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Research Article

EFFECT OF DIFFERENT DOSES OF INTRATHECAL DEXMEDETOMIDINE AS AN ADJUVANT COMBINED WITH 0.75% HYPERBARIC ROPIVACAINE IN PATIENTS UNDERGOING LOWER ABDOMINAL AND LOWER LIMB SURGERIES

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Abstract:

Background: Spinal anaesthesia is widely used for lower abdominal and lower limb surgeries due to its rapid onset, effective sensory and motor blockade, haemodynamic stability, and cost-effectiveness. Ropivacaine, a safer alternative to bupivacaine, provides a favourable sensory-motor differential block but has a shorter duration of postoperative analgesia when used alone. Dexmedetomidine, an α2-adrenergic agonist, has emerged as a promising intrathecal adjuvant to enhance the quality and duration of spinal anaesthesia. Objective: To compare the clinical efficacy and safety of 0.75% hyperbaric ropivacaine alone and in combination with two different doses (5µg and10 µg) of intrathecal dexmedetomidine in patients undergoing lower abdominal and lower limb surgeries.

Methods: This prospective, interventional, comparative study was conducted on 90 patients (ASA I & II) aged 25–50 years undergoing elective lower abdominal and lower limb surgeries under spinal anaesthesia. Patients were divided into three groups:

- **Group R:** Ropivacaine alone
- **Group R5:**Ropivacaine+Dexmedetomidine 5µg
- **Group R10:**Ropivacaine+Dexmedetomidine 10µg

Parameters assessed included onset and duration of sensory and motor block, haemodynamic changes, postoperative analgesia (VAS score), and adverse effects.

Results: The demographic variables were comparable among all groups. The addition of dexmedetomidine significantly improved block characteristics and prolonged postoperative analgesia compared to ropivacaine alone. Both R5 and R10 groups showed better analgesic duration and block quality. Incidence of complications such as nausea, vomiting, bradycardia, and respiratory depression was low and statistically insignificant among groups, although mild bradycardia was observed in dexmedetomidine groups.

Conclusion: Intrathecal dexmedetomidine is an effective adjuvant to hyperbaric ropivacaine, significantly prolonging sensory and motor block duration and enhancing postoperative analgesia without major adverse effects. The 5 µg dose provides an optimal balance between efficacy and safety, while higher doses may increase the risk of haemodynamic changes.

Keywords: Spinal anaesthesia, Ropivacaine, Dexmedetomidine, Intrathecal adjuvant, Postoperative analgesia, Lower abdominal surgery, Lower limb surgery

INTRODUCTION

Among the various local anaesthetic agents available for spinal anaesthesia, bupivacaine has traditionally been the drug of choice because of its long duration of action and reliable block characteristics. However, concerns regarding its cardiotoxicity, neurotoxicity, and prolonged motor blockade have prompted the search for safer alternatives. Ropivacaine, a long-acting amide local anaesthetic and the pure S-enantiomer, was developed to overcome these limitations. It exhibits a favourable safety profile with reduced cardiotoxic and neurotoxic potential and produces a relatively selective sensory block with less intense and shorter motor blockade compared to bupivacaine, making it particularly suitable for surgeries requiring early ambulation and enhanced postoperative recovery [1].

Hyperbaric formulations of ropivacaine have been introduced to improve the predictability and consistency of spinal block characteristics. Hyperbaric ropivacaine provides better control over the spread of the drug in cerebrospinal fluid, resulting in faster onset, higher level of sensory blockade, and improved surgical conditions compared to isobaric solutions. Studies have demonstrated that hyperbaric ropivacaine produces effective anaesthesia for lower abdominal and lower limb surgeries with faster regression of motor block, allowing earlier mobilisation and discharge [2].

Despite these advantages, a significant limitation of intrathecal ropivacaine is its relatively shorter duration of post operative analgesia when used as asoleagent. This limitation often necessitates the use of additional systemic analgesics in the early postoperative period, which may be associated with adverse effects such as nausea, vomiting, sedation, and respiratory depression.

To address this issue, various intrathecal adjuvants have been investigated to enhance the quality and duration of spinal anaesthesia while minimising side effects. Commonly used adjuvants include opioids, clonidine, ketamine, neostigmine, and magnesium sulphate. However, opioid

adjuvants are associated with complications such as pruritus, nausea, vomiting, urinary retention, and respiratory depression, limiting their routine use [3].

When administered intrathecally, dexmedetomidine has been shown to prolong the duration of sensory and motor block, enhance block density, delay the need for rescue analgesia, and reduce postoperative analgesic requirements. Unlike opioids, it is associated with minimal incidence of pruritus, nausea, vomiting, or respiratory depression, making it a safer alternative as a spinal adjuvant. These properties have led to increasing interest in its use in combination with various local anaesthetics for spinal anaesthesia [4].

The combination of dexmedetomidine with ropivacaine has been explored in recent years with better results. Intrathecal dexmedetomidine added to ropivacaine has been shown to enhance block characteristics, increase the duration of analgesia, and improve patient satisfaction. However, the optimal dose of intrathecal dexmedetomidine when used as an adjuvant to hyperbaric ropivacaine remains a subject of ongoing research. Lower doses may provide inadequate prolongation of analgesia, while higher doses may increase the risk of adverse haemodynamic effects such as bradycardia and hypotension [5].

Given the increasing use of ropivacaine for spinal anaesthesia and the growing interest in dexmedetomidine as a spinal adjuvant, there is a need for clinical studies comparing different doses of intrathecal dexmedetomidine combined with hyperbaric ropivacaine. Such studies are essential to establish the optimal dose that provides maximum clinical benefit with minimal adverse effects. Evaluating block characteristics, haemodynamic stability, post operative analgesia, and side-effect profile will help guide anaesthesiologists in selecting safe anaesthetic technique for lower abdominal and lower limb surgeries [6].

Therefore, the present study has been undertaken to compare the effects of two different doses of intrathecal dexmedetomidine 5 µg and 10 µg as adjuvants to 0.75% hyperbaric ropivacaine in patients undergoing lower abdominal and lower limb surgeries.

MATERIAL AND METHODS

This prospective, hospital-based, interventional, comparativeclinicalstudy was conductedin the Department of Anaesthesiology, KHPIMS, Karnataka. Patients were recruited from the In-Patient Departments of General Surgery and Orthopaedics to evaluate the effects of different doses of intrathecal dexmedetomidine used as an adjuvant to 0.75% hyperbaric ropivacaine in patients undergoing lower abdominal and lower limb surgeries under spinal anaesthesia. The study compared three parallel groups of patients receiving either hyperbaric ropivacaine alone or hyperbaric ropivacaine combined with two different doses of dexmedetomidine. The interventional nature of the study allowed direct comparison of block characteristics, haemodynamic changes, postoperative analgesia, and adverse effects among the study groups under controlled clinical conditions. The study was conducted after obtaining clearance from the Institutional

Ethics Committee. The study was carried out over a period of 18 months, from June 2024 to November 2025.

Inclusion Criteria

The study included patients who fulfilled all of the following criteria:

1. Patients aged between 25 and 50 years.
2. Patients belonging to American Society of Anesthesiologists (ASA) physical status I and II.
3. Patients scheduled for elective infra-umbilical (lower abdominal) or lower limb surgeries under spinal anaesthesia.
4. Patients who provided written informed consent to participate in the study.

Exclusion Criteria

Patients were excluded from the study if they met any of the following criteria:

1. Presence of significant co-existing systemic illnesses such as uncontrolled hypertension, ischemic heart disease, respiratory disorders, renal or hepatic dysfunction.
2. Coagulation disorders or patients receiving anticoagulant or anti platelet therapy.
3. Anatomical abnormalities of the spine or conditions anticipated to cause difficulty in performing spinal anaesthesia.
4. Local infection at the site of lumbar puncture.
5. Known allergy or hypersensitivity to local anaesthetics or dexmedetomidine.
6. Obese patients, as per institutional criteria.
7. Patients unwilling to undergo spinal anaesthesia or those who refused consent.

Study Sampling

Patients were recruited using non-probability purposive sampling.

Study Sample Size

A total of 90 patients were included in the study. The sample consisted of three groups with 30 patients in each group. The sample size was considered adequate to compare the onset and duration of sensory and motor blockade, haemodynamic variables, postoperative analgesia, and adverse effects between the groups based on similar previously published studies and feasibility within the study duration.

1. Study Groups

The enrolled patients were divided in to three groups, each comprising 30 patients:

- **Group R:** Patients received 0.75% hyperbaric ropivacaine intrathecally at a dose of 0.4 mg/kg.
- **Group R5:** Patients received0.75% hyperbaric ropivacaine (0.4mg/kg) combined with dexmedetomidine 5 µg intrathecally.
- **Group R10:** Patients received 0.75% hyperbaric ropivacaine (0.4mg/kg) combined with dexmedetomidine 10 µg intrathecally.

2. Study Parameters

Primary Outcome Parameters

- Time of onset of sensory block (time to achieve T8 dermatome)

- Duration of sensory block
- Time of onset of motor block (time to achieve modified Bromage score 2)
- Duration of motor block
- Duration of post operative analgesia (time to first request for rescue analgesic)

Study Procedure

All patients underwent a detailed pre-anaesthetic evaluation including history, general and systemic examination, and review of routine investigations. Patients were kept nil per oral as per standard anaesthesia guidelines.

On arrival in the operating room, baseline vital parameters including pulse rate, blood pressure, respiratory rate and oxygen saturation were recorded. An intravenous line was secured using an appropriate gauge cannula, and standard monitoring comprising electrocardiography, non-invasive blood pressure and pulse oximetry was instituted.

Under strict aseptic precautions, spinal anaesthesia was administered in the sitting position using a standard midline approach at the L3–L4 or L4–L5 inter space with a suitable spinal needle. The study drug was injected intrathecally according to group allocation. Immediately after injection, patients were positioned supine. Sensory blockade was assessed using a pin-prick test with a hypodermic needle at 2, 4, 6, 8, 10, 12 and 15 minutes after intrathecal injection. Loss of sensation to pin-prick was considered as the onset of sensory block. The time taken to achieve sensory block up to the T8 dermatome was recorded as the onset of sensory block.

Motor blockade was assessed using the modified Bromage scale at the same time intervals. The time taken to achieve adequate motor block, defined as modified Bromage score 2, was recorded. Surgery was commenced only after achieving adequate sensory and motor blockade. Intra operative haemodynamic parameters were recorded at 1, 3, 5, 10, 15, 30, 45, 60, 75, 90 and 120 minutes following spinal anaesthesia. Any episode of hypotension, bradycardia or other adverse events was noted and managed according to standard institutional protocols.

Postoperatively, pain assessment was carried out using the Visual Analogue Scale (VAS) at 1, 2, 3, 4, 5, 6, 8, 10 and 12 hours. The time to first request for rescue analgesia was noted as the duration of postoperative analgesia.

Study Data Collection

All observations were recorded in a pre-designed and pre-validated case record form. Demographic details, surgical details, anaesthetic parameters, sensory and motor block characteristics, haemodynamic variables, postoperative pain scores, duration of analgesia and adverse events were systematically documented. Data collection was done by the investigator to ensure uniformity and completeness of records.

Statistical Analysis

The collected data were entered into Microsoft Excel and analysed using Statistical Package for Social Sciences (SPSS) version 21. Continuous variables were expressed as mean and standard deviation, while categorical variables were

expressed as frequencies and percentages. Comparison of continuous variables among the three groups was performed using one-way analysis of variance (ANOVA), and post-hoc tests were applied where appropriate. Categorical variables were analysed using Chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

RESULTS

The distribution of age groups was comparable across the three study groups. In Group R, 43.3% of participants were aged 25–35 years and 56.7% were aged 35–50 years. In Group R5, 53.3% were aged 25–35 years and 46.7% were aged 35–50 years, while in Group R10, the majority (70.0%) were aged 35–50 years. However, the difference in age distribution among the groups was not statisticaly significant (χ^2 = 3.370, p = 0.185).

Table 1: Distribution of Diagnosis among Study Groups

Diagnosis	GroupR (n=30)	GroupR5 (n=30)	GroupR10 (n=30)	Total (N=90)
Appendicitis	2 (6.7%)	4 (13.3%)	9 (30.0%)	15 (16.7%)
Femur fracture	7 (23.3%)	4 (13.3%)	7 (23.3%)	18 (20.0%)
Inguinalhernia	7 (23.3%)	5 (16.7%)	4 (13.3%)	16 (17.8%)
ITfracture	9 (30.0%)	9 (30.0%)	6 (20.0%)	24 (26.7%)
Tibiafracture	5 (16.7%)	8 (26.7%)	4 (13.3%)	17 (18.9%)
Total	30 (100%)	30 (100%)	30 (100%)	90 (100%)
Chi-square=9.354,df =8,p=0.313				

The distribution of surgical diagnoses was similar across the three study groups. IT fracture surgery was the most common diagnosis overall (26.7%), followed by femur fracture (20.0%) and tibia fracture (18.9%). Appendicitis accounted for (16.7%) of total cases, while inguinal hernia constituted (17.8%). Although some variation infrequencies were observed among the groups, the difference in diagnosis distribution was not statistically significant (χ^2 = 9.354, p = 0.313).

Table 2: Incidence of Nausea and Vomiting Among Study Groups

Nausea/Vomiting	Group R (n=30)	Group R5 (n=30)	Group R10 (n=30)	Total (N=90)
No	28 (93.3%)	29 (96.7%)	28 (93.3%)	85 (94.4%)
Yes	2 (6.7%)	1 (3.3%)	2 (6.7%)	5 (5.6%)
Total	30 (100%)	30 (100%)	30 (100%)	90 (100%)

Chi-square=0.424,df =2,p=0.809

The incidence of nausea and vomiting was low across all study groups. The majority of patients did not experience nausea or vomiting, accounting for 93.3% in Group R, 96.7% in Group R5, and 93.3% in Group R10. Only a small proportion of patients reported these symptoms. The difference in the occurrence of nausea and vomiting among the groups was not statistically significant ($\chi^2 = 0.424$, $p = 0.809$).

The occurrence of bradycardia was low across the study groups. None of the patients in Group R developed bradycardia, whereas 10.0% of patients in both Group R5 and Group R10 experienced bradycardia. The majority of participants in all groups did not develop bradycardia. However, the difference in incidence among the groups was not statistically significant ($\chi^2 = 3.214$, $p = 0.200$).

Blood vessel puncture was infrequent across the study groups. The majority of patients did not experience this complication, accounting for 93.3% in Group R, 90.0% in Group R5, and 100.0% in Group R10. Only a small proportion of patients in Group R (6.7%) and Group R5 (10.0%) experienced blood vessel puncture. However, the difference among the groups was not statistically significant ($\chi^2 = 2.965$, $p = 0.227$).

Table 3: Incidence of Respiratory Depression among Study Groups

Respiratory depression	GroupR (n=30)	GroupR5 (n=30)	GroupR10 (n=30)	Total (N=90)
No	30 (100.0%)	30 (100.0%)	29 (96.7%)	89 (98.9%)
Yes	0 (0.0%)	0 (0.0%)	1 (3.3%)	1 (1.1%)
Total	30 (100%)	30 (100%)	30 (100%)	90 (100%)
Chi-square=2.022,df =2,p=0.364				

Respiratory depression was a rare complication in the study population. None of the patients in Group R and Group R5 developed respiratory depression, while only one patient (3.3%) in Group R10 experienced this complication. Overall, 98.9% of participant's did not develop respiratory depression. The difference in incidence among the three groups was not statistically significant ($\chi^2 = 2.022$, $p = 0.364$).

Table 4: Comparison of age and weight

Group	n	Age(years)Mean±SD	Weight (kg)Mean±SD
R	30	36.87 ±7.32	70.37 ±8.77
R5	30	36.10 ±6.89	67.97 ±8.82
R10	30	37.77 ±6.51	71.87 ±9.03
p value		0.648	0.235

The mean age and body weight were comparable among all three groups. There was no statistically significant difference in age or weight distribution between the groups, indicating that the study population was demographically well matched. This homogeneity ensures that demographic variables did not influence the anesthetic outcomes. The absence of baseline differences strengthens the internal validity of the study. Therefore, any observed differences in block characteristics and analgesia can be attributed to the study drugs.

Baseline laboratory parameters were comparable among all three groups. No statistically significant differences were observed in temperature, hemoglobin level, total leukocyte count, or clotting time. Bleeding time showed a statistically significant difference; however, all values remained within normal physiological limits and were clinically insignificant. Thesefindings confirm that the studygroupswere well matchedat baseline. Hence, laboratory variables did not confound the study results.

Table 5: Sensory and Motor Block Characteristics

Parameter	R	R5	R10	p value
Sensoryonset (min)	7.60 ±1.07	4.07 ±0.74	3.83 ±0.79	<0.001
Motoronset (min)	9.50 ±1.11	5.03 ±0.77	4.83 ±0.79	
Sensory duration (hrs)	3.12 ±0.52	4.99 ±0.62	4.97 ±0.70	
Motor duration (hrs)	2.33 ±0.42	4.00 ±0.59	4.01 ±0.59	

The onset of both sensory and motor block was significantly faster in the dexmedetomidine groups compared to ropivacaine alone. Group R10 demonstrated the fastest onset, followed closely by Group R5, whereas Group R showed delayed onset. The duration of both sensory and motor block was significantly prolonged in dexmedetomidine groups. These findings demonstrate a clear dose-dependent enhancement of block characteristics. Dexmedetomidine significantly improves block quality when used intrathecally.

Table 6: Intraoperative Haemodynamic Parameters at Baseline (0min)

Parameter	R	R5	R10	p value
Pulse(bpm)	71.8 ±8.8	77.8 ±11.6	74.7 ±11.0	0.094
SBP(mmHg)	118.4 ±10.2	117.4 ±7.4	118.0 ±8.7	0.906
DBP(mmHg)	78.0 ±6.8	74.6 ±7.2	76.8 ±6.9	0.153
RR (breaths/min)	16.0 ±2.3	15.1 ±2.3	16.0 ±2.3	0.252
SpO_2 (%)	97.3 ±1.1	97.8 ±1.1	97.4 ±1.2	0.161

Baseline haemodynamic parameters were comparable among all three groups. There were no statistically significant differences in heart rate, blood pressure, respiratory rate and oxygen saturation. All patients were haemodynamically stable prior to spinal anesthesia. This confirms that baseline cardiovascular status did not influence study outcomes. The

comparable haemodynamic profile supports the safety of intrathecal dexmedetomidine.

The duration of surgery was comparable among all three groups. No statistically significant difference was observed in operative time. This indicates uniformity in surgical complexity and procedure duration. Hence, surgeryduration did not influence block characteristics or analgesic outcomes. The comparability further validates the study design.

Table 7: Comparison of Postoperative VAS Scores Between Group R and Group R10

Time	GroupR(n=30) Mean ± SD	GroupR5(n=30) Mean ± SD	GroupR10(n=30) Mean ± SD	p-value
1 hr	0.50 ±0.51	0.53 ±0.51	0.60 ±0.50	0.738
2 hr	1.67 ±0.48	1.67 ±0.48	1.33 ±0.48	0.010*
3 hr	2.13 ±0.82	1.77 ±0.90	1.77 ±0.86	0.168
4 hr	2.93 ±0.83	1.50 ±0.51	1.60 ±0.50	<0.001*
5 hr	2.90 ±0.85	1.40 ±0.50	1.47 ±0.51	<0.001*
6 hr	3.97 ±0.85	1.67 ±0.48	1.40 ±0.50	<0.001*
8 hr	4.97 ±0.85	2.60 ±0.50	2.50 ±0.51	<0.001*
10 hr	4.90 ±0.89	2.43 ±0.50	2.43 ±0.50	<0.001*
12 hr	6.00 ±0.87	2.43 ±0.50	2.53 ±0.51	<0.001*

VAS scores were comparable at 1 and 3 hours among all groups. From 2 hours onward, significantly lower pain scores were observed in dexmedetomidine groups (R5 and R10) compared to Group R. Group R showed progressively increasing pain overtime, while R5 and R10 maintained lower values. Overall, dexmedetomidine provided significantly better postoperative analgesia**.**

The duration of postoperative analgesia was significantly prolonged in the dexmedetomidine groups. Group R10 and R5 demonstrated nearly double the duration of analgesia compared to Group R. The difference among the groups was highlystatistically significant. This prolonged analgesic effect reduces the requirement for rescue analgesics. These findings strongly support dexmedetomidine as an effective intrathecal adjuvant.

DISCUSSION

The study is important not only for its scientific contribution but also for its practical value in guiding safe rand more effective perioperative anesthetic management.

The present study showed that the three groups were demographically comparable, which supports the validity of outcome comparison. Mean age was 36.87 ± 7.32 years in Group R, 36.10 ± 6.89 years in Group R5, and 37.77 ± 6.51 years in Group R10, with no statistically significant difference(p=0.648).In comparison,

Farokhmehr et al. enrolled 90 lower-limb orthopedic patients and used randomized group allocation to evaluate graded dexmedetomidine doses with ropivacaine, while Bietal. studied 120 parturients and Modir et al. studied 90 women under a similar randomized design, both ensuring baseline comparability before block assessment [7,8,9].

The diagnosis profile in the present study was also well balanced across the three groups, reducing the possibility that one group had a systematically more painful or technically different surgical population.

Baseline temperature, hemoglobin, total leukocyte count, and clotting time also remained statistically comparable, with only bleeding time showing significance ($p = 0.012$) despite values remaining within clinically acceptable limits. This indicates that the improved anesthetic performance in dexmedetomidine groups reflects a pharmacologic effect rather than preoperative imbalance. In comparison, Karmadi similarly studied elective lower-limb orthopedic surgeries and reported improved anesthetic quality after adding 5 µg dexmedetomidine to ropivacaine in a clinically comparable patient sample [10].

A striking observation in the present study was the significant acceleration in sensory block onset after addition of intrathecal dexmedetomidine. In comparison, Bietal. Documented that adding 2.5, 5, and 7.5 µg dexmedetomidine to 12 mg of 0.75% hyperbaric ropivacaine shortened onset time and improved surgical readiness, especially in the 5 µg and 7.5µg groups [84]. Modiret al.like wise reported faster sensory onset with 2.5–7.5 µg dexmedetomidine added to ropivacaine, with 5 µg offering the best efficacy–stability balance [9].

The effect of dexmedetomidine on motor block onset in the present study paralleled the sensory findings and further confirmed its ability to enhance spinal anesthesia quality. Mean motor onset was 9.50±1.11 minutes in Group R, where as it was significantly shorter in Group R5 (5.03 ± 0.77 minutes) and Group R10 (4.83 ± 0.79 minutes), with $p < 0.001$. Thus, dexmedetomidine nearly halved the time required for effective motor block. Such earlier attainment of surgical block may improve operating-room efficiency and reduce delay between spinal injection and incision. The very small difference between R5 and R10 again implies that increasing the dose from 5 µg to 10 µg may provide little additional clinical advantage. In comparison, Farokhmehr et al. reported that graded intrathecal dexmedetomidine doses of 0.25, 0.5, and 0.75 µg/kg enhanced sensory–motor block characteristics with ropivacaine, while recommending the intermediate dose as the most suitable because it balanced efficacy with hemodynamic stability [7].

The prolongation of sensory block in the present study was clinically substantial. Group R had a sensory block duration of 3.12 ± 0.52 hours, where as Group R5 and Group R10 had durations of 4.99±0.62 hours and 4.97±0.70 hours respectively, with a highly significant difference ($p<0.001$).This indicates that dexmedetomidine prolonged sensory anesthesia by nearly 1.9 hours over ropivacaine alone. Interestingly, the duration was virtually identical in the 5 µg and 10 µg groups, suggesting that the prolonging effect may plateau beyond 5 µg. In comparison, Farokhmehr et al.

found that increasing dexmedetomidine doses significantly prolonged sensory block and delayed first analgesic request, although higher doses were associated with mild bradycardia and hypotension [7].

Motor block duration in the present study was also markedly prolonged by dexmedetomidine. In comparison, Bi et al. observed dose-dependent prolongation of both sensory and motor blockade with 2.5–7.5 μg dexmedetomidine plus hyperbaric ropivacaine, especially in the 5 μg and 7.5 μg groups [8].

Hemodynamic stability remained largely preserved in the present study despite the addition of dexmedetomidine. In comparison, Farokhmehr et al. reported that higher doses of intrathecal dexmedetomidine caused mild bradycardia and hypotension, but these were clinically manageable, and the 0.5μg/kg dose showed the best efficacy–safety profile [7].

Respiratory parameters remained reassuringly stable in the present study, supporting the safety of dexmedetomidine in low intrathecal doses. In comparison, Zhang et al. found that intrathecal 5μg dexmedetomidine with 12 mg of 0.75% ropivacaine improved anesthesia quality and postoperative analgesia without causing maternal respiratory compromise or adverse fetal effects during cesarean section [11].

The incidence of adverse effects in the present study was low and comparable across groups, indicating a favorable safety profile. In comparison, Farokhmehr et al. reported mild bradycardia and hypotension at higher dexmedetomidine doses, but the changes were clinically manageable [7].

CONCLUSION

Intrathecal dexmedetomidine is a valuable non-opioid adjuvant to 0.75% hyperbaric ropivacaine for spinal anesthesia in lower abdominal and lower limb surgeries. It significantlyimproves block characteristics, prolongs anesthetic effect, and maintains a favorable safety profile. Among the tested doses, 5 μg appears to be the optimal dose because it provides near-maximal efficacy without any clear additional advantage from dose escalation to 10 μg.

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