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Original Research Article

COMPARISON BETWEEN INTRATHECAL HYPERBARIC ROPIVACAINE 0.75% WITH HYPERBARIC BUPIVACAINE 0.5% IN PATIENTS UNDERGOING LOWER ABDOMINAL AND ORTHOPEDIC SURGERIES: A DOUBLE BLIND RANDOMIZED CONTROLLED STUDY

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ABSTRACT

Background: Recently introduced 0.75% hyperbaric bupivacaine, although considered less potent than 0.5%bupivacaine, produces reliable anaesthesia. This study was aimed to compare onset and duration of sensory and motor blockade in spinal anaesthesia in patients undergoing infraumbilical surgeries.

Materials and Methods: 100 patients of American Society of Anaesthesiologists grade I-III were randomised to receive spinal anaesthesia using ropivacaine 0.75% heavy 3 ml (R group) and bupivacaine 0.5 % heavy 3ml (B group). Patients were monitored for onset duration and progress of sensory and motor block as well as hemodynamic parameters. The data were presented as mean with a standard deviation and frequency with percentage. Statistical analysis was performed using InStat computer software with appropriate tests and $P < 0.05$ was considered to be significant.

Results: Ropivacaine had a slower onset of action and reached its peak effect slowly—at approximately 3.33± 1.35 minutes for onset and 7.11±1.49 minutes to peak—when compared to bupivacaine, which had an onset at 1.82 ± 0.50minutes and a peak at 6.18±0.87 minutes. Despite these differences, both agents produced comparable levels of sensory block. Motor block provided by ropivacaine weaned earlier.

Conclusion: Ropivacine 0.75% produces shorter duration but yet reliable degree of blockade and providing faster recovery and earlier mobilization.

Keywords: Intrathecal Hyperbaric Ropivacaine, Hyperbaric Bupivacaine.

INTRODUCTION

Spinal anaesthesia is commonly employed for surgeries involving the lower abdomen, pelvis, and lower limbs due to its reliability and rapid onset. Among local anaesthetics, hyperbaric bupivacaine is frequently used because of its strong and long-lasting sensory and motor blockade. However, concerns remain about its potential for cardiotoxic effects and slower recovery times.

Ropivacaine, a relatively newer local anaesthetic, has gained attention as a potentially safer alternative. It tends to produce a greater sensory block with less motor impairment and shows a reduced risk of cardiac side effects. The hyperbaric formulation of ropivacaine is being studied for its ability to provide effective spinal anaesthesia with possibly quicker onset and recovery compared to bupivacaine. However, it is 30-40% less potent than bupivacaine.[1,2,3,4]

This study compares the effects of hyperbaric bupivacaine and hyperbaric ropivacaine in spinal anaesthesia, focusing on parameters such as onset and duration of block, quality of anaesthesia, and

side effects, aiming to identify which agent provide optimal outcomes for patients undergoing infraumbilical surgeries.

MATERIALS AND METHODS

It was a prospective, randomised double blind study enrolling100 adult patients, in the age group of 18-65 years of ASA physical status grade I, II and III undergoing elective abdominal and lower limb surgeries. Study was conducted in tertiary care institute after obtaining institutional ethics committee approval during period of September 2022 to December 2024. This study was conducted in accordance with Good Clinical Practice and in a manner to conform to the Helsinki Declaration of 1975, as revised in 2013 concerning human rights. Well-being and safety of patients were maintained during study.

Patients were randomly allocated in two groups of 50 each using block randomisation and computer-generated sequence. Patients refusing to give consent, allergic to local anaesthetic, local site infection, bleeding diathesis, BMI > 35kg/m2, uncontrolled diabetes mellitus, ischemic heart disease, uncontrolled hypertension were excluded.

Patient were evaluated preoperatively including detailed airway examination and investigated according to institutional protocol. Study protocol was explained to patient and written informed consent was obtained. A night prior to surgery, patient was given tab alprazolam 0.25 mg and tab pantoprazole 40 mg. On day of surgery, NPO status and consent was checked. An iv line was secured and RL was started. Patients were attached with standard monitors including ECG, SPO2, NIBP, ETCO2, temperature probe and baseline parameters were recorded.

Using computer generated randomization patients were randomly allocated to two groups ie group R receiving subarachnoid block with 3.0 ml of 0.75% hyperbaric Ropivacaine and group B receiving 3.0 ml of 0.5% hyperbaric bupivacaine. Lumbar puncture was performed under aseptic conditions, in sitting position by midline approach by using Quincke spinal needle (25G) at L3-L4 intervertebral space. Opaque sealed numbered envelopes were used to conceal randomization sequence which were opened by principal investigator just prior to administration of spinal anesthesia. A separate investigator was asked to prepare spinal drug solution who was not involved in case or study. Anesthesiologist, who was unaware of drug in syringe, performed spinal anesthesia and monitored patients perioperatively.

Continuous monitoring of hemodynamic parameters was done and readings were recorded every 0 min, 5 mins, 10 mins, 15 mins, 30 mins, 1 hour, 2 hours, 4 hours, 6 hours, 8 hours, 12 hours, 24 hours.

The onset of sensory block was tested by 'pin-prick method' using a hypodermic needle. The time of onset was taken from the time of injection of drug into subarachnoid space to loss of pinprick sensation in L1. The highest level of sensory block, duration of sensory blockade, taken as the time from onset to the time of return of pinprick sensation to L1 dermatomal area and regression of sensory block by 2 segments was noted.

Motor block was assessed with 'Modified Bromage Score'. The time interval between injection of drug into subarachnoid space, to the patient's inability to lift the straight extended leg was taken as onset time (Bromage grade 1). The duration of motor block was taken from time of onset to complete regression of motor block (ability to lift the extended leg) (Bromage grade 0).

Quality of intraoperative anaesthesia was graded as excellent requiring no supplementary sedative or analgesia, good: requiring only sedative, fair requiring analgesia and sedation and poor which required general anesthesia.

Side effects like sedation, nausea, vomiting, shivering, pruritus and any other complications were monitored. Hypotension (MAP< 20% from baseline) was treated using mephentermine 6mg iv and bradycardia (HR<60/min) was treated using atropine 0.6 mg iv.

The data was entered using Microsoft excel sheet and was analysed using Statistical Package for Social Sciences (SPSS) version 22.0 software (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). Categorical data was presented in form of frequency and proportion. As test of significance for qualitative data inform of frequency and proportion. Chi-square test was used as test of significance for qualitative data. Continuous data like VAS score was analysed using mean and standard deviation and Mann-Whitney U test A probability of $P < 0.05$ was considered statistically significant.

RESULTS

Total 100 patients were enrolled in study with 50 patients in each group. All these patients completed study and they had comparable demographic parameters as shown in table 1.

Table 1: Demographic and clinical profiles of patients

Parameter	Group R (Mean±SD)	Group B (Mean±SD)	P value
Age (years)	48.32±12.85	47.34±10.59	0.454
Female : male(%)	44(88%):6(12%)	44(88%):6(12%)	1.0
Weight (kg)	61.9±6.68	64.18±4.68	0.051
Height in cms	164.70±3.63	165.66±3.40	0.176
BMI	22.87±2.20	23.38±1.29	0.084

ASA I: II:III	29:14:7	30:11:9	0.731
Duration of surgery (minutes)	94.37±17.69	95.00±16.99	0.856

The demographic and clinical profiles of patients in Group R and Group B were comparable (Table1). There were **no statistically significant differences** in age, gender distribution, weight, height, BMI, ASA physical status, or duration of surgery between the groups (**P > 0.05** for all parameters). This baseline similarity supports the validity of subsequent comparisons between the groups.

Table 2: Comparison of onset of sensory and motor block between two groups

Parameter	Group R (Mean±SD)	Group B (Mean±SD)	P value
Motor block in min	3.70 ± 1.41	2.02 ± 0.52	<0.001
Sensory block (Up to L_1) in min	3.33 ± 1.35	1.82 ± 0.50	<0.001

Onset of sensory and motor block was much faster in group as seen from table 2 and it was statistically significant. The **statistically significant reductions in onset times** observed in Group B may have clinical implications, especially in settings where a **faster onset of anaesthesia** is desirable for early surgical readiness or time-sensitive procedures.

Table 3: Comparison of sensory and motor block characteristics between two groups

Parameter	Group R (Mean±SD)	Group B (Mean±SD)	P value
Duration of sensory block (min)	162.74±9.84	187.90±12.73	<0.001
Duration of motor block (min)	154.5±10.40	205.58±8.82	<0.001
Time to achieve peak sensory level (min)	7.11±1.49	6.18±0.87	<0.001
Time to achieve peak motor level (min)	5.89±2.31	3.65±0.82	<0.001
Time to regress sensory block by 2 segments (min)	76.07±7.77	96.04±4.65	<0.001
Duration of sensory block (min)	162.74±9.84	187.90±12.73	<0.001
Duration of motor block (min)	154.09±10.40	205.58±8.82	<0.001

Group B demonstrated a significantly **faster onset** and **longer duration** of both sensory and motor block compared to Group R. The time to achieve peak sensory and motor levels was shorter in Group B (6.18 ± 0.87 min and 3.65 ± 0.82 min) than in Group R (7.11 ± 1.49 min and 5.89 ± 2.31 min), respectively (**P < 0.001**). Additionally, Group B had a significantly **longer duration** of sensory (187.90 ± 12.73 min) and motor block (205.58 ± 8.82 min) compared to Group R (162.74 ± 9.84 min and 154.09 ± 10.40 min) (**P < 0.001**). The time for two-segment sensory regression was also prolonged in Group B (**96.04 ± 4.65 min**) versus Group R (**76.07 ± 7.77 min**) (**P < 0.001**). (Table 3)

Table 4: Comparison of intraoperative quality of anaesthesia between two groups

Intraoperative anaesthesia	Group R	Group B	Total	P value
Excellent	36	46	82	
Good	6	2	8	
Fair	4	2	6	0.048424
Poor	4	0	4	
Total	50	50	100	

In terms of intraoperative anesthesia quality, a significantly higher number of patients in **Group B** experienced an **"Excellent"** level of anesthesia (46 patients) compared to **Group R** (36 patients). Fewer patients in Group B required classification as "Good" (2 vs. 6), "Fair" (2 vs. 4), or "Poor" (0 vs. 4), indicating a **superior anesthetic profile** in Group B. The difference between the groups was **statistically significant (P = 0.048)**. (Table 4)

Table 5: Comparison of side effects between two groups

Side Effects	Group R	Group B	P Value (Chi-Square Test)
Hypotension	3	8	0.145
Shivering	2	6	0.175
Bradycardia	0	4	0.05
Nil	41	33	0.007

The incidence of side effects differed between the groups but was mostly not statistically significant. **Hypotension** and **shivering** were more common in Group B (8 and 6 cases, respectively) than in Group R (3 and 2 cases), though these differences were **not statistically significant** (**P = 0.145** and **P = 0.175**, respectively). **Bradycardia** occurred in 4 patients in Group B and none in Group R, showing a borderline statistical significance (**P = 0.05**). Notably, the number of patients who experienced **no side effects** was significantly higher in Group R (41 patients)

compared to Group B (33 patients), a difference that was **statistically significant (P = 0.007) (Table 5).**

DISCUSSION

Ropivacaine, an amino-amide local anesthetic, shares structural similarities with bupivacaine but is approximately 30–40% less potent. It has undergone significant evaluation for its application in spinal anesthesia.[1,2] Early investigations focused on the safety and effectiveness of isobaric formulations of ropivacaine in neuraxial blocks.[5,6] Findings from these studies indicated that intrathecal administration of ropivacaine is well tolerated and provides a shorter duration of anesthesia compared to bupivacaine. Moreover, it is associated with a lower risk of transient neurological symptoms (TNS) than lignocaine when used intrathecally.[7]

The preference for hyperbaric local anaesthetics in spinal anaesthesia has grown due to their ability to deliver more consistent and predictable block profiles, enhancing the reliability of the anaesthetic effect.[3,4]

Our observations revealed that ropivacaine had a slower onset of action and reached its peak effect slowly—at approximately 3.33± 1.35 minutes for onset and 7.11±1.49 minutes to peak—when compared to bupivacaine, which had an onset at 1.82 ± 0.50minutes and a peak at 6.18±0.87 minutes. Despite these differences, both agents produced comparable levels of sensory block. However, the overall duration of sensory anaesthesia was notably shorter with ropivacaine. These results are consistent with those reported by Whiteside et al.3, who, in a study involving elective procedures under spinal anaesthesia, documented onset times of 5 minutes for 3 ml of 0.5% hyperbaric ropivacaine and 2 minutes for bupivacaine prepared in 5% and 8% glucose solutions.

It was observed that ropivacaine exerts a milder effect on motor nerves compared to bupivacaine, resulting in greater sensory-motor differentiation. Despite this, ropivacaine still provides effective and dependable spinal anesthesia, a finding consistent with results from other studies.[8,9] Similar outcomes were reported by Whiteside et al,[3] who found that the average onset time for motor blockade was approximately 15 minutes with hyperbaric ropivacaine and 10 minutes with bupivacaine, while the total duration of motor block was around 90 minutes and 180 minutes, respectively, when comparable doses were administered. We observed average onset time for motor blockade was approximately3.70 ± 1.41 minutes with hyperbaric ropivacaine and 2.02 ± 0.52 minutes with bupivacaine, while the total duration of motor block was around 154.09±10.40 minutes and 205.58±8.82 minutes, respectively.

This property of Ropivacaine's with relatively shorter duration of motor blockade makes it particularly suitable for procedures where rapid postoperative recovery and early mobilization are important.[10,11] The quicker return of motor function facilitates earlier ambulation, potentially lowering the risk of postoperative complications linked to prolonged immobility. Its characteristic of differential blockade—providing effective sensory analgesia with limited motor impairment—enhances its value as an analgesic agent. However, this same property limits its utility in intra-abdominal surgeries, where profound motor blockade and muscle relaxation are required. In contrast, it may be well-suited for lower limb orthopaedic procedures, where minimal motor blockade is sufficient and early mobility is advantageous.

Study by Gohil et al,[12] demonstrated a significantly faster onset of sensory block(2.6±0.53 min) at the T10 level compared to bupivacaine(3±0.56 min). While the time to reach the maximum sensory level was slightly shorter with ropivacaine, the difference was not statistically significant. The duration of sensory (121.16±7.73 min Vs 180.34±11.56 min) and motor blocks (149.5±8.64 min Vs210.17±13.19 min) was notably shorter with ropivacaine, indicating quicker recovery. Although both drugs had similar onset times for motor block, ropivacaine allowed for significantly earlier motor function recovery. Ropivacaine also achieved a slightly higher maximum sensory block level (T5 vs. T6). Intraoperative quality of anesthesia was comparable in both groups.

In terms of intraoperative anaesthesia quality, we observed a significantly higher number of patients in Group Bupivacaine experienced an "Excellent" level of anaesthesia (46 patients) compared to Group Ropivacaine. We also observed faster regression of sensory blockade by two segments in ropivacaine group

Similar study by Shanmugam et al. demonstrated13 bupivacaine had a slightly faster onset of motor block compared to ropivacaine. Intrathecal 0.75% ropivacaine heavy (2.2 ml) provided a more consistent sensory block than motor block and resulted in a longer-lasting sensory block than bupivacaine of the same volume. Although ropivacaine showed a slower onset and spread of sensory block with a lower cephalad level, the regression of sensory block outlasted motor recovery. In contrast, bupivacaine demonstrated a more rapid cephalad spread, achieving higher block levels (up to T4), and produced a denser motor block.

The incidence of side effects differed between the groups but was mostly not statistically significant although hypotension and shivering were more common in bupivacaine group.

This study has several limitations. The sample size of 100 patients, while informative, may lack sufficient power to detect subtle differences between the drugs. The absence of long-term follow-up limits insight into delayed side effects and full

motor recovery. Additionally, the findings are restricted to patients undergoing infraumbilical and lower limb orthopaedic surgeries, limiting generalizability to other surgical types. High-risk patients with significant comorbidities were excluded, leaving the safety profile in vulnerable populations unexplored.

Conclusion: Ropivacaine, due to its shorter motor block duration and greater sensory-motor separation, is ideal for surgeries where early mobilization is important, such as lower limb orthopaedic procedures. However, its limited motor blockade makes it less appropriate for intra-abdominal surgeries that require profound muscle relaxation.

CONCLUSION

Ropivacine 0.75% produces shorter duration but yet reliable degree of blockade and providing faster recovery and earlier mobilization.

REFERENCES

1. Whiteside JB, Burke D, Wildsmith JA. Spinal anaesthesia with ropivacaine 5 mg ml (-1) in glucose 10 mg ml (-1) or 50 mg ml (-1). Br J Anaesth 2001; 86:241-4.
2. Whiteside JB, Burke D, Wildsmith JA. Comparison of ropivacaine 0.5% (in glucose 5%) with bupivacaine 0.5% (in glucose 8%) for spinal anaesthesia for elective surgery. Br J Anaesth 2003; 90:304-8.
3. Fettes PD, Hocking G, Peterson MK, Luck JF, Wildsmith JA. Comparison of plain and hyperbaric solutions of ropivacaine for spinal anaesthesia. Br J Anaesth 2005; 94:107-11.
4. Kallio H, Snäll EV, Tuomas CA, Rosenberg PH. Comparison of hyperbaric and plainropivacaine 15 mg in spinal anaesthesia for lower limb surgery. Br J Anaesth 2004; 93:664-9.
5. vanKleef JW, Veering BT, Burm AG. Spinal anesthesia with ropivacaine: A double-blind study on the efficacy and safety of 0.5% and 0.75% solutions in patients undergoing minor lower limb surgery. AnesthAnalg 1994; 78:1125-30.
6. Wahedi W, Nolte H, Klein P. Ropivacaine for spinal anesthesia. A dose-finding study. Anaesthesist 1996; 45:737-44.
7. Hocking G, Wildsmith JA. Intrathecal drug spread. Br J Anaesth 2004; 93:568-78. Zaric D, Christiansen C, Pace NL, Punjasawadwong Y. Transient neurologic symptoms after spinal anesthesia with lidocaine versus other local anesthetics: A systematic review of randomized, controlled trials. AnesthAnalg 2005; 100:1811-6.
8. Brockway MS, Bannister J, McClure JH, McKeown D, Wildsmith JA. Comparison of extradural ropivacaine and bupivacaine. Br J Anaesth 1991; 66:31-7.
9. Morrison LM, Emanuelsson BM, McClure JH, Pollok AJ, McKeown DW, Brockway M, et al. Efficacy and kinetics of extradural ropivacaine: Comparison with bupivacaine. Br J Anaesth 1994; 72:164-9.]
10. McDonald SB, Liu SS, Kopacz DJ, Stephenson CA. Hyperbaric spinal ropivacaine: A comparison to bupivacaine in volunteers. Anesthesiology 1999; 90:971-7.
11. Gautier PE, De Kock M, Van Steenberge A, Poth N, Lahaye-Goffart B, Fanard L, et al. Intrathecal ropivacaine for ambulatory surgery. Anesthesiology 1999; 91:1239-45.
12. Pratiti J Gohil, Pankti Panchal, Gauri M. Panjabi, Jinal J. Gohil, Ushma H. Thakar, & Raghav R. Rathi. (2023). Anesthetic efficacy and safety of ropivacaine 0.75% versus bupivacaine 0.5% for spinal anesthesia in patients undergoing lower limb orthopedic surgery. Asian Journal of Medical Sciences, 14(10), 9–14.)
13. Shanmugam PS, Ravi M. Comparison study of intrathecal 0.75% ropivacaine heavy versus 0.5% bupivacaine heavy for safety & efficacy of patients posted for elective lower abdominal surgeries: A randomized comparative study. J Pharm Negat Results. 2022;13(Special Issue 9):605-611.