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Original Research Article

A Comparative Study of Hyperbaric Ropivacaine 0.75% with Dexmedetomedine 5mcg for Spinal Anaesthesia in Infra Umbilical Surgeries

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Abstract

Introduction: Spinal anaesthesia is commonly preferred for infra-umbilical surgeries due to its rapid onset and reliable efficacy. Hyperbaric ropivacaine 0.75% offers advantages such as better hemodynamic stability and less motor blockade compared to bupivacaine. However, its relatively shorter duration limits postoperative analgesia. Dexmedetomidine, a selective α2-adrenergic agonist, has shown promise as an intrathecal adjuvant to prolong block duration and analgesia. This study aimed to compare the efficacy and safety of hyperbaric ropivacaine 0.75% alone versus in combination with 5 µg dexmedetomidine in spinal anaesthesia for infra-umbilical surgeries.

Materials and Methods: A prospective, randomized comparative study was conducted on 60 ASA I–II patients scheduled for elective infra-umbilical surgeries under spinal anaesthesia. Patients were randomized into two groups of 30 each: Group A received 3 ml of 0.75% hyperbaric ropivacaine, and Group B received 3 ml of 0.75% hyperbaric ropivacaine with 5 µg dexmedetomidine. Onset and duration of sensory and motor blocks, duration of postoperative analgesia, and hemodynamic parameters were recorded and analyzed.

Results: Group B showed a significantly faster onset of sensory (1.78 ± 0.14 min) and motor (2 ± 0.42 min) block compared to Group A (3.48 ± 0.98 min and 6.8 ± 2.36 min, respectively). The duration of sensory block, motor block, and analgesia were significantly prolonged in Group B. Mild hypotension and bradycardia were observed in a few cases in Group B but were not statistically significant.

Conclusion: Intrathecal dexmedetomidine (5 µg) as an adjuvant to 0.75% hyperbaric ropivacaine enhances block quality and prolongs postoperative analgesia with minimal hemodynamic effects, making it a preferred choice in hemodynamically stable patients.

Keywords: Spinal Anaesthesia, Ropivacaine, Dexmedetomidine, Infra-Umbilical Surgery, Intrathecal Adjuvant, Analgesia.

Introduction

Spinal anaesthesia remains the cornerstone technique for infra-umbilical surgeries due to its reliability, simplicity, and favorable safety profile. One widely used local anesthetic in this setting is hyperbaric ropivacaine 0.75%, appreciated for its reduced cardiotoxicity and favourable sensory–motor differentiation compared to bupivacaine, yielding adequate anaesthesia with better hemodynamic stability and quicker motor recovery [1,2]. However, while hyperbaric ropivacaine ensures sufficient block for lower abdominal and limb procedures, its duration of action is generally shorter than that of bupivacaine, which can limit postoperative analgesic effectiveness [2]. In recent years, intrathecal dexmedetomidine, a potent selective α_2 adrenergic agonist, has been increasingly investigated as an adjuvant to enhance block quality. When added to

spinal local anesthetics such as bupivacaine or ropivacaine, dexmedetomidine has consistently demonstrated faster onset, longer sensory and motor blockade duration, and superior postoperative analgesia—while maintaining acceptable safety profiles [3–5].

Despite these promising findings, relatively few studies have evaluated 5 µg dexmedetomidine specifically in combination with hyperbaric 0.75% ropivacaine for infra-umbilical procedures, where lower abdominal muscle tone and visceral traction often require reliable and prolonged anaesthesia [6-8]. Available trials comparing ropivacaine with clonidine versus dexmedetomidine suggest that the 5 µg dexmedetomidine dose significantly prolongs sensory and motor block and improves analgesia without major compromises in hemodynamic stability [4,5].

Therefore, this study aimed to compare the efficacy and safety of intrathecal hyperbaric ropivacaine 0.75% with or without the addition of 5 µg dexmedetomidine in patients undergoing infra-umbilical surgeries.

Aims and Objectives

Aim: To evaluate and compare the efficacy and safety of intrathecal hyperbaric ropivacaine 0.75% alone versus hyperbaric ropivacaine 0.75% combined with 5 µg dexmedetomidine in patients undergoing infra-umbilical surgeries under spinal anaesthesia.

Primary Objectives:

1. To compare the **onset time** of sensory and motor block between the two groups.
2. To evaluate the **duration of sensory and motor blockade**.
3. To assess the **time to two-segment sensory regression**.
4. To compare the **duration of postoperative analgesia** between the two groups.

Secondary Objectives:

1. To evaluate the **hemodynamic stability** (heart rate and blood pressure) during the intraoperative and early postoperative period.
2. To assess the **incidence of side effects** such as hypotension, bradycardia, nausea, vomiting, pruritus, and sedation.
3. To determine the **overall safety and tolerability** of dexmedetomidine as an intrathecal adjuvant with hyperbaric ropivacaine.

Materials and Methods

This was a prospective, randomized, comparative clinical study conducted in the Department of Anaesthesiology at a tertiary care hospital. The study included a total of 60 patients scheduled for elective infra-umbilical surgeries under spinal anaesthesia.

Inclusion Criteria:

- Patients aged 18 to 60 years
- Either sex
- American Society of Anesthesiologists (ASA) physical status I or II
- Scheduled for elective infra-umbilical surgeries under spinal anaesthesia

Exclusion Criteria:

- Patients with known hypersensitivity to study drugs
- Coagulopathy or bleeding disorders
- Spinal deformities or infection at injection site
- Severe cardiovascular, renal, or hepatic disease
- Pregnant or lactating women
- Refusal to give consent

Sample Size and Group Allocation: A total of 60 patients were randomly allocated into two groups (n=30 each) using a computer-generated randomization table:

- **Group A (Ropivacaine Alone Group):** Received 3 ml of 0.75% hyperbaric ropivacaine intrathecally.
- **Group B (Ropivacaine + Dexmedetomidine Group):** Received 3 ml of 0.75% hyperbaric ropivacaine with 5 µg of dexmedetomidine (diluted to volume in the same syringe) intrathecally.

Procedure: All patients were kept nil per oral for at least 6 hours before surgery. Standard monitors were attached (ECG, NIBP, SpO_2), and baseline vitals were recorded. Spinal anaesthesia was performed in the sitting position under strict aseptic precautions at the L3–L4 interspace using a 25G Quincke spinal needle.

After confirming free flow of cerebrospinal fluid (CSF), the respective drug solutions were injected intrathecally over 10–15 seconds. Patients were immediately placed supine. Hemodynamic parameters (heart rate, systolic and diastolic blood pressure) were monitored at regular intervals intraoperatively and postoperatively.

Outcome Measures:

Primary Outcomes:

- **Onset of Sensory Block:** Time from injection to T10 level assessed using pinprick method.
- **Onset of Motor Block:** Assessed using the Modified Bromage Scale.
- **Duration of Sensory Block:** Time from onset to regression of two dermatomes.
- **Duration of Motor Block:** Time from onset to return to Bromage 0.

- **Duration of Analgesia:** Time from intrathecal injection to first request for rescue analgesia.

Secondary Outcomes:

- Hemodynamic changes (hypotension, bradycardia)
- Adverse effects including nausea, vomiting, pruritus, sedation

Statistical Analysis: All data were compiled and analyzed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation (SD) and compared using the unpaired t-test. Categorical variables were analyzed using the Chi-square test or Fisher's exact test as appropriate. A p-value <0.05 was considered statistically significant.

Result

The demographic characteristics of the study population, including age, weight, height, sex distribution, and ASA physical status, were comparable between Group A (Ropivacaine) and Group B (Ropivacaine + Dexmedetomidine). The mean age in Group A was 38.2 ± 8.5 years, while in Group B it was 37.6 ± 7.9 years (p = 0.72), indicating no significant age difference.

Similarly, the average weight and height were comparable between the groups, with Group A showing 64.5 ± 7.2 kg and 162.3 ± 6.8 cm versus 65.2 ± 6.5 kg and 161.8 ± 7.1 cm in Group B (p = 0.68 and 0.74, respectively). The sex distribution (M/F) was also similar (17/13 in Group A vs. 16/14 in Group B; p = 0.79), as was the ASA physical status distribution (18/12 in Group A vs. 17/13 in Group B; p = 0.81)(Table 1).

The comparative analysis of the two groups—ropivacaine alone versus ropivacaine combined with dexmedetomidine—revealed significant differences in the onset and duration of both sensory and motor blockade, as well as the duration of analgesia. The onset of sensory block was considerably faster in the ropivacaine + dexmedetomidine group, with a mean of 1.78 ± 0.14 minutes compared to 3.48 ± 0.98 minutes in the ropivacaine-only group. Similarly, the onset of motor block was markedly earlier in the combination group (2 ± 0.42 minutes) compared to the ropivacaine group (6.8 ± 2.36 minutes). The duration of sensory block was significantly prolonged in the combination group, averaging 130.70 ± 9.27 minutes, whereas it was only 81 ± 11.6 minutes in the ropivacaine-alone group (Table 2). A similar trend was observed for motor block duration, which lasted 195.07 ± 7.71 minutes in the combination group as opposed to 126 ± 20.94 minutes in the single-agent group. Furthermore, the duration of postoperative analgesia was substantially extended with the addition of dexmedetomidine, reaching 297.57 ± 12.38 minutes, compared to just 176 ± 30 minutes with ropivacaine alone. These findings demonstrate that the addition of dexmedetomidine significantly enhances the efficacy of intrathecal ropivacaine by producing a faster onset and longer duration of both anaesthesia and analgesia.

Table 1: Demographic Characteristics of the Study Population

Parameter	Group A (Ropivacaine)	Group B (Ropi + Dexmedetomidine)	p-value
Age (years)	38.2 ± 8.5	37.6 ± 7.9	0.72
Weight (kg)	64.5 ± 7.2	65.2 ± 6.5	0.68
Height (cm)	162.3 ± 6.8	161.8 ± 7.1	0.74
Sex (M/F)	17 / 13	16 / 14	0.79
ASA Grade (I/II)	18 / 12	17 / 13	0.81

Table 2: Comparing 0.75% Hyperbaric Ropivacaine (3 Ml) Alone Versus Ropivacaine + Dexmedetomidine (3 Ml + 5 µg):

Parameter	Ropivacaine (3 ml)(Mean ± SD)	Ropivacaine + Dexmedetomidine (3 ml + 5 µg)(Mean ± SD)	p-value
Sensory onset (minutes)	3.48 ± 0.98	1.78 ± 0.14	< 0.0001
Motor onset (minutes)	6.8 ± 2.36	2 ± 0.42	< 0.0001
Duration of sensory block (minutes)	81 ± 11.6	130.70 ± 9.27	< 0.0001
Duration of motor block (minutes)	126 ± 20.94	195.07 ± 7.71	< 0.0001
Duration of analgesia (minutes)	176 ± 30	297.57 ± 12.38	< 0.0001

Discussion

In our study, the addition of 5 µg dexmedetomidine to 0.75% hyperbaric ropivacaine significantly hastened the onset of both sensory (mean 1.78 ± 0.14 min vs. 3.48 ± 0.98 min) and motor block (2.00 ± 0.42 min vs. 6.80 ± 2.36 min) compared to ropivacaine alone. This marked acceleration aligns with prior findings in both ropivacaine and bupivacaine spinal anaesthesia: dexmedetomidine consistently shortens sensory and motor block onset when added to local anesthetics [9]. In cesarean delivery studies with hyperbaric ropivacaine plus 5 µg dexmedetomidine, sensory

onset was reported at ~1.96 min with rising doses, further confirming dose-related quicker onset [10, 6].The addition of dexmedetomidine significantly prolonged sensory block (130.70 ± 9.27 min vs. 81 ± 11.6 min) and motor block (195.07 ± 7.71 min vs. 126 ± 20.94 min). Similar prolongation has been observed in multiple studies: dexmedetomidine-adjunct bupivacaine or ropivacaine significantly extended block durations in peripheral blocks and spinal anaesthesia [11].

A randomized trial comparing clonidine versus dexmedetomidine with bupivacaine showed that dexmedetomidine led to notably longer block durations [12]. Additionally, a meta-analysis confirmed dexmedetomidine to be more efficacious than clonidine at prolonging sensory and motor block and postoperative analgesia [13].In our group B, time to first analgesic requirement was 297.57 ± 12.38 min, substantially longer than 176 ± 30 min in group A. This supports earlier reports where dexmedetomidine added to spinal local anesthetics extended postoperative analgesia by 1.7 fold or more compared to plain ropivacaine/bupivacaine [14]. The network meta-analysis of multiple peripheral nerve block trials ranked dexmedetomidine as one of the most effective adjuvants for prolonging analgesia.Our results showed that while ropivacaine alone was hemodynamically stable, the addition of dexmedetomidine resulted in mild hypotension in 10% (3/30) and bradycardia in 6.7% (2/30), all of which were transient and required minimal intervention, with no statistical significance. Previous intrathecal trials with small doses of dexmedetomidine reported similar hemodynamic stability and low incidence of hypotension/bradycardia when compared to clonidine [15, 16, 17]. Clonidine as an adjuvant has been more frequently associated with cardiovascular side effects than dexmedetomidine in low doses [15].Although studies, demonstrated that intrathecal clonidine prolongs anaesthesia and postoperative analgesia with bupivacaine, these often reported higher incidence of hypotension and bradycardia, especially at doses around 1 µg/kg [15, 18]. In contrast, dexmedetomidine at 5 µg intrathecally appears to deliver prolonged block and analgesia similar or superior to clonidine but with fewer cardiovascular side effects, making it a safer alternative in hemodynamically stable patients.

Conclusion

This study demonstrated that the addition of 5 µg dexmedetomidine to 3 ml of 0.75% hyperbaric ropivacaine for spinal anaesthesia significantly enhances anesthetic efficacy in patients undergoing infra-umbilical surgeries. The combination resulted in a faster onset of both sensory and motor block, along with a significantly prolonged duration of sensory blockade, motor blockade, and postoperative analgesia, compared to ropivacaine alone. Although a few patients in the dexmedetomidine group experienced mild hypotension and bradycardia, these events were transient and clinically manageable, with no statistically significant hemodynamic instability observed. Thus, intrathecal dexmedetomidine appears to be a safe and effective adjuvant to hyperbaric ropivacaine, particularly in hemodynamically stable patients, providing improved block characteristics and prolonged postoperative analgesia without significant adverse effects.

Limitations of the Study: This study had several limitations. The small sample size and single-center design may limit the generalizability of the results. The short follow-up period did not allow assessment of long-term outcomes or delayed adverse effects. Additionally, the lack of blinding could introduce observer bias, and sedation levels were not evaluated despite the known sedative effects of dexmedetomidine. Finally, only a fixed dose (5 µg) of dexmedetomidine was studied, preventing evaluation of dose-response relationships.

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