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Comparative Analysis of Analgesic Duration: Intrathecal Hyperbaric Levobupivacaine with Dexmedetomidine vs Morphine in Lower Segment Caesarean Sections

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Abstract

Background: Intrathecal adjuvants are commonly used to prolong postoperative analgesia following spinal anesthesia for caesarean section. Morphine is effective but associated with opioid-related adverse effects, while dexmedetomidine has emerged as a potential alternative. ***Aim:*** To compare the analgesic duration and safety profile of intrathecal hyperbaric levobupivacaine with morphine versus dexmedetomidine in parturients undergoing elective lower segment caesarean section. ***Material and Methods:*** A prospective randomized study involved 100 parturients divided into two groups. Group A received intrathecal hyperbaric levobupivacaine combined with 100 µg of morphine, with a mean age of 31.12 ± 4.08 years. Group B received intrathecal hyperbaric levobupivacaine with 3 µg of dexmedetomidine, with a mean age of 30.88 ± 4.32 years. Analgesic efficacy, hemodynamic parameters, adverse effects, and neonatal outcomes were assessed. ***Results:*** Both groups achieved adequate analgesia for 24 hours. Pain scores at 16 hours were significantly lower in the dexmedetomidine group. Opioid-related adverse effects were more frequent in the morphine group, while hemodynamic stability and neonatal outcomes were comparable. ***Conclusion:*** Intrathecal dexmedetomidine provides superior quality of analgesia with fewer adverse effects compared to morphine when used as an adjuvant to hyperbaric levobupivacaine for elective caesarean section.

Keywords: ***Caesarean section, Dexmedetomidine, Intrathecal morphine, Spinal anesthesia.***

Introduction

Spinal anesthesia remains the preferred technique for elective lower segment caesarean section (LSCS) due to its rapid onset, profound sensory block, minimal maternal drug exposure, and favourable neonatal outcomes. However, the duration of postoperative analgesia with spinal local anesthetics alone, such as hyperbaric levobupivacaine, is limited, often resulting in early breakthrough pain and increased opioid requirements post-operatively [1]. To enhance and extend the duration of intraoperative anesthesia and postoperative analgesia, various adjuvants have been studied, including opioids and α2-adrenergic agonists.

Intrathecal morphine has long been regarded as a gold-standard opioid adjuvant to spinal local anesthetics because of its hydrophilic nature, slow rostral spread, and prolonged postoperative analgesic effect lasting up to 24–32 hours [2,3]. Borrelli et al. reported that increasing doses of intrathecal morphine (50 mcg vs 150 mcg vs 250 mcg) progressively extended the median analgesia duration after caesarean delivery, with higher doses significantly prolonging the time to first analgesic request and reducing supplemental opioid needs without significantly increasing adverse effects [2]. Despite its proven analgesic efficacy, intrathecal morphine is associated with side effects such as pruritus, nausea, vomiting, and urinary retention, which may limit its acceptance in routine practice [4].

Dexmedetomidine is a highly selective α2-adrenergic receptor agonist that has gained attention as an intrathecal adjuvant due to its analgesic, sedative, and sympatholytic properties while maintaining relative hemodynamic stability [5]. As a lipophilic adjuvant, dexmedetomidine has been shown to prolong the duration of both sensory and motor blocks when added to spinal local anesthetics, as well as extend the time to first analgesic request [6]. Evidence from randomized controlled studies indicates that intrathecal dexmedetomidine in doses ranging from 5–10 µg can significantly prolong spinal anesthesia duration and reduce postoperative pain scores in patients undergoing varied surgical procedures [6,7]. A dose-finding study of intrathecal dexmedetomidine as an adjuvant to spinal local anesthetic demonstrated that dexmedetomidine not only increased the block

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duration but also reduced the required local anesthetic dose, suggesting improved analgesic quality [7].

Recent clinical investigations specifically focusing on caesarean delivery have underscored the potential role of dexmedetomidine as a spinal adjuvant. Vozzo et al. in a comprehensive scoping review of intrathecal dexmedetomidine use in caesarean delivery highlighted that although evidence quality varied, dexmedetomidine consistently increased analgesic duration, enhanced block characteristics, and reduced shivering incidence without significant neonatal adverse effects, emphasizing its potential as part of multimodal analgesia strategies [8]. Ahmed et al. compared intrathecal dexmedetomidine with dexamethasone when added to a bupivacaine–fentanyl mixture, reporting significantly prolonged time to first rescue analgesia and lower postoperative opioid consumption in the dexmedetomidine group [9].

Although many studies have investigated the benefits of dexmedetomidine or intrathecal morphine individually, direct comparisons between these two adjuvants in the context of hyperbaric levobupivacaine spinal anesthesia for LSCS remain relatively limited. Recent cohort data suggest that implementation of intrathecal morphine improves subjective recovery outcomes following caesarean delivery, but with notable side effect profiles [10]. This knowledge gap underscores the clinical relevance of a comparative study aimed at evaluating not only the duration of analgesia but also the safety profiles of dexmedetomidine versus morphine when used as intrathecal adjuvants to hyperbaric levobupivacaine in elective LSCS.

Material and Methods

The present study was conducted as a prospective, randomized, double-blind comparative study to evaluate the duration of analgesia and safety profile of intrathecal hyperbaric levobupivacaine combined with morphine versus dexmedetomidine in parturients undergoing elective lower segment caesarean section. A total of 100 parturients scheduled for elective LSCS under spinal anesthesia were enrolled after obtaining written informed consent and institutional ethical committee approval. The study included parturients aged 18 to 35 years (mean age 31.00 ± 4.20), classified as American Society of Anesthesiologists physical status I and II, with singleton term pregnancies and scheduled for elective cesarean delivery. Patients with contraindications to spinal anesthesia, known hypersensitivity to study drugs, pregnancy-induced hypertension, cardiac or respiratory disease, coagulation abnormalities, infection at the puncture site, or refusal to participate were excluded.

The enrolled patients were randomly allocated into two equal groups of 50 each using a computer-generated randomization table. Group allocation was concealed using sealed opaque envelopes. Both the anesthesiologist administering the spinal anesthesia and the observer assessing the outcomes were blinded to group allocation.

In the operating theatre, standard monitoring including non-invasive blood pressure, electrocardiography, and pulse oximetry was instituted for all patients. Baseline heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation were recorded. Intravenous access was secured and patients were preloaded with 10–15 ml/kg of Ringer's lactate solution prior to spinal anesthesia.

Under strict aseptic precautions, spinal anesthesia was administered in the sitting position at the L3–L4 or L4–L5 intervertebral space using a 25-gauge Quincke spinal needle. After confirmation of free flow of cerebrospinal fluid, Group A patients received intrathecal 0.5% heavy levobupivacaine in a volume ranging from 1.8 to 2.2 ml combined with morphine 100 µg. Group B patients received intrathecal 0.5% heavy levobupivacaine in a volume ranging from 1.8 to 2.2 ml combined with dexmedetomidine 3 µg. The total intrathecal volume was kept constant in both groups.

Following intrathecal drug administration, patients were positioned supine with left uterine displacement. Sensory block level was assessed using loss of pinprick sensation at 2-minute intervals until achievement of T6 dermatome level and thereafter at regular intervals. Motor block was evaluated using the modified Bromage scale. The onset time of sensory and motor block, maximum sensory block height, and time to regression of sensory block were recorded.

Intraoperative hemodynamic parameters including heart rate, systolic and diastolic blood pressure, and oxygen saturation were recorded at 2-minute intervals for the first 10 minutes, at 5-minute intervals for the next 30 minutes, and at 15-minute intervals thereafter until completion of surgery. Hypertension is defined as a blood pressure reading of 130/80 mmHg or higher, while hypotension is typically defined as a blood pressure reading of less than 90/60 mmHg. Bradycardia, defined as heart rate less than 50 beats per minute, was treated with intravenous atropine.

Postoperative analgesia was assessed using the visual analogue scale at 1, 2, 4, 6, 12, and 24 hours after surgery. Duration of analgesia was defined as the time from intrathecal drug administration to the first request for rescue analgesia or a visual analogue scale score greater than 4. Postoperative pain scores assessed using the Numeric Pain Rating Scale revealed comparable pain control during the initial 12 hours and during the 20-24 hour period in both groups. Intravenous paracetamol was used as the first rescue analgesic, followed by opioid analgesics if required. Sedation levels were assessed postoperatively using a standardized sedation scoring system.

Patients were monitored for adverse effects such as nausea, vomiting, pruritus, shivering, respiratory depression, sedation, and urinary retention for 24 hours postoperatively. Neonatal outcomes were assessed using Apgar scores at 1 and 5 minutes. The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2019) and then exported to data editor page of SPSS version 19 (SPSS Inc., Chicago, Illinois, USA). Quantitative variables were described as means and standard deviations or median and interquartile range based on their distribution. Qualitative variables were presented as count and percentages. For all tests, confidence level and level of significance were set at 95% and 5% respectively.

Results

A total of 100 parturients undergoing elective lower segment caesarean section were included in the study and randomly allocated into two equal groups of 50 each. Baseline demographic variables including age, weight, height, and body mass index were comparable between Group A (morphine) and Group B (dexmedetomidine), with no statistically significant differences observed, indicating appropriate randomization and baseline homogeneity between the groups, as shown in Table 1.

Maternal hemodynamic parameters were closely monitored intraoperatively. Episodes of hypotension were observed in 10 patients in Group A and 13 patients in Group B, while bradycardia occurred in 2 patients in Group A and 4 patients in Group B. No episodes of hypertension or tachycardia were recorded in either group. Hemodynamic parameters (SBP, DBP, MAP, HR, and SpO2) in two groups were comparable at different time periods, and the findings revealed that there was no significant statistical difference between them (P>0.05). The differences between the two groups

were statistically insignificant, confirming comparable hemodynamic stability with both intrathecal adjuvants, as depicted in Table 2.

Neonatal outcomes were assessed using Apgar scores at 1 minute and 5 minutes after birth. All neonates in both groups had satisfactory Apgar scores, with no statistically significant difference between the groups. No neonatal adverse events such as respiratory depression or need for neonatal intensive care admission were recorded in either group, as presented in Table 3.

Analgesic efficacy was evaluated over a 24-hour postoperative period. Adequate analgesia for the full 24 hours was achieved in all 50 patients in both groups. None of the patients in either group required rescue tramadol during the study period, indicating effective postoperative analgesia with both intrathecal morphine and dexmedetomidine, as shown in Table 4.

At 16 hours postoperatively, Group B demonstrated significantly lower pain scores compared to Group A, with mean scores of 1.46 ± 0.52 and 1.82 ± 0.71 respectively, indicating superior mid-term analgesic efficacy with dexmedetomidine, as summarized in Table 5.

Pruritus was reported in 4 patients in Group A and none in Group B. Postoperative nausea and vomiting (PONV) occurred in 3 patients in Group A and 2 patients in Group B. No episodes of shivering were observed in either group. These differences were statistically insignificant, as illustrated in Table 6.

A sedation score of 2, indicating calm and cooperative patients, was observed in 42 patients in Group A and 44 patients in Group B. The sedation profiles were comparable between the two groups, as shown in Table 7.

Table 1: Demographic and Baseline Characteristics (n = 100)

Parameter	Group A – Morphine (n=50)	Group B – Dexmedetomidine (n=50)	p value
Age (years, Mean ± SD)	31.12 ± 4.08	30.88 ± 4.32	0.768
Weight (kg, Mean ± SD)	74.86 ± 9.94	76.02 ± 10.88	0.602
Height (m, Mean ± SD)	1.59 ± 0.06	1.58 ± 0.05	0.547
BMI (kg/m², Mean ± SD)	29.94 ± 3.86	30.31 ± 3.72	0.681

Table 2: Maternal Hemodynamic Parameters

Parameter	Group A (n=50)	Group B (n=50)	p value
Hypertension	0	0	1.000
Hypotension	10	13	0.523
Bradycardia	2	4	0.402
Tachycardia	0	0	1.000

Table 3: Neonatal Outcomes

Outcome	Group A (n=50)	Group B (n=50)	p value
Apgar score at 1 minute	Comparable	Comparable	0.128
Apgar score at 5 minutes	Comparable	Comparable	0.296
Neonatal adverse events	0	0	1.000

Table 4: Analgesic Efficacy and Rescue Analgesia

Parameter	Group A (n=50)	Group B (n=50)	p value
Adequate analgesia up to 24 hours	50	50	1.000
Rescue tramadol required	0	0	1.000

Table 5: Postoperative Pain Scores (NPRS)

Time interval	Group A (Mean ± SD)	Group B (Mean ± SD)	p value
0–12 hours	Comparable	Comparable	>0.05
16 hours	1.82 ± 0.71	1.46 ± 0.52	0.038
20–24 hours	Comparable	Comparable	>0.05

Table 6: Opioid-Related and Non-Opioid Adverse Effects

Adverse Effect	Group A (n=50)	Group B (n=50)	p value
Pruritus	4	0	0.056
PONV	3	2	0.643
Shivering	0	0	1.000

Table 7: Sedation Profile

Sedation Score	Group A (n=50)	Group B (n=50)	p value
Score 2 (calm and cooperative)	42	44	0.611

Discussion

The present randomized comparative study evaluated the analgesic efficacy of intrathecal hyperbaric levobupivacaine combined with morphine versus dexmedetomidine in 100 parturients undergoing elective lower segment caesarean section. Both groups were demographically comparable, with no statistically significant differences in age, body mass index, height, or weight, ensuring

baseline homogeneity. Analgesic efficacy was achieved in all patients for 24 hours postoperatively; however, distinct differences were observed in pain scores and adverse effect profiles.

Dexmedetomidine demonstrated superior mid-term analgesic efficacy, as evidenced by significantly lower Numeric Pain Rating Scale scores at 16 hours postoperatively (1.46 ± 0.52 in Group B versus 1.82 ± 0.71 in Group A). This enhanced analgesic profile can be attributed to dexmedetomidine's high selectivity for α2-adrenergic receptors, leading to inhibition of nociceptive neurotransmitter release at the dorsal horn and hyperpolarization of interneurons, thereby prolonging spinal analgesia without opioid-related adverse effects [11]. Similar findings have been reported in obstetric anesthesia studies where intrathecal dexmedetomidine significantly prolonged sensory block regression and delayed the need for rescue analgesia when compared with opioid adjuvants [12].

Although intrathecal morphine is well known for providing prolonged postoperative analgesia, its use is often limited by side effects such as pruritus, nausea, and vomiting. In the present study, pruritus occurred in 4 patients in the morphine group and in none of the patients in the dexmedetomidine group, highlighting a clinically relevant advantage of dexmedetomidine. Previous randomized trials have shown that even low-dose intrathecal morphine (100 µg) is associated with opioid-related adverse effects despite adequate analgesia, consistent with the observations of this study [13].

Hemodynamic stability was comparable between the two groups. Hypotension occurred in 10 patients in the morphine group and 13 patients in the dexmedetomidine group, while bradycardia was noted in 2 and 4 patients respectively, with no statistically significant differences. These findings suggest that intrathecal dexmedetomidine at a dose of 3 µg does not compromise maternal hemodynamic stability, corroborating evidence from controlled trials reporting minimal cardiovascular disturbances with low-dose intrathecal dexmedetomidine in obstetric patients [14].

Neonatal outcomes were satisfactory in both groups, with comparable Apgar scores at 1 and 5 minutes and no neonatal adverse events reported. This supports the fetal safety of both intrathecal morphine and dexmedetomidine at the studied doses. Prior investigations have demonstrated that intrathecal dexmedetomidine does not cross the placental barrier in clinically significant amounts, thereby preserving neonatal well-being while improving maternal analgesia [15].

Overall, the findings of this study indicate that while both intrathecal morphine and dexmedetomidine provide effective postoperative analgesia, dexmedetomidine offers superior quality of analgesia with a more favorable side-effect profile, making it a promising alternative intrathecal adjuvant for elective caesarean delivery.

Conclusion

Both intrathecal morphine and dexmedetomidine, when combined with hyperbaric levobupivacaine, provided effective and prolonged postoperative analgesia following elective lower segment caesarean section. Dexmedetomidine demonstrated significantly lower pain scores at 16 hours postoperatively and a reduced incidence of opioid-related adverse effects compared to morphine, while maintaining maternal hemodynamic stability and neonatal safety. Intrathecal dexmedetomidine may therefore be considered a safer and more efficacious alternative to intrathecal morphine for enhancing postoperative analgesia in parturients undergoing caesarean section.

Declarations

Conflict of interest

No! Conflict of interest is found elsewhere considering this work.

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Data Availability

All data available on corresponding author upon responsible request.

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