the rationale behind the current study's use of a 15 g dosage of fentanyl. Ezz Gehan *et al* [23] used 20 μg dexmedetomidine intrathecally, which formed the basis of the dexmedetomidine dose in this study.

Dexmedetomidine does not pass the placenta very much and has a high placental retention (0.77 maternal/fetal index). Like fentanyl, it is maintained in placental tissue due to its high lipophilicity. Dexmedetomidine has been shown in studies to have significant placental retention and to directly and dose-dependently increase the frequency and amplitude of uterine contractions, suggesting potential

benefits for usage as an auxiliary analgesic during labor [24]. Fyneface-Ogan *et al* [25]. compared 2.5 mg of hyperbaric bupivacaine and 2.5 μg of dexmedetomidine intrathecally with bupivacaine and fentanyl intrathecally in labor, and found that the combination of the two drugs considerably prolonged sensory block in laboring women.

Dexmedetomidine has been shown in studies to have significant placental retention and to directly and dose-dependently increase the frequency and amplitude of uterine contractions, suggesting potential benefits for usage as an auxiliary analgesic during labor. Dexmedetomidine was therefore expected to produce great analgesia and have no motor block after intrathecal delivery, making it an appropriate medication for labor analgesia. Its intrathecal usage in labor, however, continues to be against the rules. There were no expected negative effects on the infant due to the 10 μg dose used in this study, which was lower than prior intravenous doses utilized during pregnancy. Dexmedetomidine inhibits the firing of nociceptive neurons triggered by peripheral A and C fibers by acting on receptors in the substantia gelatinosa of the dorsal horn of the spinal cord. Additionally, it prevents the release of substance P, a nociceptive neurotransmitter [26].

Al-Mustafa *et al* [27]. and Hala *et al* [28]. observed dose-dependent prolongation of the duration of action of analgesia with reduced analgesic requirement when intrathecal dexmedetomidine dosages increased (5, 10, and 15 μg). Mahdy *et al* [29] observed that there were no negative effects on mothers or newborns in any group following intrathecal dexmedetomidine and fentanyl injection, which is consistent with our findings. In a parturient with a tethered spinal cord, Palanisamy *et al* [30]. successfully used i.v. dexmedetomidine as an addition to opioid-based PCA and general anesthesia for the respective provider of labor analgesia and cesarean delivery anesthesia. The results for the mother and the baby were positive.

As a result, it is proposed that with the extended duration of analgesia demonstrated by intrathecal dexmedetomidine and fentanyl, as well as a lack of side effects (such as sedation, respiratory depression, hypotension in the mother, and neonatal depression), could be considered an appealing alternative for labor analgesia. The findings of this study will be important in low-resource economies where there is a lack of equipment, accessories, and knowledge necessary to implement an epidural analgesia service [31].

Intrathecal bupivacaine/dexmedetomidine may be the only medication given as a single shot to multiparous women in labor due to the prolonged time of analgesia it displayed in our study. Dexmedetomidine may provide additional benefits for women going through labor and delivery because it doesn't have any negative side effects including drowsiness, respiratory depression, maternal hypotension, or neonatal depression. Although this study advances our understanding of dexmedetomidine, more research may be required to fully understand how this drug works to relieve labor pain. However, this trial demonstrated that intrathecal low-dose dexmedetomidine administered in a single shot had significant potential to reduce discomfort during labor and delivery. In primiparous women in labor and childbirth, a greater dose of intrathecal DMT may be required in order to achieve a more potent and longer block.

Conclusion

Contrary to dexmedetomidine or fentanyl used alone, intrathecal dexmedetomidine prolongs the duration of analgesia and reduces the prevalence of side effects. A secure and reliable technique for labor analgesia is the use of an intrathecal adjuvant walking epidural. With intrathecal dexmedetomidine, the block's intensity and duration are greater. The likelihood of a normal vaginal birth is increased with fentanyl. Dexmedetomidine should not be used as an intrathecal adjuvant for labor analgesia; fentanyl should. Compared

to fentanyl, it offers an acceptable level of labor analgesia with a longer analgesic duration. It keeps hemodynamic stability while having no negative effects on the mother or the newborn.

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