Original Research Article

Comparative Study of Bupivacaine Heavy (0.5%) and Ropivacaine Heavy (0.75%) in Spinal Anaesthesia for Lower Abdominal Surgeries

Dr Amit Chandak[1]*

[1]Assistant Professor, Department of Anaesthesia, SAL Institute of Medical Sciences, Ahmedabad, Gujarat, India

*Corresponding Author; Email: drchandakamit@gmail.com

Abstract

Background:

Spinal anaesthesia is widely used for lower abdominal surgeries due to its effectiveness and safety. Bupivacaine heavy (0.5%) has been the standard agent; however, ropivacaine heavy (0.75%) is gaining popularity owing to its lower cardiotoxicity and favorable recovery profile. This study aims to compare the onset, duration, sensory and motor block characteristics, and hemodynamic stability between the two agents.

Materials and Methods:

A prospective, randomized, double-blinded study was conducted on 60 patients (ASA Grade I and II) undergoing elective lower abdominal surgeries. Patients were randomly divided into two groups: Group B (n=30) received 3 ml of 0.5% hyperbaric bupivacaine, and Group R (n=30) received 3 ml of 0.75% hyperbaric ropivacaine intrathecally. Onset and duration of sensory and motor blockade, time to two-segment regression, total duration of analgesia, and intraoperative hemodynamic changes were recorded and analyzed.

Results:

The onset of sensory block was faster in Group B (3.2 ± 0.6 minutes) compared to Group R (4.1 ± 0.8 minutes). However, the duration of motor block was significantly shorter in Group R (125 ± 10 minutes) than in Group B (160 ± 12 minutes), promoting early ambulation. Hemodynamic parameters were more stable in Group R, with fewer incidences of hypotension and bradycardia. The total duration of analgesia was slightly longer in Group B (180 ± 15 minutes) than in Group R (165 ± 12 minutes).

Conclusion:

Both bupivacaine heavy (0.5%) and ropivacaine heavy (0.75%) are effective for spinal anaesthesia in lower abdominal surgeries. Ropivacaine provides a shorter motor block duration and better hemodynamic stability, making it a safer alternative for day-care procedures.

Keywords: Bupivacaine, Ropivacaine, Spinal anaesthesia, Lower abdominal surgery, Motor block, Hemodynamic stability

Introduction

Spinal anaesthesia is a commonly employed regional technique for lower abdominal, pelvic, and lower limb surgeries due to its rapid onset, dense neural blockade, and minimal systemic drug exposure (1). Among the local anaesthetic agents used, hyperbaric bupivacaine 0.5% has remained a preferred choice because of its potent sensory and motor blockade, prolonged duration, and predictable spread in the subarachnoid space (2). However, bupivacaine is associated with dose-dependent cardiotoxicity and prolonged motor block, which can delay early ambulation and increase postoperative morbidity, especially in ambulatory settings (3,4). Ropivacaine, a newer amide-type local anaesthetic, is structurally similar to bupivacaine but exhibits reduced lipid solubility, resulting in a favorable safety profile and lower cardiotoxic potential (5). When formulated as a hyperbaric solution, ropivacaine provides reliable sensory block with relatively shorter motor block duration, making it advantageous for day-care and short-stay surgeries (6,7). Studies have demonstrated that ropivacaine at higher concentrations, such as 0.75%, can offer effective spinal anaesthesia comparable to bupivacaine, with better hemodynamic stability and faster recovery of motor function (8,9).

This study aims to compare the clinical efficacy of intrathecal bupivacaine heavy 0.5% and ropivacaine heavy 0.75% in patients undergoing lower abdominal surgeries, focusing on the onset and duration of sensory and motor block, hemodynamic effects, and overall recovery profile.

Materials and Methods

A total of 60 adult patients, aged between 18 and 60 years, belonging to the American Society of Anesthesiologists (ASA) physical status I and II, scheduled for elective lower abdominal surgeries under spinal anaesthesia, were enrolled in the study.

Inclusion criteria included patients undergoing lower abdominal surgeries such as hernia repair, appendectomy, and gynecological procedures. **Exclusion criteria** were patients with contraindications to spinal anaesthesia, allergy to local anaesthetics, coagulation disorders, spinal deformities, or pre-existing neurological deficits.

Patients were randomly divided into two groups using a computer-generated randomization list:

- **Group B** (n = 30): Received 3 ml of 0.5% hyperbaric bupivacaine intrathecally.
- **Group R** (n = 30): Received 3 ml of 0.75% hyperbaric ropivacaine intrathecally.

All patients underwent standard pre-anaesthetic evaluation. In the operating room, baseline vital signs including heart rate, blood pressure, respiratory rate, and oxygen saturation were

recorded. Intravenous access was secured, and all patients were preloaded with 10 ml/kg of Ringer's lactate solution.

Under strict aseptic precautions and with the patient in the sitting position, spinal anaesthesia was administered at the L3–L4 interspace using a 25-gauge Quincke spinal needle. The study drug was injected intrathecally over 10 seconds, and the patient was immediately placed in the supine position.

Parameters recorded included:

- Onset time of sensory block (defined as the time from intrathecal injection to loss of pinprick sensation at T10).
- Onset time of motor block (defined by Bromage scale).
- Maximum sensory level achieved.
- Duration of sensory block (time from injection to regression to S1).
- Duration of motor block (time to complete recovery of motor function).
- Time to two-segment regression.
- Hemodynamic changes including heart rate and blood pressure at 5-minute intervals for the first 30 minutes, then every 10 minutes until the end of surgery.
- Any complications such as hypotension, bradycardia, nausea, or vomiting were noted and treated appropriately.

All data were recorded and analyzed using appropriate statistical tools. Continuous variables were expressed as mean ± standard deviation and compared using the unpaired t-test. Categorical variables were compared using the Chi-square test. A p-value < 0.05 was considered statistically significant.

Results

A total of 60 patients were enrolled and completed the study, with 30 patients in each group. The demographic data, including age, weight, height, and duration of surgery, were comparable between the two groups and showed no statistically significant difference ($p > 0.05$) (Table 1). The onset of sensory block was significantly faster in Group B (3.2 ± 0.6 minutes) compared to Group R (4.0 ± 0.7 minutes), ($p < 0.001$). Similarly, the onset of motor block was quicker in Group B (4.8 ± 0.9 minutes) than in Group R (6.1 ± 1.0 minutes), ($p < 0.01$) (Table 2).

Group R showed a shorter duration of motor block (130 ± 10 minutes) compared to Group B (160 ± 12 minutes), ($p < 0.001$). However, duration of sensory block was longer in Group B (180 ± 15 minutes) than in Group R (165 ± 13 minutes), ($p = 0.002$). Time for two-segment regression was also shorter in Group R (82 ± 9 minutes) versus Group B (96 ± 11 minutes), ($p = 0.001$) (Table 3).

Hemodynamic stability was better maintained in Group R. The incidence of hypotension was higher in Group B (26.7%) than in Group R (10%), and bradycardia was observed in 3 patients in Group B and 1 patient in Group R (Table 4).

Table 1. Demographic Characteristics of Study Participants

Parameter	Group B (n = 30)	Group R (n = 30)	*p*-value
Age (years)	38.4 ± 10.2	37.8 ± 9.6	0.78
Weight (kg)	64.3 ± 8.5	65.1 ± 9.2	0.66
Height (cm)	165.2 ± 6.4	166.1 ± 7.1	0.59
Duration of surgery (min)	72.4 ± 14.1	70.9 ± 13.6	0.61

Table 2. Onset Time of Sensory and Motor Block

Parameter	Group B	Group R	*p*-value
Onset of sensory block (min)	3.2 ± 0.6	4.0 ± 0.7	<0.001
Onset of motor block (min)	4.8 ± 0.9	6.1 ± 1.0	0.004

Table 3. Duration of Blocks and Regression

Parameter	Group B	Group R	*p*-value
Duration of sensory block (min)	180 ± 15	165 ± 13	0.002
Duration of motor block (min)	160 ± 12	130 ± 10	<0.001
Time to two-segment regression (min)	96 ± 11	82 ± 9	0.001

Table 4. Hemodynamic Events

Event	Group B (n = 30)	Group R (n = 30)	*p*-value
Hypotension (%)	8 (26.7%)	3 (10.0%)	0.09
Bradycardia (%)	3 (10.0%)	1 (3.3%)	0.30
Nausea/Vomiting	2 (6.7%)	1 (3.3%)	0.55

Interpretation: As seen in Tables 2 and 3, while bupivacaine had a faster onset and longer duration of both sensory and motor blocks, ropivacaine offered quicker recovery and better hemodynamic stability (Table 4), making it more suitable for short-stay or ambulatory procedures.

Discussion

The present study compared the clinical efficacy and safety profile of intrathecal bupivacaine 0.5% heavy and ropivacaine 0.75% heavy in patients undergoing lower abdominal surgeries. The findings demonstrate that while bupivacaine produced a faster onset and longer duration of both sensory and motor blocks, ropivacaine offered a more favorable recovery profile and superior hemodynamic stability.

Bupivacaine has long been established as a reliable agent for spinal anaesthesia due to its potent and long-acting sensory and motor blockade (1,2). In the current study, the onset of sensory block was significantly faster in the bupivacaine group, consistent with previous literature (3,4). However, the prolonged duration of motor blockade observed with bupivacaine (mean 160 ± 12 minutes) may delay postoperative mobilization, a drawback particularly in ambulatory and short-stay procedures (5,6).

Ropivacaine, a newer amide local anaesthetic, offers several advantages due to its lower lipid solubility, resulting in reduced motor block intensity and lesser cardiotoxic potential compared to bupivacaine (7,8). Our study showed that the motor block duration was significantly shorter with ropivacaine (130 ± 10 minutes), aligning with findings from studies by Kallio et al. and Van Kleef et al. (9,10). This suggests ropivacaine's suitability for surgeries where early ambulation is desirable.

Another important aspect is hemodynamic stability. In our study, hypotension and bradycardia occurred less frequently in the ropivacaine group, which corroborates findings from Gautier et al. and Whiteside et al., who observed that ropivacaine causes less sympathetic blockade (11,12). This property makes it a preferable choice in elderly patients or those with cardiovascular comorbidities (13).

Although the duration of analgesia was slightly longer in the bupivacaine group, the clinical significance may be limited when rapid recovery is prioritized. Furthermore, the time for two-segment regression was shorter in the ropivacaine group, which facilitates faster discharge in outpatient settings (14).

Overall, the choice between the two agents should be tailored based on surgical duration, patient comorbidities, and postoperative recovery expectations. Ropivacaine's profile of providing adequate sensory blockade with early motor recovery and stable hemodynamics makes it a valuable alternative to bupivacaine, especially in ambulatory anaesthesia (15).

Conclusion

Ropivacaine 0.75% and bupivacaine 0.5% are both effective for spinal anaesthesia in lower abdominal surgeries. However, ropivacaine offers better hemodynamic stability and a shorter duration of motor block, making it a safer and more suitable option for day-care and short-stay procedures.

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