



Original Article

A Comparative Study between Intrathecal Bupivacaine with Dexmedetomidine and Intrathecal Bupivacaine with Buprenorphine for Post-operative Analgesia in Lower Abdominal Surgery

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OPEN ACCESS

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Received: 14-10-2025

Accepted: 29-10-2025

Available online: 16-11-2025

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ABSTRACT

Background: Effective management of postoperative pain following lower abdominal surgeries remains a key component of perioperative care. Spinal anesthesia with bupivacaine provides satisfactory surgical anesthesia but limited postoperative analgesia. The search for optimal adjuvants to prolong analgesia with minimal side effects has led to evaluation of dexmedetomidine and buprenorphine.

Aim: To compare the onset and duration of sensory and motor block, duration of postoperative analgesia, and hemodynamic stability between intrathecal bupivacaine with dexmedetomidine and bupivacaine with buprenorphine in patients undergoing lower abdominal surgeries.

Methods: Sixty adult patients (ASA I–II, aged 20–60 years) scheduled for elective lower abdominal surgeries were randomly allocated into two groups (n=30 each). Group D received 15 mg of 0.5% hyperbaric bupivacaine with 5 µg dexmedetomidine, while Group B received 15 mg bupivacaine with 60 µg buprenorphine intrathecally. Hemodynamic parameters, onset and regression times, duration of analgesia, and side effects were recorded and statistically analyzed.

Results: The mean duration of postoperative analgesia was significantly longer in Group D (12.5 ± 2.3 h) than Group B (9.0 ± 1.5 h; p<0.001). The onset times of sensory and motor block were comparable. Hemodynamic parameters remained stable in both groups, with mild sedation in Group D being beneficial. Adverse effects were minimal in both groups.

Conclusion: Intrathecal dexmedetomidine (5 µg) as an adjuvant to bupivacaine provides longer postoperative analgesia than buprenorphine (60 µg) without significant hemodynamic compromise or adverse events.

Keywords: Spinal anesthesia, Dexmedetomidine, Buprenorphine, Bupivacaine, Postoperative analgesia.

INTRODUCTION

Pain after surgery is an expected but undesirable component of the postoperative period. Uncontrolled pain may lead to sympathetic activation, increased myocardial oxygen consumption, delayed recovery, and prolonged hospital stay. Effective postoperative analgesia thus enhances patient comfort, facilitates early ambulation, and decreases morbidity.

Spinal anesthesia using hyperbaric bupivacaine is one of the most common anesthetic techniques for infraumbilical and lower abdominal surgeries due to its rapid onset, dense block, and minimal systemic drug exposure. However, the duration of postoperative analgesia is limited to approximately 2–4 hours. To overcome this limitation, various adjuvants have been evaluated to prolong the duration and improve the quality of anesthesia and postoperative pain control.

Dexmedetomidine, a highly selective α_2 -adrenoceptor agonist, produces analgesia by acting on both spinal and

supraspinal sites, reducing sympathetic outflow and enhancing inhibitory pain pathways. It also exhibits sedative and anxiolytic properties without significant respiratory depression. Buprenorphine, a semi-synthetic opioid, acts as a partial μ -opioid receptor agonist and κ -antagonist. Its lipid solubility enables easy diffusion into the spinal cord, resulting in prolonged analgesia.

Although both agents have shown promising results, few comparative studies have directly evaluated their efficacy and safety when combined with intrathecal bupivacaine. This study aims to compare the onset and duration of sensory and motor blockade, duration of analgesia, hemodynamic effects, and adverse events associated with intrathecal dexmedetomidine versus buprenorphine as adjuvants to bupivacaine in lower abdominal surgeries.

MATERIALS AND METHODS

This prospective, randomized, comparative study was conducted in the Department of Anaesthesiology, Government Medical College, Thrissur, after obtaining Institutional Ethics Committee approval and written informed consent from all participants.

Inclusion criteria included ASA physical status I and II patients, aged 20–60 years, undergoing elective lower abdominal surgeries. Exclusion criteria included patients with spinal deformities, coagulopathies, systemic diseases affecting hemodynamic stability, allergy to study drugs, and refusal to participate.

Patients were randomized into two groups using a computer-generated randomization sequence:

- Group D: 15 mg (3 mL) of 0.5% hyperbaric bupivacaine + 5 μ g (0.5 mL) dexmedetomidine.
- Group B: 15 mg (3 mL) of 0.5% hyperbaric bupivacaine + 60 μ g (0.2 mL) buprenorphine + 0.3 mL normal saline.

All patients received standard premedication with midazolam 0.02 mg/kg IV and were hydrated with 500 mL Ringer lactate before spinal anesthesia. Under aseptic precautions, spinal anesthesia was performed at L3–L4 interspace using a 25G Quincke needle. Following intrathecal injection, patients were positioned supine.

Hemodynamic parameters (heart rate, systolic and diastolic blood pressure, mean arterial pressure, oxygen saturation) were monitored at baseline and at 5-minute intervals for 30 minutes, then every 15 minutes intraoperatively and hourly postoperatively for 6 hours. Onset and regression of sensory block were assessed using pinprick method, and motor block was graded using the Modified Bromage Scale. Pain intensity was assessed by the Visual Analogue Scale (VAS: 0–10). The time to first rescue analgesia (VAS >3) was recorded.

Adverse effects such as bradycardia, hypotension, nausea, vomiting, pruritus, sedation, and respiratory depression were noted. Statistical analysis was performed using SPSS software. Student's t-test was applied for continuous variables, Chi-square for categorical variables, and $p < 0.05$ was considered statistically significant.

RESULTS

Demographic parameters such as age, sex, body mass index (BMI), and ASA physical status were comparable between both groups ($p > 0.05$), ensuring homogeneity.

The mean onset of sensory block at T10 level was 2.5 ± 0.8 minutes in Group D and 2.8 ± 1.0 minutes in Group B ($p = 0.23$). The onset of motor block (Bromage 3) occurred at 4.2 ± 1.1 minutes in Group D and 4.5 ± 1.2 minutes in Group B ($p = 0.18$). Thus, the onset of anesthesia was statistically comparable.

The duration of sensory block regression to S2 was significantly longer in Group D (210 ± 25 minutes) compared to Group B (170 ± 20 minutes; $p < 0.001$). The duration of effective analgesia, defined as the time from intrathecal injection to first rescue analgesic, was 12.5 ± 2.3 hours in Group D versus 9.0 ± 1.5 hours in Group B ($p < 0.001$).

Hemodynamic parameters including heart rate and mean arterial pressure were stable throughout the intraoperative period in both groups. Minor bradycardia was observed in two patients in Group D and managed with atropine. Sedation score was higher in Group D but within safe limits. No cases of respiratory depression were reported.

Postoperative nausea and vomiting were reported in three patients in Group B and one in Group D. Pruritus was more common in the buprenorphine group. No neurological complications or urinary retention were noted.

FIGURES

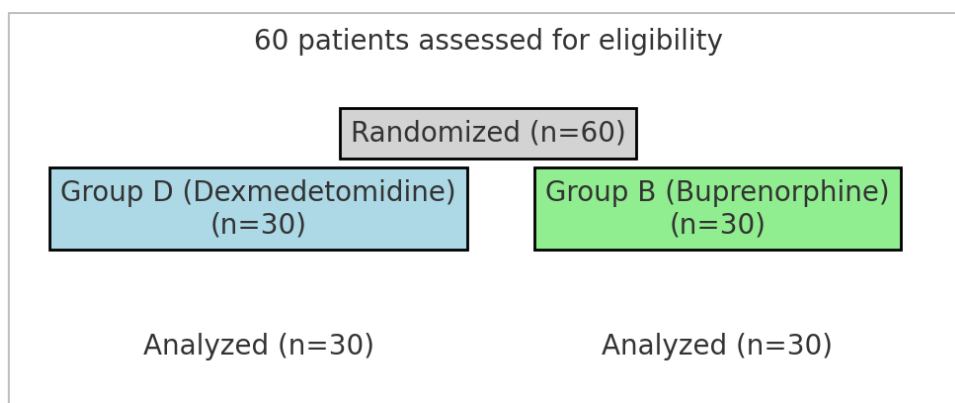


Figure 1: CONSORT flow diagram of study design

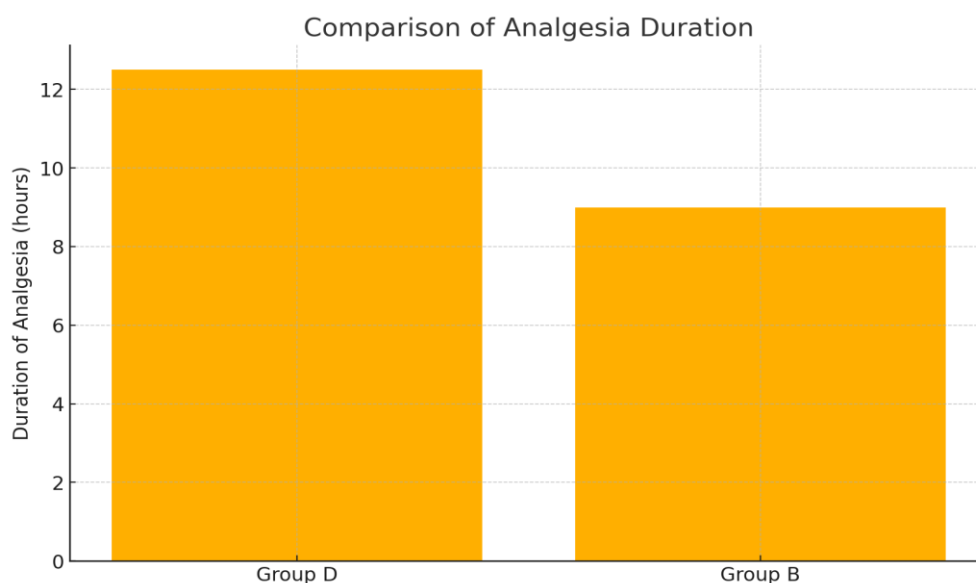


Figure 2: Comparison of duration of postoperative analgesia

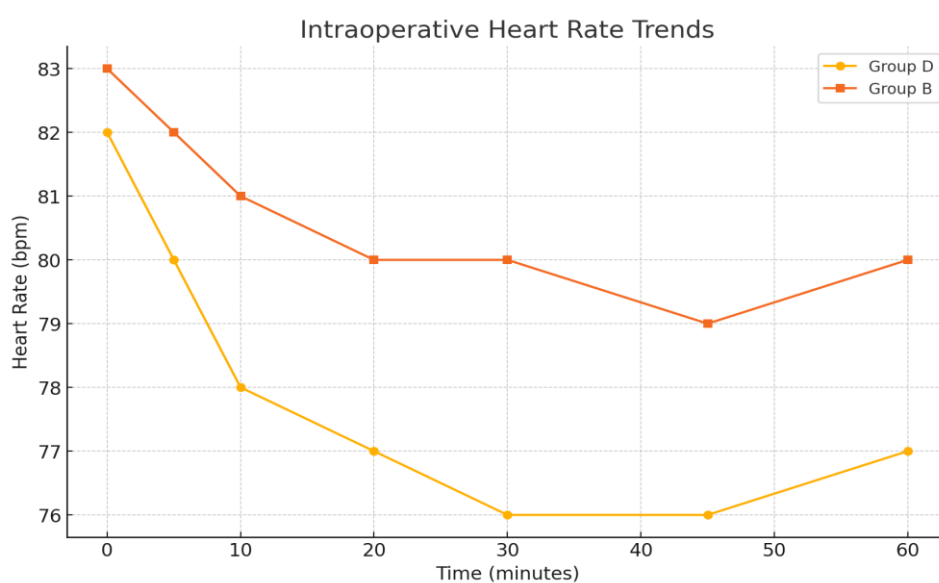


Figure 3: Intraoperative heart rate trends between groups

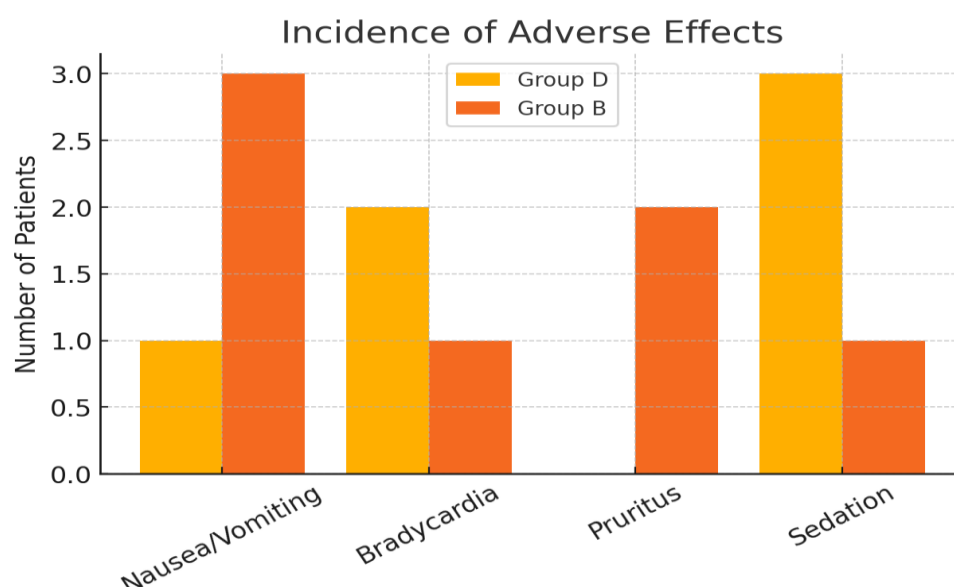


Figure 4: Incidence of adverse effects

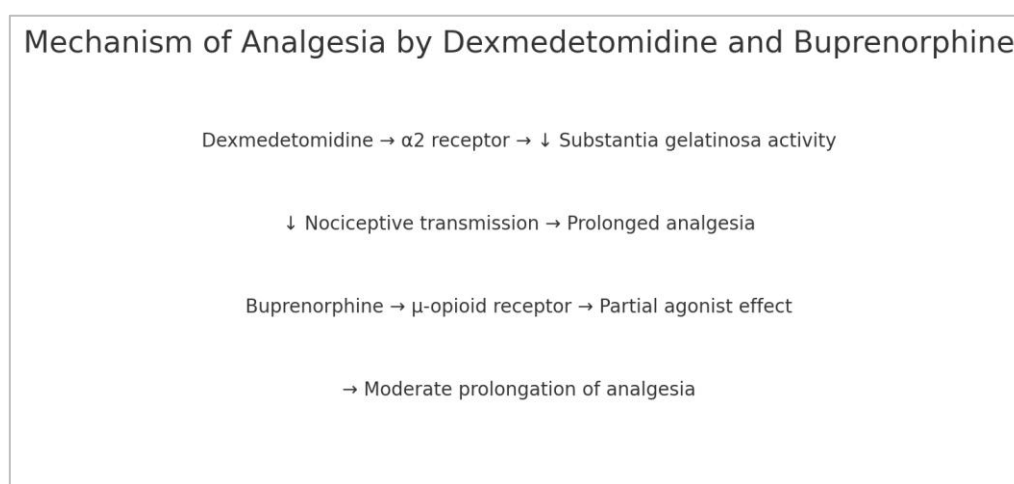


Figure 5: Mechanism of analgesia for dexmedetomidine and buprenorphine

DISCUSSION

This study demonstrates that intrathecal dexmedetomidine, as an adjuvant to bupivacaine, provides significantly longer postoperative analgesia compared to buprenorphine. The prolonged duration of analgesia and stable hemodynamics support its use for lower abdominal surgeries.

Dexmedetomidine acts by binding to presynaptic C-fiber and postsynaptic dorsal horn neurons, inhibiting release of substance P and reducing nociceptive transmission. Additionally, its synergism with local anesthetics enhances sensory and motor block duration. These findings align with Gupta et al. [1], who observed that 5 µg dexmedetomidine with bupivacaine increased block duration and reduced analgesic requirements compared to buprenorphine.

Chiranjeevi et al. [3] and Bojaraaj et al. [4] also reported longer analgesic duration and better sedation with dexmedetomidine compared to opioids. The mild sedation noted in this study may be attributed to its central sympatholytic effect, which is beneficial in reducing anxiety.

Buprenorphine provides analgesia by partial activation of µ-opioid receptors. However, its ceiling effect on analgesia and higher incidence of nausea and pruritus limit its use compared to dexmedetomidine. The absence of respiratory depression in both groups confirms the safety of low-dose adjuvant use.

Limitations of the study include a relatively small sample size and lack of long-term follow-up for chronic pain outcomes. Additionally, the study did not include a control group receiving plain bupivacaine, which could have quantified absolute improvement.

Nevertheless, the findings reinforce that dexmedetomidine is a superior adjuvant for spinal anesthesia, providing longer, smoother, and more comfortable postoperative recovery.

CONCLUSION

Intrathecal administration of dexmedetomidine (5 µg) as an adjuvant to 0.5% hyperbaric bupivacaine significantly prolongs postoperative analgesia and provides stable hemodynamic conditions compared to buprenorphine (60 µg). Dexmedetomidine offers superior quality of block, extended analgesia, minimal adverse effects, and patient comfort. It can be considered a valuable adjuvant in lower abdominal surgeries performed under spinal anesthesia.

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