Section: Anaesthesia

Original Research Article

COMPARATIVE STUDY OF THE EFFICACY OF 0.5% HEAVY BUPIVACAINEAND 0.75% HEAVY ROPIVACAINE IN SPINAL ANAESTHESIA FOR LOWER ABDOMINAL SURGERIES IN 18 TO 50 YRS

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ABSTRACT

Background: Spinal anaesthesia is widely used for lower abdominal surgeries because of its rapid onset, reliable sensory and motor blockade, and favorable safety profile. Hyperbaric bupivacaine remains the standard intrathecal local anaesthetic; however, it is associated with prolonged motor blockade and greater hemodynamic fluctuations. Hyperbaric ropivacaine, a newer amide local anaesthetic, offers a potentially safer alternative with less cardiotoxicity, earlier motor recovery, and improved postoperative mobilization. This study compares the efficacy and safety of 0.5% heavy bupivacaine and 0.75% heavy ropivacaine for spinal anaesthesia in lower abdominal surgeries. The aim of the study is to compare the efficacy of 0.5% heavy Bupivacaine and 0.75% heavy Ropivacaine for spinal anaesthesia in patients undergoing lower abdominal surgeries in 18 to 50yrs. The objective is to Time of onset of action, Highest level of sensory and motor blockade, Time of onset of bromage 3, Intraoperative heart rate, blood pressure, spo2, Regression to bromage 0 & Side effects.

Materials and Methods: It was a randomized controlled study includes Patients of either sex aged between 18 to 50 years of ASA- 1 & 2, undergoing surgeriesunder spinal anaesthesia. The study was conducted during the period from August 2023 to January 2025 at Siddhartha medical college, Government General Hospital, Vijayawada. Patients were randomly allocated into two groups. All spinal blocks were performed by a single anesthesiologist who also recorded the observations. GROUP B – 45 patients given 3 ml of 0.5% Hyperbaric Bupivacaine (15mg) GROUP R – 45 patients given 3ml of 0.75% Hyperbaric Ropivacaine (22.5mg)

Results: The present study compared the efficacy and safety of 0.75% heavy ropivacaine and 0.5% heavy bupivacaine for spinal anaesthesia in a cohort of 90 patients. The study aimed to evaluate several key outcomes, including the onset time of sensory and motor blocks, duration of block, hemodynamic effects, pain relief, and complications. The results revealed significant differences in the onset time of sensory and motor blocks, with bupivacaine providing a faster onset of both sensory and motor block compared to ropivacaine. Bupivacaine also reached the T10 sensory level and the highest level of sensory block more quickly than ropivacaine, demonstrating its faster spreading ability in the spinal cord. However, ropivacaine demonstrated a shorter duration of motor block, suggesting a quicker recovery of motor function, which could be beneficial in outpatient surgeries.In terms of hemodynamic effects, bupivacaine caused more pronounced and sustained hypotension compared to ropivacaine. This finding highlights the importance of careful monitoring of blood pressure in patients receiving bupivacaine,

especially those with pre-existing cardiovascular conditions. Although both agents had similar VAS scores at later time points, bupivacaine provided better early pain relief, suggesting it is more effective at providing rapid analgesia in the early stages of anaesthesia. The study also reported no significant differences in complications between the two groups, with both drugs demonstrating a comparable safety profile in terms of hypotension, bradycardia, pruritis, and urinary retention

Conclusion: The findings of this study suggest that the choice between these two agents should be based on the specific needs of the patient and the nature of the surgical procedure. For patients requiring rapid onset and long-lasting sensory block, bupivacaine may be the preferred choice. For patients who need a quicker recovery, particularly those undergoing outpatient procedures, ropivacaine may be the better option. Further studies with larger and more diverse patient populations are needed to confirm these findings and provide additional insights into the optimal use of these agents in different clinical settings.

Keywords: Bupivacaine, Ropivacaine, Spinal Aneasthesia, Sensory Block, Lower abdominal Surgeries

INTRODUCTION

Spinal anaesthesia is a form of neuraxial anaesthesia wherein a local anaesthetic is administered into the cerebrospinal fluid in the lumbar region to anaesthetise the nerves emanating from the spinal cord. Spinal anaesthesia is predominantly utilised for anaesthesia and/or analgesia in various operations involving the lower extremities, lower abdomen, pelvis, and perineum. Spinal anaesthesia is sometimes employed during spinal surgery.[1,2]

Spinal anaesthesia is administered by inserting a needle between the lumbar vertebrae and penetrating the dura to deliver anaesthetic drugs.

Spinal anaesthesia is a commonly used technique of central neuraxial blockade, mostly applied for surgeries involving the lower belly, pelvis, and lower extremities to reduce postoperative complications. Bupivacaine, levobupivacaine, and ropivacaine are often utilised local anaesthetics in neuraxial anaesthesia. Bupivacaine and ropivacaine are categorised as amide local anaesthetics. Nonetheless, bupivacaine is associated with heightened cardiotoxicity. Ropivacaine, a chiral molecule including just the s-enantiomer, offers the advantage of inducing a more targeted blockade, resulting in less motor impairment. This feature can facilitate the early onset of ambulation, hence reducing the probability of deep vein thrombosis and providing additional benefits linked to walking. Ropivacaine and bupivacaine have comparable effectiveness at elevated dosages regarding the lowest local anaesthetic concentration. At reduced dosages, ropivacaine has lesser potency compared to bupivacaine. Consequently, when administered in a 1.5:1 ratio with bupivacaine, ropivacaine yields an equivalent level of block quality while eliciting fewer side effects.[1-4]

Hyperbaric solutions are considered more predictable due to their wider and more concentrated distribution, leading to reduced variability across patients. Ropivacaine was formerly available only as an isobaric formulation; however, the use of dextrose is necessary to create a hyperbaric solution when required. It is crucial to use caution while manually mixing dextrose, since it may provide a risk of infection. Ropivacaine is being marketed as a hyperbaric solution.[2,4,5] Nevertheless, there have been limited thorough evaluations contrasting the effects of 0.75% hyperbaric ropivacaine with those of equipotent hyperbaric bupivacaine at a concentration of 0.5%. Consequently, it is challenging to conclusively assess the advantages and disadvantages of one medicine relative to another (6,7,8). This research aims to assess the effectiveness of 0.5% heavy Bupivacaine and 0.75% heavy Ropivacaine in spinal anaesthesia for lower abdominal procedures in individuals aged 18 to 50 years.

Aims & Objectives

The aim of the study is to compare the efficacy of 0.5% heavy Bupivacaine and 0.75% heavy Ropivacaine for spinal anaesthesia in patients undergoing lower abdominal surgeries in 18 to 50yrs.

Objectives

To study

- Time of onset of action
- Highest level of sensory and motor blockade
- Time of onset of bromage 3
- Intraoperative heart rate, blood pressure, spo2
- Regression to bromage 0
- Side effects

MATERIALS AND METHODS

Study Subjects: Patients of either sex aged between 18 to 50 years of ASA- 1 & 2, undergoing surgeriesunder spinal anaesthesia.

Study Design: Randomised Controlled Study

Study Period: August 2023 to January 2025

Place of Study: Siddhartha medical college, Government General Hospital, Vijayawada.

Inclusion Criteria

- Adult patients of either sex aged between 18 to 50 years
- ASA 1 and 2 physical status undergoing surgeries under spinal anaesthesia.

Exclusion Criteria

- Age <18years and >50years
- ASA Grade 3 & 4
- Infection at the site of injection
- Coagulopathy, Bleeding disorders
- Active disease of CNS
- Congenital anomalies of lower spine
- History of allergy to local anaesthetics
- Pregnancy

Sample Size: n= 90 (45 in each group)

Ethical Considerations: This study was conducted following prior approval from the instituitional ethical committee (IEC). Each participant was provided written informed consent after being thoroughly informed about study purpose, procedures, benefits, and potential risks in a clear and understandable manner. To protect participant confidentiality, the collected data was anonymized by removing names and identification details before analysis. The entire study adhered to the principles outlined in the Declaration of Helsinki.

Study Procedure: After obtaining approval from the Institutional Ethics Committee and written informed consent from all participants, this randomized comparative study was conducted on 90 patients aged 18–50 years, belonging to ASA physical status I and II, posted for elective lower abdominal surgeries under spinal anesthesia. Patients with co-morbid illnesses were excluded.

Randomization: Patients were randomly allocated into two groups. The study drug was prepared by an anesthesiologist not involved in the study. All spinal blocks were performed by a single anesthesiologist who also recorded the observations.

Group B – 45 patients given 3 ml of 0.5% Hyperbaric Bupivacaine (15mg) GROUP R – 45 patients given 3ml of 0.75% Hyperbaric Ropivacaine (22.5mg)

Pre-anesthetic evaluation was performed on the evening prior to surgery.

Patients were kept nil per oral for solids for 6 hours and clear fluids for 2 hours before surgery.

Premedication consisted of tablet Alprazolam 0.5 mg the night before surgery; no premedication was given on the day of surgery.

Intravenous access was secured using an 18G cannula.

Standard intraoperative monitoring included heart rate (HR), systolic, diastolic and mean arterial blood pressure (MAP), electrocardiography (ECG), and oxygen saturation (SpO_2), using a multi-channel monitor.

Patients were placed in the flexed lateral position. After aseptic preparation, lumbar puncture was performed at the L2–L3 or L3–L4 interspace through a midline approach using a Quincke spinal needle. After confirming free flow of cerebrospinal fluid, the study drug was injected into the subarachnoid space. Patients were immediately placed supine with the operating table flat, and supplemental oxygen was administered.

Assessment Parameters:

- Time of onset of action
- Highest level of sensory and motor blockade.
- Time of onset of Bromage 3
- Intraoperative heart rate, Blood pressure, Sp02.
- Regression to Bromage 0.
- Pain assessed using visual analogue(VAS) score
- Side effects

Sensory blockade was evaluated by the pinprick method (23/25G hypodermic needle). Testing was done every 2 minutes for first 10 mins, every 5 minutes for the next 15 minutes, every 10 minutes for the next 30 minutes, and every 1 hour until end of surgery.

Motor blockade was assessed using the Modified Bromage scale. Time to onset of Bromage 3, and regression to Bromage 0, were noted.

Intraoperative monitoring of Heart rate, systolic and diastolic blood pressure, MAP, ECG, SpO_2 was done.

Adverse Effects: Recorded as nausea, vomiting, hypotension, bradycardia, urinary retention, and respiratory depression.

Statistical analysis: All analyses were conducted using SPSS version 26 (SPSS Inc., Chicago, IL). Descriptive statistics were computed. Continuous variables were expressed as mean and standard deviations while categorical data was expressed as frequencies and percentages. Tests of association i.e., independent t-test and Chi-square test were utilised to assess statistical significance of association between continuous variables and categorical variables, respectively. The confidence interval was set at 95%. The results were considered significant with a p-value less than 0.05.

Table 1: Comparison of age group between the groups

Group			
AgeGroup	**0.75% Heavy Ropivacaine**	**0.5% Heavy Bupivacaine**	**Total**
≤ 20	3	5	8
21 –25	16	18	34
26 -30	21	19	40
>30	5	3	8
Total	45	45	90
	p-value= 0.80		

[Table 1] compares the age distribution between the 0.75% heavy ropivacaine and 0.5% heavy bupivacaine groups. The majority of patients in both groups fall within the 21–30 age range. Age group distributions are similar between the two groups, with no statistically significant difference observed (p=0.75), indicating comparability interms of age.

Table 2: Distribution of anthropometry

Index	Group	Mean	Std. Deviation	p-value
Weight in Kgs	0.75% Heavy Ropivacaine 0.5% Heavy Bupivacaine	61.71 64.31	4.71 9.54	0.15
Height in cms	0.75% Heavy Ropivacaine 0.5% Heavy Bupivacaine	159.06 159.37	5.84 7.54	0.85
BMI	0.75% Heavy Ropivacaine 0.5% Heavy Bupivacaine	25.46 26.17	2.51 4.15	0.39

[Table 2] displays that for weight, the 0.75% Heavy Ropivacaine group has a mean of61.71 kg (SD = 4.71) while the 0.5% Heavy Bupivacaine group has a mean of 64.31 kg (SD = 9.54), with a p-value of 0.15 indicating no significant difference. Heights are nearly identical, with the 0.75% Heavy Ropivacaine group averaging 159.06 cm (SD = 5.84) and the 0.5% Heavy Bupivacaine group 159.37 cm (SD = 7.54), and a p-value of 0.85 showing no significant difference. BMI values are also similar, with the 0.75% Heavy Ropivacaine group having a mean of 25.46 (SD = 2.51) and the 0.5% Heavy Bupivacaine group 26.17 (SD = 4.15), and a p-value of 0.39, suggesting no significant difference.

Table 3: Comparison of ASA Grade

Group			
ASA Grade	**0.75% Heavy Ropivacaine**	**0.5% Heavy Bupivacaine**	**Total**
I	35	36	71
II	10	9	19
Total	45	45	90
	p-value = 0.80 (Not Significant)		

[Table 3] compares the ASA (American Society of Anesthesiologists) grades between the two study groups. A majority of patients in both the 0.75% heavy ropivacaine and 0.5% heavy bupivacaine groups were classified as ASA Grade I, with fewer patients in Grade II. The distribution is nearly identical between groups, and the difference is not statistically significant. (p = 0.80), indicating similar preoperative health status.

Table 4: Comparison of baseline vitals

Vital	Group	Mean	Std. Deviation	p-value
PreOp PR	0.75% Heavy Ropivacaine	82.80	10.19	0.10
PreOp PR	0.5% Heavy Bupivacaine	78.97	9.15	
PreOp SBP	0.75% Heavy Ropivacaine	128.14	13.36	0.25
PreOp SBP	0.5% Heavy Bupivacaine	132.31	16.39	
PreOp DBP	0.75% Heavy Ropivacaine	80.51	9.06	0.32
PreOp DBP	0.5% Heavy Bupivacaine	83.37	14.35	
PreOp SpO2	0.75% Heavy Ropivacaine	98.77	0.88	0.33
PreOp SpO2	0.5% Heavy Bupivacaine	99.03	1.27	

[Table 4] compares baseline vital signs between the 0.75% Heavy Ropivacaine and 0.5% Heavy Bupivacaine groups. For preoperative pulse rate (PR), the 0.75% Heavy Ropivacaine group has a mean of 82.80 (SD = 10.19) compared to 78.97 (SD = 9.15) in the 0.5% Heavy Bupivacaine group, with a p-value of 0.10, indicating no significant difference. Systolic blood pressure (SBP) is 128.14 (SD = 13.36) for 0.75% Heavy Ropivacaine and 132.31 (SD = 16.39) for 0.5% Heavy Bupivacaine, with a p-value of 0.25, showing no significant difference. Diastolic blood pressure (DBP) averages 80.51 (SD = 9.06) in the 0.75% Heavy Ropivacaine group and 83.37 (SD = 14.35) in the 0.5% Heavy Bupivacaine group, with a p-value of 0.32, indicating no significant difference. Preoperative oxygen saturation (SpO2) is 98.77% (SD = 0.88) for 0.75%

Table 5: Comparison of time of onset of sensory block

Time of onset of Sensory Block	Mean	Standard Deviation
0.75% Heavy Ropivacaine	4.24	1.33
0.5% Heavy Bupivacaine	2.90	1.24
p-value = 0.001 (Statistically Significant)		

[Table 5] compares the time of onset of sensory block between 0.75% heavy Ropivacaine and 0.5% heavy Bupivacaine. The onset was significantly faster with Bupivacaine (mean = 2.90 ± 1.24 minutes) comparedto Ropivacaine (mean = 4.24 ± 1.33 minutes). The difference is statistically significant (p = 0.001), indicating that Bupivacaine provides a quicker onset of sensory block than Ropivacaine.

Table 6: Comparison of time of onset of motor block

Time of onset of Motor Block	Mean	Standard Deviation
0.75% Heavy Ropivacaine	9.23	2.54
0.5% Heavy Bupivacaine	8.14	3.68
p-value = 0.65 (Statistically Significant)		

[Table 6] compares the time of onset of motor block between 0.75% heavy Ropivacaine and 0.5% heavy Bupivacaine. Although Ropivacaine had a slightly longer mean onset time (9.23 ± 2.54 minutes) compared to Bupivacaine (8.14 ± 3.68 minutes), the difference was not statistically significant (p = 0.65), indicating comparable onset times for motor block between the two agents.

Table 7: Comparison of time to reach T10 level

Time to reach T10 level	Mean	Standard Deviation
0.75% Heavy Ropivacaine	6.24	2.11
0.5% Heavy Bupivacaine	4.26	1.12
p-value = 0.04 (Statistically Significant)		

[Table 7] compares the time taken to reach the T10 sensory level between 0.75% heavy Ropivacaine and 0.5% heavy Bupivacaine. Bupivacaine reached the T10 level significantly faster (mean = 4.26 ± 1.12 minutes) than Ropivacaine (mean = 6.24 ± 2.11 minutes). The difference is statistically significant (p = 0.02), suggesting a more rapid cephalad spread of sensory block with Bupivacaine.

Table 8: Comparison of time taken to achieve the highest level of block

Time to achieve the highest level of block	Mean	Standard Deviation
0.75% Heavy Ropivacaine	14.98	1.65
0.5% Heavy Bupivacaine	10.22	1.26
p-value = 0.02 (Statistically Significant)		

[Table 8] compares the time taken to achieve the highest level of sensory block between 0.75% heavy Ropivacaine and 0.5% heavy Bupivacaine. Ropivacaine took significantly longer (mean = 14.98 ± 1.65 minutes) compared to Bupivacaine (mean = 10.22 ± 1.26 minutes). The difference is statistically significant (p = 0.02), indicating a faster onset to peak sensory level with Bupivacaine.

Table 9: Comparison of Pulse Rate between both groups

Pulse Rate	0.5% Heavy Bupivacaine	0.75% Heavy Ropivacaine	p-value
At 0 min	83.11 ± 10.99	82.84 ± 11.39	0.87
At 5th min	83.91 ± 13.64	81.99 ± 9.62	0.10
At 10th min	82.69 ± 13.86	81.77 ± 8.87	0.65
At 15th min	83.66 ± 10.77	82.84 ± 5.65	0.26
At 20th min	82.92 ± 10.23	81.51 ± 16.31	0.84
At 25th min	81.69 ± 9.31	80.03 ± 11.23	0.56
At 30th min	80.86 ± 9.51	79.29 ± 11.45	0.78

[Table 9] compares pulse rates at various time intervals between patients receiving 0.5% heavy Bupivacaine and 0.75% heavy Ropivacaine. At all time points from baseline to 30 minutes, pulse rates were comparable between the two groups, with no statistically significant differences observed (all p-values > 0.05). This indicates that both anesthetic agents had a similar effect on heart rate over the observation period.

Table 10: Comparison of Systolic Blood Pressure between both groups

SBP	0.75% Heavy Ropivacaine	0.5% Heavy Bupivacaine	p-value
At 0 min	131.86 ± 20.04	128.20 ± 11.05	0.65
At 5th min	126.60 ± 14.73	124.49 ± 14.52	0.68
At 10th min	119.29 ± 17.37	112.34 ± 14.44	0.03
At 15th min	114.83 ± 17.33	109.71 ± 17.37	0.02
At 20th min	113.69 ± 15.04	108.11 ± 15.91	0.05
At 25th min	113.14 ± 15.00	107.49 ± 23.29	0.04
At 30th min	112.09 ± 12.85	106.09 ± 10.58	0.01

[Table 10] compares systolic blood pressure (SBP) between the 0.75% heavy Ropivacaine and 0.5% heavy Bupivacaine groups over time. Both groups had similar baseline SBP values. However, from the 5th minute onward, the Bupivacaine group consistently exhibited significantly lower SBP readings compared to the Ropivacaine group, with p-values ranging from <0.001 to 0.01. This indicates a more pronounced and sustained hypotensive effect with Bupivacaine during the intraoperative period.

Table 11: Comparison of Diastolic Blood Pressure between both groups

DBP	0.75% Heavy Ropivacaine	0.5% Heavy Bupivacaine	p-value
At 0 min	85.57 ± 9.16	83.83 ± 9.04	0.42
At 5th min	82.51 ± 8.99	75.97 ± 9.35	< 0.001
At 10th min	78.54 ± 9.72	73.51 ± 10.99	0.03
At 15th min	74.89 ± 8.21	71.57 ± 17.37	0.02
At 20th min	75.11 ± 7.97	71.03 ± 9.76	0.05
At 25th min	74.69 ± 7.25	72.31 ± 9.84	0.04
At 30th min	75.91 ± 10.81	71.89 ± 7.54	0.02

[Table 11] compares diastolic blood pressure (DBP) between the 0.75% heavy Ropivacaine and 0.5% heavy Bupivacaine groups across various time points. While baseline DBP was similar, the Bupivacaine group consistently exhibited lower DBP values from the 5th minute onward. The differences were statistically significant at all measured intervals except baseline ($p < 0.05$), with the most significant drop noted at the 5th minute ($p < 0.001$). These findings suggest that Bupivacaine induces a greater and earlier reduction in diastolic blood pressure compared to Ropivacaine.

Table 12: Comparison of Mean Arterial Blood Pressure between both groups

MAP	0.75% Heavy Ropivacaine	0.5% Heavy Bupivacaine	p-value
At 0 min	92.71 ± 14.77	88.91 ± 12.45	0.21
At 5th min	91.83 ± 12.05	82.51 ± 13.33	< 0.001
At 10th min	88.09 ± 12.43	77.97 ± 13.90	0.01
At 15th min	85.43 ± 12.46	76.46 ± 13.21	< 0.001
At 20th min	84.29 ± 14.07	76.49 ± 13.62	0.01
At 25th min	82.77 ± 12.91	76.03 ± 13.11	0.03
At 30th min	82.09 ± 13.28	76.17 ± 10.82	0.04

[Table 12] compares mean arterial pressure (MAP) between the 0.75% heavy Ropivacaine and 0.5% heavy Bupivacaine groups over time. Although baseline MAP values were comparable ($p = 0.21$), the Bupivacaine group consistently demonstrated significantly lower MAP from the 5th minute onwards ($p < 0.05$ at all time points). The most marked difference occurred at the 5th and 15th minutes ($p < 0.001$), indicating that Bupivacaine produces a more pronounced and sustained hypotensive effect compared to Ropivacaine.

Table 13: Comparison of VAS score between both groups

VAS Score	0.5% Heavy Bupivacaine	0.75% Heavy Ropivacaine	p-value
At 0 min	1.91 ± 0.89	3.31 ± 1.62	0.21
At 5th min	1.11 ± 0.68	2.09 ± 1.52	0.01
At 10th min	0.43 ± 0.50	1.31 ± 0.96	0.03
At 15th min	0.00 ± 0.00	0.49 ± 0.74	0.46
At 20th min	0.00 ± 0.00	0.14 ± 0.43	0.31
At 25th min	0.00 ± 0.00	0.00 ± 0.00	1.00
At 30th min	0.00 ± 0.00	0.00 ± 0.00	1.00

[Table 13] compares Visual Analog Scale (VAS) scores between the 0.5% Heavy Bupivacaine and 0.75% Heavy Ropivacaine groups at various times. At 0 minutes, there was no significant difference in VAS scores between the groups (0.5% Heavy Bupivacaine: 1.91 ± 0.89, 0.75% Heavy Ropivacaine: 3.31 ± 1.62, $p = 0.21$). Significant differences were noted at 5 and 10 minutes, with 0.5% Heavy Bupivacaine showing lower VAS scores compared to 0.75% Heavy Ropivacaine ($p = 0.01$ and $p = 0.03$, respectively). No significant differences were found at 15, 20, 25, and 30 minutes ($p = 0.46$, $p = 0.31$, $p = 1.00$, and $p = 1.00$, respectively), where both groups reported minimal pain.

Table 14: Complications between both groups

Complications	0.5% Heavy Bupivacaine	0.75% Heavy Ropivacaine	p-value
Vomiting	0	0	-
Pruritis	0	0	-
Hypotension	5	2	0.46

Bradycardia	2	0	0.84
Urinary Retention	0	0	-
Respiratory Depression	0	0	-

[Table 14] shows that hypotension occurred in 5 patients in the Bupivacaine group and in 2 patients in the Ropivacaine group (p = 0.46). Nausea was reported in 1 patient receiving bupivacaine and none in the ropivacaine group (p = 0.84). Bradycardia was observed in 2 patients in the Bupivacine group and 1 patient in the Ropivacaine group (p = 0.54). None of these differences were statistically significant, indicating a comparable safety profile between the two drugs in terms of observed complications.

Table 15: Comparison of duration of motor blockage (Regression to Bromage 0)

Duration of motor blockage	Mean	Standard Deviation
0.75% Heavy Ropivacaine	122.46	34.26
0.5% Heavy Bupivacaine	166.84	32.15
p-value < 0.001 (Statistically Significant)		

[Table 15] compares the duration of motor block, measured as time to regression to Bromage 0, between the two groups. The motor block lasted significantly longer with 0.5% heavy Bupivacaine (mean = 166.84 ± 32.15 minutes) compared to 0.75% heavy Ropivacaine (mean = 122.46 ± 34.26 minutes). This difference is statistically significant (p < 0.001), indicating that Bupivacaine produces a more prolonged motor blockade than Ropivacaine.

DISCUSSION

Age Distribution Comparison: [Table 1] compares the age distribution between two groups: the 0.75% Heavy Ropivacaine group and the 0.5% Heavy Bupivacaine group. In both groups, the majority of patients fell within the 21–30 age range. Specifically, in the 0.75% Heavy Ropivacaine group, 21 patients were aged 21-25 years and 16 were aged 26-30 years. Similarly, in the 0.5% Heavy Bupivacaine group, 18 patients were aged 21-25 years, and 19 were aged 26-30 years. The difference in age distribution between the two groups was not statistically significant (p-value = 0.80), indicating that both groups were comparable in terms of age.

In a study conducted by Yennawar et al. in 2017, two groups were compared: Group A received 3ml of 0.5% hyperbaric bupivacaine, while Group B received 3ml of 0.75% isobaric ropivacaine. The mean age of patients in Group A was64.39 years, while the mean age of patients in Group B was 65.46 years.[9]

Anthropometric Characteristics: [Table 2] displays the anthropometric data, comparing weight, height, and BMI across both groups. The 0.75% Heavy Ropivacaine group had a mean weight of 61.71 kg (SD = 4.71) and the 0.5% Heavy Bupivacaine group had a mean weight of 64.31 kg (SD = 9.54), with a p-value of 0.15, suggesting no significant difference in weight. Heights were almost identical: 159.06 cm (SD = 5.84) for Ropivacaine and 159.37 cm (SD = 7.54) for Bupivacaine, with a p-value of 0.85. BMI values also showed nosignificant difference, with a p-value of 0.39. These results suggest that both groups were similar in terms of body weight, height, and BMI.

ASA Classification: The ASA grade distribution in [Table 3] showed that the majority of patients in both groups were classified as ASA Grade I (healthy patients), with fewer patients classified as Grade II (mild systemic disease). There was no significant difference between the groups in terms of ASA grade (p-value = 0.80), further suggesting that the preoperative health status of both groups was comparable.

Baseline Vital Signs: [Table 4] compares the baseline vital signs between the two groups. The preoperative pulse rate, systolic and diastolic blood pressures (SBP and DBP), and oxygen saturation (SpO2) were all similar between the 0.75% Heavy Ropivacaine and 0.5% Heavy Bupivacaine groups. For instance, the mean preoperative pulse rate was 82.80 (SD = 10.19) for Ropivacaine and 78.97 (SD = 9.15) for Bupivacaine, with a p-value of 0.10 indicating no significant difference. Similarly, preoperative SBP (128.14 vs. 132.31), DBP (80.51 vs. 83.37), and SpO2 (98.77% vs. 99.03%) were comparable, with p-values suggesting no significant differences between the groups

Time to Onset of Sensory Block: [Table 5] compares the time to onset of sensory block between the two groups. The 0.5% Heavy Bupivacaine group exhibited a faster onset of sensory block, with a mean time of 2.90 minutes (SD = 1.24), while the 0.75% Heavy Ropivacaine group had a mean time of 4.24 minutes (SD = 1.33). The difference was statistically significant (p-value = 0.001), suggesting that Bupivacaine provides a quicker onset of sensory block compared to Ropivacaine.

Time to Reach T10 Sensory Level: [Table 7] demonstrates the time taken to reach the T10 sensory level, with Bupivacaine reaching this level more rapidly (mean = 4.26 minutes) compared to Ropivacaine (mean = 6.24 minutes). The difference was statistically significant (p-value = 0.04), indicating that Bupivacaine has a faster cephalad spread of sensory block.

Time to Achieve Maximum Sensory Block Level

[Table 8] shows that the time taken to achieve the highest level of sensory block was shorter with Bupivacaine (mean = 10.22 minutes) compared to Ropivacaine (mean = 14.98 minutes). The difference was statistically significant (p-value = 0.02), further supporting Bupivacaine's faster onset of action.

Blood Pressure and Pulse Rate Changes

[Tables 9-11] compare the pulse rate, systolic blood pressure (SBP), and diastolic blood pressure (DBP) between the two groups at various time intervals. For pulse rate, no significant differences were observed at any time point. However, significant differences were found in blood pressure readings. The Bupivacaine group exhibited lower SBP, DBP, and mean arterial pressure (MAP) compared to the Ropivacaine group from the 5th minute onward, with p-values indicating significant hypotensive effects associated with Bupivacaine.

Visual Analog Scale (VAS) Pain Scores:

[Table 13] compares VAS scores, which assess pain levels at various times post-injection. At 5 minutes and 10 minutes, the Bupivacaine group reported significantly lower pain levels than the Ropivacaine group, with p-values of 0.01 and 0.03, respectively. However, no significant differences were found after 15 minutes, indicating that pain levels were generally minimal in both groups at later time points.

Complications: [Table 14] summarizes the complications observed during the study. Both groups experienced similar complication rates, with hypotension being the most common issue, affecting 5 patients in the Bupivacaine group and 2 in the Ropivacaine group. Other complications such as bradycardia and pruritis were rare, with no significantdifferences between the two groups (p-values > 0.05). This suggests a comparable safety profile for both anesthetic agents.

Duration of Motor Block: [Table 15] compares the duration of motor block between the two groups. The 0.5% Heavy Bupivacaine group had a significantly longer motor block duration (mean = 166.84 minutes) compared to the 0.75% Heavy Ropivacaine group (mean = 122.46 minutes). The difference was statistically significant ($p < 0.001$), suggesting that Bupivacaine provides a longer-lasting motor blockade than Ropivacaine.

Comparison with similar studies: Spinal anesthesia remains a cornerstone in regional anesthesia, particularly for lower abdominal, pelvic, and lower limb surgeries. The choice of local anesthetic agents significantly influences the onset, duration, and quality of the block, as well as the safety profile. This discussion aims to compare the findings of the present study with existing literature on the use of 0.75% heavy ropivacaine and 0.5% heavy bupivacaine in spinal anesthesia.[10]

Onset of Sensory and Motor Block: The present study observed a significantly faster onset of sensory block with 0.5% heavy bupivacaine (mean = 2.90 minutes) compared to 0.75% heavy ropivacaine (mean = 4.24 minutes), with a p-value of 0.001. This finding aligns with Kalbande et al. (2024), who reported that ropivacaine exhibited a slower onset for both sensory (153.90 ± 6.53 seconds) and motor blockades (301 ± 6.62 seconds) compared tobupivacaine (92.46 ± 12.16 seconds and 239.96 ± 6.27 seconds, respectively).

Time to Reach T10 Sensory Level and Maximum Sensory Block: The present study found that bupivacaine reached the T10 sensory level significantly faster (mean = 4.26 minutes) than ropivacaine (mean = 6.24 minutes), with a p-value of 0.04. Similarly, bupivacaine achieved the highest level of sensory block more rapidly (mean = 10.22 minutes) compared to ropivacaine (mean = 14.98 minutes), with a p-value of 0.02. These results are consistent with findings from Boztuğ et al., 2006, who reported that isobaric ropivacaine 15 mg provided a higher sensory block level and shorter sensory onset and offset times than isobaric bupivacaine 7.5 mg.[8]

Duration of Motor Block: The present study observed a significantly longer duration of motor block with 0.5% heavy bupivacaine (mean = 166.84 minutes) compared to 0.75% heavy ropivacaine (mean = 122.46 minutes), with a p-value < 0.001. This finding is corroborated by Bhat et al. (2013), who reported that the duration of motor block was significantly shorter in the ropivacaine group compared with the bupivacaine group.[10]

Hemodynamic Effects: In the present study, bupivacaine induced a more pronounced and sustained hypotensive effect compared to ropivacaine, with significantly lower systolic, diastolic, and mean arterial pressures from the 5th minute onward. These results are in line with Bhat et al. (2013), who observed that ropivacaine caused fewer side effects, including hypotension, compared to bupivacaine.[10]

Pain Relief (VAS Scores): The present study reported significantly lower Visual Analog Scale (VAS) scores at 5 and 10 minutes post-injection in the bupivacaine group compared to the ropivacaine group, indicating better early pain relief with bupivacaine. However, no significant differences were observed at later time points. This is consistent with Kalbande et al. (2024), who found that bupivacaine provided better motor-recovery profiles and fewer side effects.[11]

Complications: The present study observed a comparable safety profile between the two anesthetic agents, with no significant differences in the incidence of complications such as hypotension, bradycardia, pruritis, urinary retention, or respiratory depression. This is consistent with findings from Bhat et al. (2013), who reported no side effects and stable hemodynamics in the ropivacaine group.[10]

In summary, the present study's findings align with existing literature, demonstrating that 0.5% heavy bupivacaine provides a faster onset of sensory and motor blocks, better early pain relief, and a more

pronounced hypotensive effect compared to 0.75% heavy ropivacaine. However, ropivacaine offers a shorter duration of motor block and a better safety profile, with fewer side effects. The choice between these two agents should be guided by the specific clinical requirements, including the desired duration of block, hemodynamic stability, and side effect profile.[12,13]

The study comparing 0.75% heavy ropivacaine and 0.5% heavy bupivacaine for spinal anesthesia provided a detailed analysis of several parameters, including onset timessensory and motor block characteristics, blood pressure changes, pain relief and complications. Both ropivacaine and bupivacaine are widely used local anesthetics, but their pharmacodynamic profiles, including the speed of onset, duration of block, and hemodynamic effects, can vary significantly, making it crucial to compare them for clinical applications.

Ropivacaine is a long-acting local anesthetic that has become increasingly popular for spinal anesthesia due to its favorable safety profile, especially in terms of cardiovascular stability. Bupivacaine, on the other hand, is known for its potent analgesic effects, but it can be associated with a higher incidence of hypotension and other cardiovascular side effects. This study examined the differences in the onset time, duration of sensory and motor blocks, and hemodynamic effects between the two agents, providing insights into their comparative efficacy and safety.

The onset time of sensory block was found to be significantly faster with bupivacaine compared to ropivacaine. This suggests that bupivacaine may be preferable in clinical situations where a rapid onset of anesthesia is required, such as in emergency surgeries or procedures where quick pain relief is necessary. The difference in onset time could be attributed to the pharmacokinetic properties of bupivacaine, which may allow it to reach its site of action more rapidly than ropivacaine. These findings are consistent with previous studies that have also demonstrated a quicker onset of sensory block with bupivacaine compared to ropivacaine, especially when used in similar concentrations and doses.

In contrast, the duration of motor block was significantly longer with bupivacaine, which might make it more suitable for surgeries requiring prolonged motor blockade. For instance, surgeries involving the lower limbs or long-duration procedures may benefitfrom bupivacaine's longer motor block duration, as it helps in providing extended muscle relaxation during the procedure. However, the longer duration of motor block with bupivacaine also raises concerns regarding postoperative mobility, as patients may experience prolonged motor weakness or delayed recovery of motor function, which could impact early ambulation post-surgery. This is an area where ropivacaine's relatively shorter duration of motor block could provide a benefit, especially in outpatient surgeries where early recovery and mobility are desirable.

The hemodynamic effects of both anesthetics were also examined, with bupivacaine causing a more pronounced and sustained hypotensive effect compared to ropivacaine. This observation is significant, as hypotension can be a common side effect of spinal anesthesia, particularly in older patients or those with underlying cardiovascular conditions. While both agents led to decreases in systolic, diastolic, and mean arterial pressures, the degree of hypotension was more pronounced and prolonged in the bupivacaine group. This suggests that while bupivacaine may offer superior pain control, it may also require more careful monitoring of blood pressure, especially in patients at risk of hypotension or cardiovascular instability. Ropivacaine, with its less pronounced effect on blood pressure, may be a better option for patients with significant comorbidities or those who are particularly sensitive to blood pressure fluctuations.

Pain relief was assessed using the Visual Analog Scale (VAS), with bupivacaine providing better early pain relief, particularly at the 5- and 10-minute marks. This suggests that bupivacaine may be more effective at providing immediate analgesia, which is an important consideration in surgeries where rapid and reliable pain control is required. However, the difference between the two agents became less pronounced over time, with both groups reporting minimal pain at the later time points. Thisindicates that while bupivacaine may provide faster relief, the long-term effectiveness of pain control is comparable between the two anesthetics.

In terms of complications, both anesthetics had a similar safety profile, with no significant differences in the incidence of hypotension, bradycardia, pruritis, urinary retention, or respiratory depression. This is a reassuring finding, as it suggests that while there may be differences in the efficacy of the two agents in terms of onset time, block duration, and hemodynamic effects, both are relatively safe when used in the appropriate clinical context. The low incidence of severe complications in both groups reflects the overall safety of spinal anesthesia and highlights the importance of proper patient selection, monitoring, and management during the procedure.

The present study contributes valuable data to the ongoing discussion about the optimal use of ropivacaine and bupivacaine in spinal anaesthesia. While both agents have their advantages and limitations, the choice between them should be guided by the specific requirements of the procedure, patient characteristics, and the desired outcomes in terms of pain relief, hemodynamic stability, and recovery time. Ropivacaine may be preferred in cases where a quicker recovery of motor function and fewer hemodynamic fluctuations are important, while bupivacaine may be more suitable for procedures requiring prolonged anaesthesia and more effective early pain control.

Furthermore, the study's findings are consistent with previous research comparing these two agents, reinforcing the understanding that bupivacaine offers faster onset times and longer duration of block, while ropivacaine provides a safer option in terms of hemodynamic stability and a more controlled sedative effect. The comparison of these two local anaesthetics provides a clearer understanding of their respectiveprofiles, enabling clinicians to make informed decisions based on individual patient needs and surgical requirements.

In conclusion, the findings from this study provide important insights into the relative benefits and drawbacks of 0.75% heavy ropivacaine and 0.5% heavy bupivacaine for spinal anaesthesia. By considering factors such as onset time, duration of block, hemodynamic effects, pain relief, and complications, clinicians can better tailor their anaesthetic approach to optimize patient outcomes. Further research, including larger studies with more diverse patient populations and various surgical procedures, will be necessary to continue refining our understanding of the most appropriate use of these anaesthetics in spinal anaesthesia.

Limitations:

While this study provides valuable insights into the comparative efficacy and safety profiles of 0.75% heavy ropivacaine and 0.5% heavy bupivacaine for spinal anesthesia, several limitations should be considered when interpreting the findings.

- Sample Size and Generalizability
- Exclusion of Certain Patient Groups
- Short-Term Follow-Up
- Lack of Detailed Adverse Event Monitoring
- Single-Center Study Design

CONCLUSION

In conclusion, both 0.75% heavy ropivacaine and 0.5% heavy bupivacaine are effective agents for spinal anaesthesia, each with distinct advantages depending on the clinical requirements. Bupivacaine demonstrated a faster onset of sensory and motor blocks and superior early pain relief, making it a favourable choice for surgeries where rapid onset and potent analgesia are desired. However, the longer duration of motor block and more significant hypotensive effects associated with bupivacaine necessitate careful consideration, particularly in patients who may be at risk for hypotension or require early recovery of motor function. Ropivacaine, on the other hand, provided a shorter duration of motor block and a more favourable safety profile in terms of hemodynamic stability, making it an appropriate choice for patients who need a quicker recovery and are at higher risk for cardiovascular complications.

The findings of this study suggest that the choice between these two agents should be based on the specific needs of the patient and the nature of the surgical procedure. For patients requiring rapid onset and long-lasting sensory block, bupivacaine may be the preferred choice. For patients who need a quicker recovery, particularly those undergoing outpatient procedures, ropivacaine may be the better option. Further studies with larger and more diverse patient populations are needed to confirm these findings and provide additional insights into the optimal use of these agents in different clinical settings.

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