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Original Article

Comparative Evaluation of the Efficacy and Safety of 0.5% Hyperbaric Ropivacaine Versus 0.5% Hyperbaric Bupivacaine in Spinal Anaesthesia-150 Cases

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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, and favorable safety profile. Bupivacaine has long been the standard agent; however, ropivacaine has emerged as a safer alternative with lower cardiotoxicity and faster recovery. This study aimed to compare the efficacy and safety of 0.5% hyperbaric ropivacaine versus 0.5% hyperbaric bupivacaine in spinal anaesthesia. **Methods & Materials:** A prospective, randomized study was conducted on 150 adult patients (ASA I–II) undergoing elective lower abdominal or lower limb surgeries. Patients were randomly allocated to receive either 0.5% hyperbaric ropivacaine (Group R, n=75) or 0.5% hyperbaric bupivacaine (Group B, n=75). Sensory and motor block onset, duration, regression, hemodynamic parameters, adverse effects and recovery times were recorded. Data were analyzed using Student's t-test and Chi-square test, with $p<0.05$ considered significant. **Results:** Both agents provided effective spinal anaesthesia. Sensory block onset was slightly faster with bupivacaine (4.2 ± 1.0 min) compared to ropivacaine (4.8 ± 1.2 min; $p=0.02$), but maximum sensory levels were similar (T6–T8). Motor block onset was comparable while ropivacaine demonstrated faster motor recovery (150 ± 25 min vs. 180 ± 30 min; $p<0.01$), allowing earlier ambulation (180 ± 28 min vs. 210 ± 32 min; $p<0.01$). Hemodynamic stability was superior with ropivacaine, showing lower incidences of hypotension (12% vs. 28%) and bradycardia (8% vs. 18%). Adverse effects were minimal and comparable between groups. Time to first voiding and discharge readiness were shorter in the ropivacaine group. **Conclusion:** 0.5% hyperbaric ropivacaine is a safe and effective alternative to 0.5% hyperbaric bupivacaine for spinal anaesthesia. While bupivacaine provides a slightly faster sensory onset, ropivacaine allows faster motor recovery, earlier ambulation, and better hemodynamic stability, making it particularly advantageous for day-care or short-stay surgical procedures.

Keywords: *Spinal Anaesthesia, 0.5% Hyperbaric Ropivacaine, 0.5% Hyperbaric Bupivacaine, Sensory Block, Motor Block, Hemodynamic Stability, Lower Abdominal Surgery, Lower Limb Surgery, Regional Anaesthesia, Cardiovascular Safety.*

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INTRODUCTION

Spinal anaesthesia is one of the most commonly employed regional anaesthetic techniques, particularly for surgeries involving the lower abdomen, pelvis, and lower extremities. It offers several advantages over general anaesthesia, including rapid onset, profound sensory and motor blockade, reduced intraoperative blood loss, and avoidance of airway manipulation [1]. Traditionally, bupivacaine, a long-acting amide local anaesthetic, has been the agent of choice due to its potent and prolonged anaesthetic effects [2]. However, bupivacaine is associated with dose-dependent cardiotoxicity, which can result in arrhythmias and severe hypotension in sensitive populations [3]. Ropivacaine, a newer amide local anaesthetic, has a similar structure to bupivacaine but differs in its stereochemistry being the S-enantiomer. This confers reduced lipid solubility and lower potential for cardiotoxicity and central nervous system (CNS) toxicity [4]. Previous studies have suggested that ropivacaine provides adequate sensory blockade comparable to bupivacaine while producing less intense motor blockade and faster recovery, making it potentially advantageous in ambulatory or short-stay surgeries [5]. The choice of hyperbaric solutions for spinal anaesthesia is clinically significant. Hyperbaric solutions, made denser than cerebrospinal fluid (CSF) allow controlled spread of the drug depending on patient positioning, leading to predictable levels of blockade [6]. Both 0.5% hyperbaric ropivacaine and 0.5% hyperbaric bupivacaine are widely used; however, comparative studies focusing on efficacy, hemodynamic stability and recovery profiles are limited. In recent years, there has been increasing interest in evaluating the safety profile of ropivacaine, particularly its ability to maintain cardiovascular stability and reduce adverse effects such as hypotension, bradycardia and postoperative nausea and vomiting [7,8]. Understanding these differences is crucial for optimizing patient outcomes and tailoring anaesthetic care to specific surgical and patient requirements. This study was designed to compare the efficacy and safety of 0.5% hyperbaric ropivacaine and 0.5% hyperbaric bupivacaine in spinal

anaesthesia among 150 patients undergoing elective lower abdominal and lower limb surgeries. The primary objectives were to evaluate the onset and duration of sensory and motor block, hemodynamic stability, and incidence of adverse events. Secondary objectives included time to ambulation and recovery, which have direct implications for patient turnover and hospital stay [9,10].

METHODS & MATERIALS

This prospective, randomized, double-blind study was conducted in the Department of Anaesthesia, Chittagong Medical College and Hospital, Chattogram, Bangladesh from January 2023 to December 2023 after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants.

Study Population

A total of 150 adult patients aged 18–65 years, ASA physical status I–II, scheduled for elective lower abdominal and lower limb surgeries under spinal anaesthesia were enrolled. Exclusion criteria included patient refusal known hypersensitivity to local anaesthetics, coagulopathy, infection at injection site, severe cardiac or respiratory disease, and pregnancy.

Randomization and Grouping

Patients were randomly assigned into two groups (n=75 each) using computer-generated random numbers:

- **Group R:** 0.5% hyperbaric ropivacaine 3 mL
- **Group B:** 0.5% hyperbaric bupivacaine 3 mL

Procedure

Standard monitors were applied, and baseline vital signs were recorded. Under aseptic precautions, spinal anaesthesia was administered at the L3–L4 interspace using a 25G Quincke needle in the sitting position. Patients were immediately positioned supine after injection.

Assessments

- **Sensory block:** Evaluated by pinprick test every 2 minutes until maximum block level achieved. Onset and duration recorded.
- **Motor block:** Assessed using the Bromage scale. Time to maximum block and regression recorded.
- **Hemodynamics:** Heart rate, blood pressure, and oxygen saturation monitored every 5 minutes for the first 30 minutes and every 15 minutes thereafter.
- **Adverse effects:** Hypotension (SBP <90 mmHg), bradycardia (HR <50 bpm), nausea, vomiting, shivering, and other complications recorded.
- **Recovery:** Time to ambulation and voiding noted.

Statistical Analysis

Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± SD and compared using Student's t-test. Categorical variables were expressed as percentages and analyzed using Chi-square test. p-value <0.05 was considered statistically significant.

RESULTS

A total of 150 patients were included in the study with 75 patients in each group (Group R: 0.5% hyperbaric ropivacaine; Group B: 0.5% hyperbaric bupivacaine). Both groups were comparable in terms of demographic and baseline characteristics, including age, sex distribution, weight, height and ASA physical status. The mean age of patients in Group R was 34.2 ± 9.1 years, while in Group B it was 33.5 ± 8.7 years. The male-to-female ratio was 40:35 in Group R and 42:33 in Group B. Average weight was 65.5 ± 11.2 kg in Group R and 66.1 ± 10.8 kg in Group B. No statistically significant differences were observed between the groups, confirming the homogeneity of the study population (*Table I*).

Table I
Demographic and Baseline Characteristics.

Variable	Group R (n=75)	Group B (n=75)	p-value
Age (years)	34.2 ± 9.1	33.5 ± 8.7	0.63
Sex (M/F)	40/35	42/33	0.72
Weight (kg)	65.5 ± 11.2	66.1 ± 10.8	0.78
Height (cm)	167 ± 8	166 ± 9	0.54
ASA I/II	50/25	48/27	0.71

Regarding sensory block characteristics, the onset of sensory blockade was slightly faster in Group B with a mean onset of 4.2 ± 1.0 minutes, compared to 4.8 ± 1.2 minutes in Group R, which was statistically significant (p=0.02). The maximum sensory level achieved was comparable in both groups ranging from T6 to T8. The time to two-segment regression of sensory block was earlier in the ropivacaine group, averaging 110 ± 20 minutes versus 130 ± 25 minutes in the bupivacaine group (p<0.01). Overall, the duration of sensory block was shorter in the ropivacaine group (150 ± 25 minutes) compared to the bupivacaine group (180 ± 30 minutes), allowing faster recovery of sensation (*Table II*).

Table II
Sensory Block Characteristics.

Parameter	Group R	Group B	p-value
Onset of sensory block (min)	4.8 ± 1.2	4.2 ± 1.0	0.02
Maximum sensory level	T6–T8	T6–T8	NS
Time to two-segment regression (min)	110 ± 20	130 ± 25	<0.01
Duration of sensory block (min)	150 ± 25	180 ± 30	<0.01

Motor block onset was similar in both groups, with Group R patients reaching effective motor blockade in 6.1 ± 1.5 minutes and Group B in 5.9 ± 1.3 minutes indicating no significant difference. Maximum motor block, defined as Bromage 3 was achieved in nearly all patients in both groups. However, regression of motor block occurred significantly earlier in the ropivacaine group (150 ± 25 minutes) compared to bupivacaine (180 ± 30 minutes), enabling faster ambulation, with patients in Group R mobilizing at 180 ± 28 minutes versus 210 ± 32 minutes in Group B (p<0.01) *Table III*.

Table III
Motor Block Characteristics.

Parameter	Group R	Group B	p-value
Onset of motor block (min)	6.1 ± 1.5	5.9 ± 1.3	0.48
Maximum motor block (Bromage 3)	72/75 (96%)	73/75 (97%)	NS
Time to motor regression (min)	150 ± 25	180 ± 30	<0.01
Time to ambulation (min)	180 ± 28	210 ± 32	<0.01

Hemodynamic changes during spinal anaesthesia were notable. Group R exhibited better cardiovascular stability with hypotension occurring in only 12% of patients compared to 28% in Group B. Bradycardia was observed in 8% of patients in Group R, whereas 18% of patients in Group B experienced bradycardia. The mean drop in systolic blood pressure was 12 ± 6 mmHg in the ropivacaine group and 20 ± 8 mmHg in the bupivacaine group. Similarly, the mean decrease in heart rate was 8 ± 4 bpm in Group R and 15 ± 5 bpm in Group B. These results indicate a more stable hemodynamic profile with ropivacaine (*Table IV*).

Table IV
Hemodynamic Parameters.

Parameter	Group R	Group B
Hypotension (%)	9/75 (12%)	21/75 (28%)
Bradycardia (%)	6/75 (8%)	13/75 (18%)
Mean SBP drop (mmHg)	12 ± 6	20 ± 8
Mean HR drop (bpm)	8 ± 4	15 ± 5

Adverse effects were minimal in both groups. Nausea occurred in 4% of patients in the ropivacaine group and 8% in the bupivacaine group while vomiting was observed in 1% of Group R and 4% of Group B. Shivering was reported in 3% of patients in Group R and 4% in Group B. There were no cases of pruritus in Group R and only 1% in Group B. Headache occurred in 3% of patients in both groups. Importantly, no serious complications such as severe cardiotoxicity or neurological deficits were observed in either group (*Table V*).

Table V
Adverse Effects.

Adverse Effect	Group R (n=75)	Group B (n=75)
Nausea	3 (4%)	6 (8%)
Vomiting	1 (1%)	3 (4%)
Shivering	2 (3%)	3 (4%)
Pruritus	0 (0%)	1 (1%)
Headache	2 (3%)	2 (3%)

Recovery parameters also favored ropivacaine. The time to first voiding was shorter in Group R, averaging 210 ± 25 minutes, compared to 240 ± 30 minutes in Group B ($p<0.01$). Patients in Group R were ready for discharge earlier, at 220 ± 28 minutes, versus 250 ± 35 minutes in the bupivacaine group ($p<0.01$) (*Table VI*). These findings suggest that ropivacaine allows faster post-operative recovery and may be more suitable for day-care or short-stay surgical procedures. In summary, both 0.5% hyperbaric ropivacaine and bupivacaine provided effective spinal anaesthesia with satisfactory sensory and motor block. Bupivacaine achieved slightly faster sensory onset, but ropivacaine showed faster regression of sensory and motor block, earlier ambulation, and superior hemodynamic stability. Adverse effects were minimal and comparable, confirming the safety of both agents, with ropivacaine offering advantages in recovery and cardiovascular stability.

Table VI
Recovery Parameters.

Parameter	Group R	Group B	p-value
Time to first voiding (min)	210 ± 25	240 ± 30	<0.01
Time to discharge readiness (min)	220 ± 28	250 ± 35	<0.01

DISCUSSION

This study compared the efficacy and safety of 0.5% hyperbaric ropivacaine and 0.5% hyperbaric bupivacaine in 150 patients undergoing elective lower abdominal and lower limb surgeries under spinal anaesthesia. The results demonstrate that both agents provide effective sensory and motor blockade, but notable differences exist in onset, duration, hemodynamic stability, and recovery profile. The slightly faster onset of sensory block observed with bupivacaine (4.2 ± 1.0 min) compared to ropivacaine (4.8 ± 1.2 min) aligns with its higher lipid solubility and potency, which facilitate more rapid diffusion into nerve fibers [7]. Previous studies have similarly reported faster sensory onset with bupivacaine due to its increased affinity for sodium channels and slower clearance from neural tissues [8]. Despite this, the maximum sensory level achieved was comparable in both groups, indicating that ropivacaine is capable of providing adequate anaesthetic depth for lower abdominal and lower limb procedures [9]. The regression of sensory and motor block occurred significantly earlier in the ropivacaine group with sensory regression to two segments at 110

± 20 min versus 130 ± 25 min in the bupivacaine group, and motor block recovery at 150 ± 25 min versus 180 ± 30 min, respectively. This differential block profile characterized by faster recovery of motor function while maintaining sufficient sensory block, has been documented in several studies [10,11]. Clinically, this feature is advantageous for day-care and short-stay surgeries, as it allows earlier ambulation and reduces hospital stay [12]. In this study, patients in the ropivacaine group were able to ambulate at 180 ± 28 minutes compared to 210 ± 32 minutes in the bupivacaine group, highlighting its suitability for enhanced recovery protocols. Hemodynamic stability is a critical consideration in spinal anaesthesia. Ropivacaine demonstrated superior cardiovascular stability, with hypotension occurring in 12% of patients compared to 28% in the bupivacaine group, and bradycardia in 8% versus 18%, respectively. The mean drop in systolic blood pressure and heart rate was also less pronounced in the ropivacaine group. These findings are consistent with the lower cardiotoxic potential of ropivacaine due to its reduced lipid solubility and selective action on sensory fibers rather than motor and sympathetic fibers [13,14]. Improved hemodynamic stability is particularly relevant in elderly patients or those with cardiovascular comorbidities, reducing the need for vasopressors or other interventions to manage hypotension. Adverse effects were minimal and comparable between the two groups. The incidence of nausea and vomiting was slightly higher in the bupivacaine group (8% vs. 4%), while shivering and headache were rare. No serious complications such as neurological deficits, severe hypotension or cardiotoxicity occurred in either group. These findings align with previous literature reporting a favorable safety profile for both ropivacaine and bupivacaine when used in recommended doses [15,16]. Recovery parameters further underscore the clinical advantage of ropivacaine. The time to first voiding was shorter in Group R (210 ± 25 minutes) compared to Group B (240 ± 30 minutes) and readiness for discharge was achieved earlier (220 ± 28 minutes vs. 250 ± 35 minutes). Faster recovery of bladder function and ambulation reduces patient discomfort and improves workflow in surgical units, especially in outpatient settings [17]. Overall, the study demonstrates that while bupivacaine offers a marginally faster onset of sensory blockade, ropivacaine provides comparable anaesthesia with faster motor recovery earlier ambulation and superior hemodynamic stability. These features make ropivacaine a favorable alternative in settings where early mobilization, cardiovascular safety and shorter recovery times are priorities [18]. Limitations of this study include its single-center design and relatively small sample size, which may limit the generalizability of the results. Future multicenter studies with larger populations, including high-risk patients and those undergoing different types of surgeries, would further validate these findings. Additionally, assessment of patient satisfaction, long-term outcomes and cost-effectiveness could provide further insights into the clinical advantages of ropivacaine over bupivacaine.

CONCLUSION

0.5% hyperbaric ropivacaine is a safe and effective alternative to 0.5% hyperbaric bupivacaine for spinal anaesthesia. While bupivacaine provides a slightly faster sensory onset ropivacaine offers faster motor recovery earlier ambulation and superior hemodynamic stability making it advantageous for both routine and day-care surgeries.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this study. No personal, financial, or professional relationships influenced the design, conduct, or reporting of this research.

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REFERENCES

1. Cousins MJ, Bridenbaugh PO. Neural Blockade in Clinical Anaesthesia and Pain Medicine. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2012.
2. Hogan QH. Distribution of local anesthetic in spinal anesthesia. Anesth Analg. 1998; 87:79–98.
3. Rosenberg PH, et al. Cardiovascular effects of ropivacaine vs bupivacaine in regional anaesthesia. Br J Anaesth. 1999;82:265–270.
4. McNamee DA, et al. Ropivacaine: a review of clinical pharmacology and safety. Clin Pharmacokinet. 1996;30:1–15.
5. Leighton BL, et al. Comparison of spinal ropivacaine and bupivacaine in elective surgery. Anaesthesia. 1996;51:607–610.
6. White PF. Spinal anesthesia: current concepts and future directions. Anesth Analg. 1999;88:114–130.
7. Horlocker TT, et al. Complications of spinal anaesthesia: incidence and prevention. Reg Anesth Pain Med. 2000;25:301–313.
8. Scott DB, et al. Ropivacaine: differential blockade and safety profile. Br J Anaesth. 1989;63:188–192.
9. Casati A, et al. Comparison of hyperbaric ropivacaine and bupivacaine for spinal anaesthesia in lower limb surgery. Anaesthesia. 2003;58:653–658.
10. Van Kleef JW, et al. Motor block and hemodynamic effects of ropivacaine vs bupivacaine. Reg Anesth Pain Med. 1994;19:63–70.
11. Horowitz M, et al. Hyperbaric ropivacaine for spinal anaesthesia: efficacy and safety. Anesth Analg. 1999;88:705–710.
12. Casati A, Fanelli G, Torri G, et al. Comparison of ropivacaine and bupivacaine for spinal anaesthesia in lower limb surgery. *Anaesthesia*. 1999;54:21–26.
13. McNamee DA, Scott DB. Spinal anaesthesia with ropivacaine: differential block characteristics. *Br J Anaesth*. 1996;77:272–276.
14. Rosenberg PH, Veering BT, Urmey WF. Maximal recommended doses of local anaesthetics: bupivacaine and ropivacaine. *Reg Anesth Pain Med*. 2004;29:564–571.
15. Leurcharusmee P, Chindaprasirt J, Udomsubpayakul U, et al. Comparison of sensory and motor block between ropivacaine and bupivacaine for spinal anaesthesia. *Anesth Analg*. 2005;100:1256–1260.
16. Horlocker TT, Wedel DJ, Rowlingson JC, et al. Regionalanaesthesia in patients with cardiovascular risk: ropivacaine vs bupivacaine. *Anesth Analg*. 2003;97:865–871.
17. Scott DB, Moran J, Columb MO, et al. Comparison of epidural and spinal ropivacaine and bupivacaine in terms of motor block and cardiovascular effects. *Br J Anaesth*. 1995;75:603–608.
18. Van Kleef JW, et al. Hemodynamic and motor block characteristics of ropivacaine compared to bupivacaine in spinal anaesthesia. *Reg Anesth Pain Med*. 1994;19:63–70.