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Original Research Article

A comparative study of spinal anesthesia with hyperbaric ropivacaine plus dexmedetomidine and hyperbaric bupivacaine plus dexmedetomidine in lower abdominal and lower limb surgeries

[1]Dr. T Anusha, [2]Dr. Yalala Shamili, [3]Dr. Kiran Kumar Suggala

[1]Assistant Professor, Mamata Medical College, Khammam, Telangana, India
[2]PG Final Year, Mamata Medical College, Khammam, Telangana, India
[3]Professor and HOD, Mamata Medical College, Khammam, Telangana, India

Corresponding Author:
Dr. Yalala Shamili

Abstract

Aims: The aim of the study is to compare the onset, duration of sensory and motor block, and hemodynamic changes between equipotent doses of 0.75% Ropivacaine H with dexmedetomidine & 0.5% Bupivacaine H with dexmedetomidine.
Materials and Methods: This was a comparative study conducted on ASA grade I and II patients, aged between 18 and 60 years, scheduled for elective lower abdominal and lower limb surgeries. Minimum of 60 patients, divided into two groups, Group R, and Group B (30 patients in each Group). Group R patients received hyperbaric ropivacaine 0.75% 3cc + 10 mcg dexmedetomidine and Group B patients received hyperbaric bupivacaine 0.5% 3cc + 10 mcg dexmedetomidine. Monitoring of vitals and observation for the block parameters were carried out and compared. Categorical data are compared using the Chi-Square test. Continuous variables are compared using a student t-test. P-value < 0.05 is considered significant.
Results: Time taken for sensory onset, maximum sensory block, and complete motor block was faster in group B. Time taken for sensory regression to S1 and duration of motor block was longer in group B. However, subjects in group B experienced lesser mean systolic, diastolic, and mean arterial pressures when compared to group R. Duration of sensory and motor block was increased with the addition of adjuvant Dexmedetomidine.
Conclusion: Spinal anesthesia with intrathecal 0.75% Ropivacaine H with dexmedetomidine has characteristically delayed onset, with a shorter duration of action on the sensory as well as motor nerve roots when compared to 0.5% Bupivacaine H with dexmedetomidine. Complications like hypotension and bradycardia were less in the Ropivacaine group. Compared to the bupivacaine group, better alternative for spinal anesthesia in the geriatric population. With a shorter recovery profile, Ropivacaine is a useful agent for Spinal Anesthesia for the intermediate duration of surgeries and for ambulatory surgeries.

Keywords: 0.75% Hyperbaric Ropivacaine, 0.5% hyperbaric bupivacaine, Dexmedetomidine, Spinal anesthesia

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Introduction

Spinal anesthesia is widely used because of its fast onset and effective sensory and motor blockade for surgeries. Bupivacaine is available as a racemic mixture of its enantiomers, dextro-Bupivacaine, and levobupivacaine [1]. In the last few years, its pure S-enantiomer Ropivacaine has been introduced into clinical practice because of its lower toxic effects on the heart and central nervous system [2, 3-5]. Thus, ropivacaine, with its efficacy, lower propensity for motor block, and reduced potential for CNS toxicity and cardiotoxicity, appears to be an important option for regional anesthesia and management of postoperative pain [6].
Alpha-2 adrenergic receptor agonists such as clonidine and dexmedetomidine have been the focus of interest for their sedative, analgesic, and perioperative sympatholytic properties. Dexmedetomidine α2:α1 selectivity is eight times higher than that of Clonidine [7]. It prolongs the duration of both sensory and motor blockade induced by local anesthetics thereby prolonging the duration of analgesia.

Objective

The aim of the study is to compare the onset, duration of motor and sensory block, and hemodynamic changes between equipotent doses of 0.75% Ropivacaine H with Dexmedetomidine and 0.5% Bupivacaine H with Dexmedetomidine.

Inclusion criteria

Patient willing for study and who has given informed and written consent, belonging to ASA classes 1 & 2 between the age of 18 and 60 years with no local infection and neurological deficit.

Exclusion criteria

Patient's refusal and belonging to ASA grade III and IV with baseline heart rate < 60bpm and baseline BP < 100/50mmHg.Patients who are allergic to protocol drugs and on anti-coagulants. Patients with cardiorespiratory, hepatic, and renal problems and those who are undergoing emergency surgeries

Materials and Methods

This was a comparative study conducted on ASA grade I and II patients, aged between 18 and 60 years, scheduled for elective lower abdominal and lower limb surgeries in Mamata General Hospital for a period of one year after obtaining approval from the institutional ethics committee. Minimum of 60 patients, divided into two groups, Group R, and Group B (30 patients in each Group). Group R patients received hyperbaric ropivacaine 0.75% 3cc + 10 mcg dexmedetomidine and Group B patients received hyperbaric bupivacaine 0.5% 3cc + 10 mcg dexmedetomidine. Patients in the study underwent thorough preoperative evaluation which included history, Hb, PCV, BT, CT, RFT, Blood sugar, ECG, CXR, Platelet count, Blood grouping, and cross-matching done. Hypotension, tachycardia, and bradycardia were noted. Assessment of sensory blockade by pinprick and motor blockade by Modified Bromage scale was done.

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Assessment of sensory block

1. Time of onset of sensory block (Time taken to attain T10 dermatome).
2. Time taken for maximum Sensory block. (Time taken to attain T6 dermatome).
3. Sensory block duration. (Time taken to regress up to S1 dermatome)

Assessment of motor block

1. Time taken for a complete motor block. (Time taken to achieve Bromage score 3).
2. Motor block duration. (Time of regression to Bromage score 0).
3. Grade 3-unable to move feet or knees (complete).
4. Grade 2-able to move feet only (almost complete).
5. Grade 1-just able to move knees (partial).
6. Grade 0-full flexion of feet and knees (none).

Results

Demographics

The demographic characteristics of the two groups did not differ significantly. Table 1 displays the results.

Table 1: Demographic characteristics of the study participants

Parameters	Group B (n=30)	Group R (n=30)	P-value
Age	32.67±8.12	35.12±7.45	0.76
Gender (M: F)	20:10	22:8	0.56
Weight (Kgs)	60.87±8.12	59.76±12.21	0.12
Height	158.43±10.45	160.24±7.12	0.25
ASA (I/II)	13/17	14/16	0.54

Time taken for onset of sensory block (minutes)

Time taken for onset of sensory block was observed to be longer in Group R compared to group B (4.32±0.48 vs 2.18±0.19 mins; p=0.001). Table 2 displays the results.

Table 2: Time taken for onset of sensory block between the two groups

Parameters	Group B (n=30)	Group R (n=30)	P value
Time taken for onset of sensory block (mins)	2.18±0.19	4.32±0.48	0.001

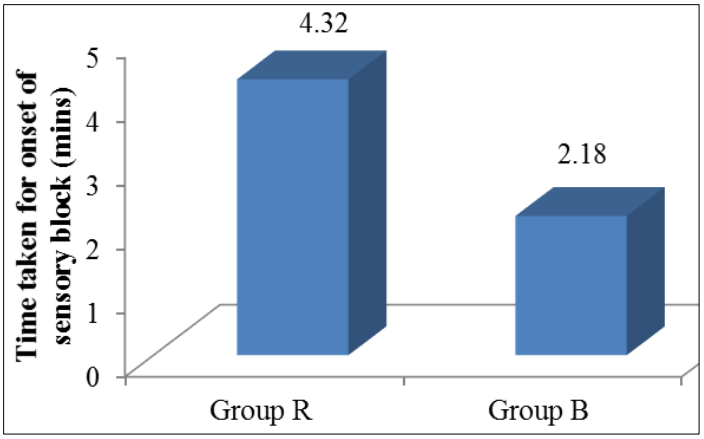

Fig 1: Time taken for onset of sensory block between the two groups

Time taken to attain maximum sensory blockade

The time taken to attain maximum sensory blockade was observed to be significantly longer in group R as compared to group B (15.25±4.12 vs 7.56±2.48 mins; p=0.006). Table 3 displays the results.

Table 3: Time taken to attain maximum sensory blockade between the two groups

Parameters	Group B (n=30)	Group R (n=30)	P value
The time taken to attain maximum sensory blockade (mins)	7.56±2.48	15.25±4.12	0.006

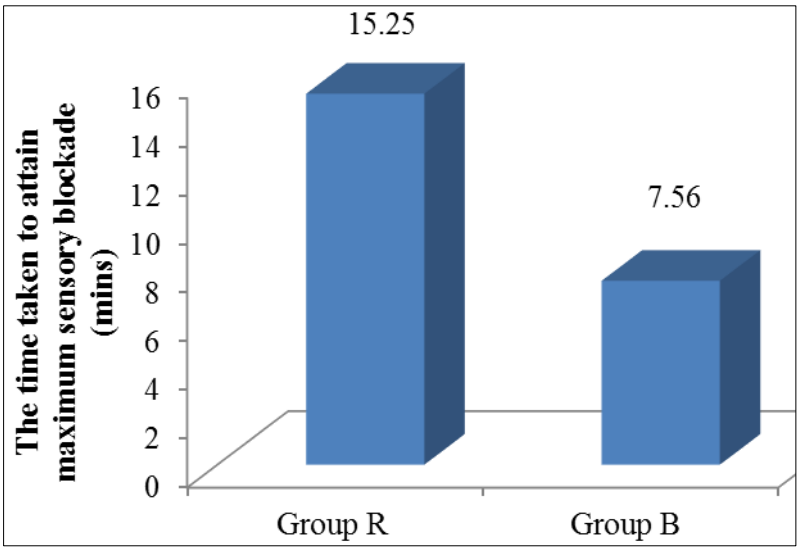

Fig 2: Time taken to attain maximum sensory blockade between the two groups

Time taken for regression of sensory block to S1

The time taken for regression of sensory block to S1 was observed to be significantly longer in group B as compared to group R (320.56±38.34 vs 218.33±30.36 min; p=0.006). Table 4 displays the results.

Table 4: Time taken for regression of Sensory block to S1 between the two groups

Parameters	Group B (n=30)	Group R (n=30)	P value
The time taken for regression of sensory block to S1 (mins)	320.56±38.34	218.33±30.36	0.002

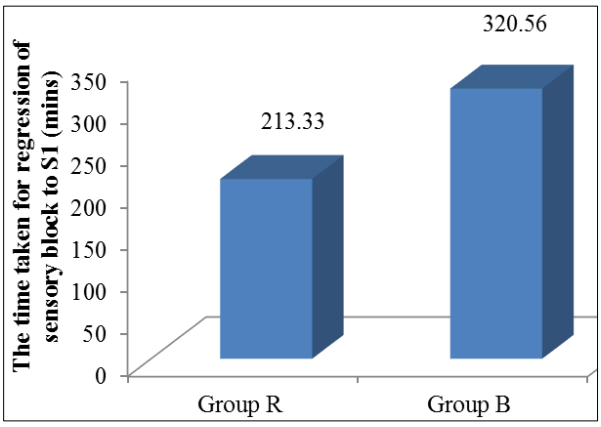

Fig 3: Time taken for Sensory regression to S1 between the groups

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Time taken to attain complete motor block

The time taken to attain complete motor block was observed to be significantly longer in group R compared to group B (6.21±1.65 vs 3.65±0.76 mins; p=0.000). Table 5 displays the results.

Table 5: Time taken to attain complete motor block between the two groups.

Parameters	Group B (n=30)	Group R (n=30)	P value
The time taken to attain complete motor block (min)	3.65±0.76	6.21±1.65	0.000

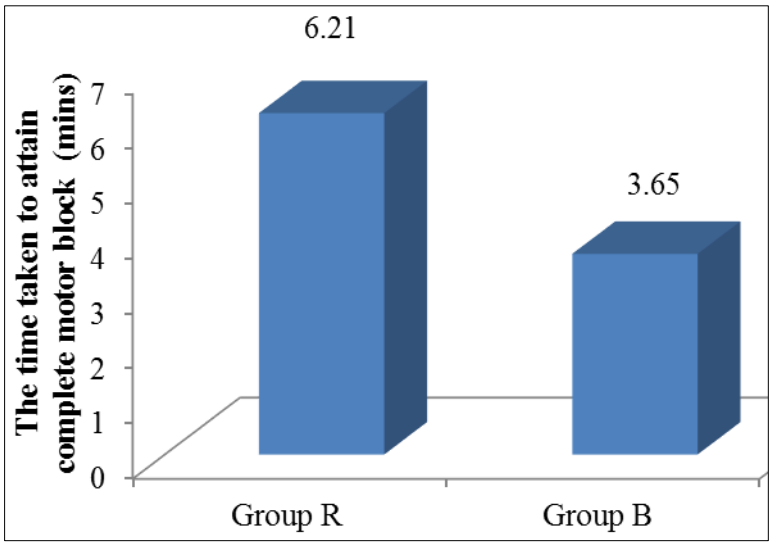

Fig 4: Time taken to attain complete motor block

Motor block duration

Motor block duration was observed to be significantly shorter in group R as compared to group B and it was found to be significant (189.45 ±24.65 vs 312±35.25 mins; p= 0.006). Table 6 displays the results.

Table 6: Motor block duration between the two groups

Parameters	Group B (n=30)	Group R (n=30)	P-value
Motor block duration (mins)	312.42 ±35.25	189.45 ±24.65	0.006

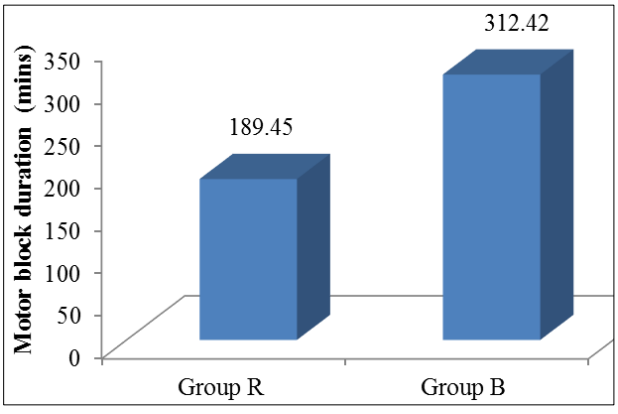

Fig 5: Motor block duration between the two groups

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Table 7: Comparison of mean heart rate between the two study groups at various points of time (n=60)

Time	Group Bupivacaine (N=30)		Group Ropivacaine (N=30)		P value
	Mean HR (/min)	SD	Mean HR (/min)	SD	
0 min	79.2	7.8	76.6	8.8	0.329
3 min	77.4	7.8	75.2	8.9	0.421
6 min	76.7	7.8	74.4	8.6	0.381
9 min	75.3	7.4	72.8	9.0	0.343
12 min	73.9	6.7	71.7	9.1	0.390
15 min	73.6	5.4	72.2	8.6	0.527
20 min	72.7	5.8	71.5	9.0	0.617
25 min	72.8	4.3	71.6	9.0	0.593
30 min	71.5	5.5	71.5	8.1	0.982
35 min	70.9	5.6	71.4	7.5	0.831
40 min	71.3	5.6	70.7	7.2	0.770
45 min	70.3	4.9	70.9	6.9	0.753
50 min	69.9	5.2	71.4	7.1	0.436
55 min	69.8	6.0	71.5	6.9	0.399
60 min	70.5	4.9	72.2	6.6	0.358
70 min	71.1	5.6	72.4	6.4	0.482
80 min	71.5	5.9	72.1	6.3	0.758
90 min	71.9	6.0	71.7	6.2	0.918
120 min	72.5	6.1	72.4	5.9	0.958
180 min	74.9	7.5	72.2	6.0	0.225
240 min	74.7	7.7	72.2	6.5	0.274
300 min	73.7	7.5	73.2	5.8	0.833
360 min	72.8	5.8	73.6	7.5	0.709

Two groups showed no significant difference in the mean heart rate throughout the intraoperative period.

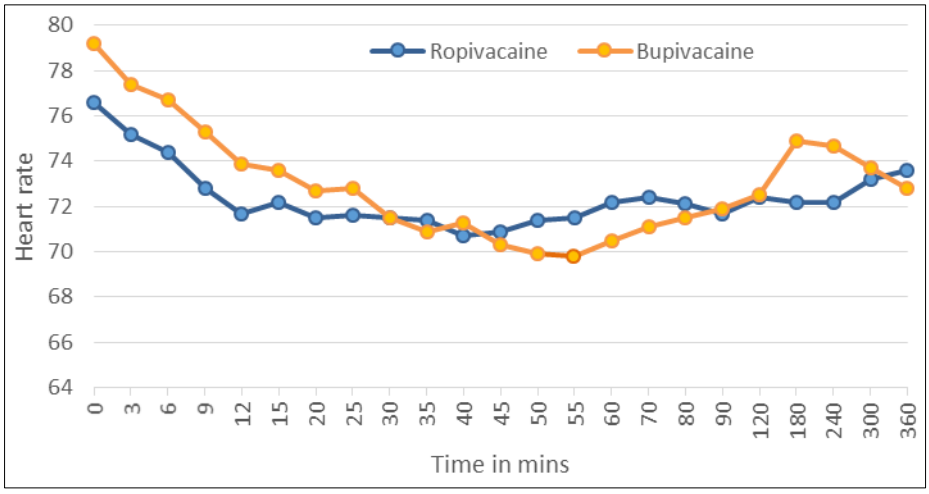

Fig 6: Comparison of mean heart rate between the two study groups at various points of time (n=60)

Table 8: Comparison of mean systolic blood pressure (SBP) between the two study groups at various points of time (n=60)

Time	Group Bupivacaine (N=30)		Group Ropivacaine (N=30)		P value
	Mean SBP (mmHg)	SD	Mean SBP (mmHg)	SD	
0 min	124.7	10.1	123.4	11.0	0.710
3 min	113.9	8.2	119.1	9.5	0.072

6 min	110.4	6.9	116.8	10.4	0.027
9 min	107.9	6.1	114.9	9.3	0.008
12 min	110.5	6.0	113.6	7.7	0.164
15 min	110.5	4.5	112.6	7.7	0.299
20 min	110.4	4.1	113.2	7.5	0.151
25 min	111.0	3.9	113.8	6.0	0.088
30 min	111.3	5.7	115.2	7.6	0.074
35 min	111.4	5.6	117.0	6.9	0.007
40 min	113.4	5.3	117.3	6.6	0.047
45 min	113.4	4.5	118.5	6.9	0.009
50 min	109.3	21.9	118.4	7.2	0.085
55 min	117.1	6.3	118.4	6.7	0.530
60 min	115.3	25.4	119.1	6.8	0.523
70 min	120.9	8.0	119.4	7.1	0.536
80 min	115.9	24.9	120.3	6.8	0.445
90 min	122.1	6.2	120.8	7.3	0.546
120 min	111.5	5.1	121.2	7.5	<0.001
180 min	113.4	4.6	122.8	6.9	<0.001
240 min	113.5	4.2	123.0	7.4	<0.001
300 min	109.6	22.1	122.5	7.8	0.018
360 min	116.7	6.2	123.2	7.9	0.006

Two groups showed significant differences in mean Systolic blood pressure at several points of time. Lesser systolic blood pressures were observed in subjects of the Bupivacaine group than in subjects of the Ropivacaine group.

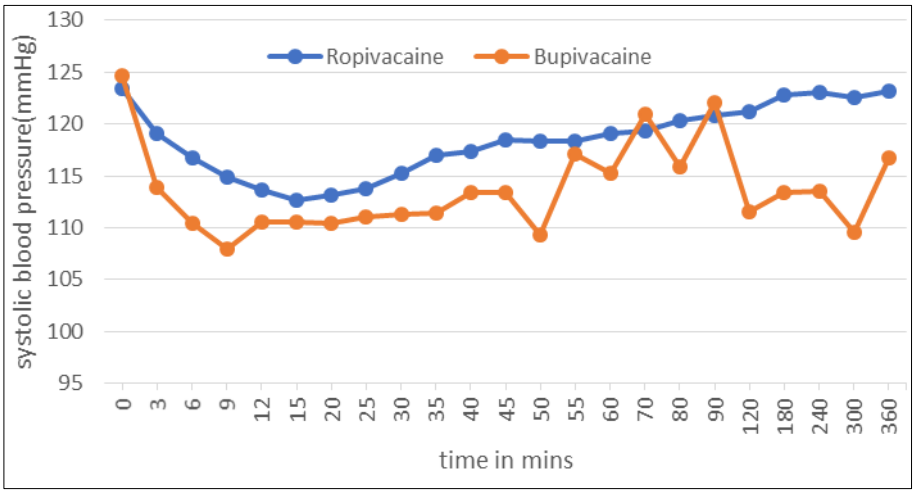

Fig 7: Comparison of mean systolic blood pressure between the two study groups at various points of time (n=60)

Table 9: Comparison of mean diastolic blood pressure (DBP) between the two study groups at various points of time (n=60)

Time	Group Ropivacaine (N=30)		Group Bupivacaine (N=30)		P value
	Mean DBP (mm Hg)	SD	Mean DBP (mm Hg)	SD	
0 min	82.6	7.6	73.6	6.7	0.000
3 min	72.8	17.1	69.7	5.8	0.446
6 min	75.2	6.4	67.8	5.9	0.001
9 min	74.9	7.0	67.9	5.8	0.001
12 min	75.9	7.1	66.6	4.9	0.000
15 min	74.3	6.2	66.1	4.1	0.000

20 min	73.9	7.5	67.8	4.9	0.004
25 min	73.2	7.5	67.9	4.1	0.009
30 min	70.7	7.8	68.4	4.2	0.253
35 min	72.4	7.0	69.5	4.4	0.126
40 min	72.8	6.5	69.7	4.7	0.092
45 min	72.4	7.0	70.8	4.2	0.390
50 min	72.4	8.0	70.7	4.1	0.403
55 min	71.6	8.3	71.8	4.0	0.923
60 min	74.3	7.4	72.2	4.3	0.280
70 min	73.9	6.8	72.6	4.5	0.478
80 min	74.1	7.5	71.7	4.3	0.221
90 min	75.4	7.9	71.4	4.1	0.054
120 min	75.9	7.2	72.6	4.6	0.091
180 min	76.2	6.8	73.2	5.4	0.130
240 min	76.6	8.0	73.4	5.5	0.149
300 min	76.6	7.9	73.9	5.2	0.211
360 min	74.6	8.5	73.4	4.9	0.587

Two groups showed significant differences in mean Diastolic blood pressure at the initial period of the intraoperative period. Lesser diastolic blood pressures were observed in subjects of the Bupivacaine group than in subjects of the Ropivacaine group.

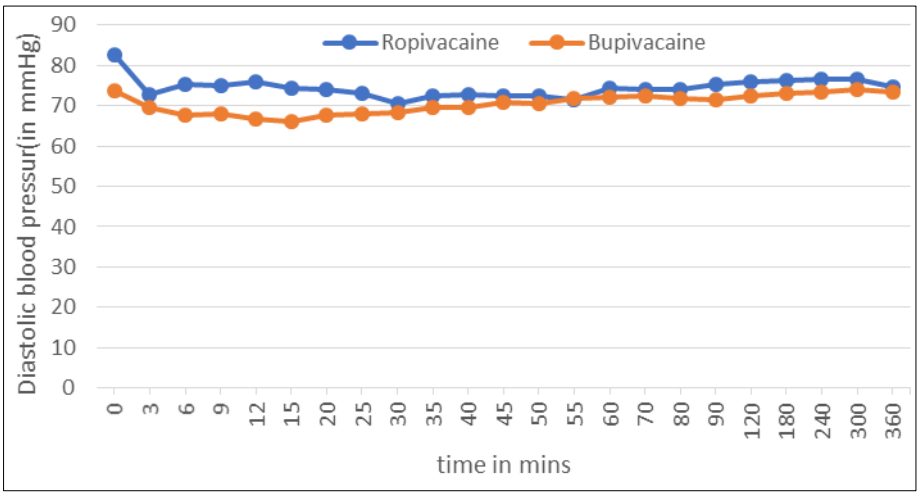

Fig 8: Comparison of mean diastolic blood pressure between the two study groups at various points of time (n=60)

Table 10: Comparison of mean arterial blood pressure (MAP) between the two study groups at various points of time (n=60)

Time	Group Ropivacaine (N=30)		Group Bupivacaine (N=30)		P value
	Mean MAP (mm Hg)	SD	Mean MAP (mm Hg)	SD	
0 min	97.9	6.1	90.3	7.9	0.002
3 min	89.0	7.2	86.1	6.6	0.193
6 min	86.9	5.8	82.6	4.6	0.014
9 min	85.9	5.9	82.3	4.6	0.035
12 min	82.4	18.1	82.3	3.5	0.971
15 min	86.1	4.7	81.7	4.8	0.007
20 min	86.3	5.5	82.8	4.8	0.038
25 min	85.7	5.4	83.4	4.5	0.158
30 min	84.4	6.0	83.9	4.6	0.769
35 min	85.4	5.0	85.3	4.2	0.919

40 min	85.7	4.0	85.5	4.7	0.913
45 min	86.3	4.5	86.1	4.4	0.888
50 min	86.5	5.6	86.2	4.3	0.850
55 min	86.7	5.9	87.4	4.4	0.672
60 min	89.7	5.1	87.7	4.4	0.194
70 min	85.8	18.8	88.0	4.2	0.604
80 min	89.6	5.1	88.2	4.5	0.359
90 min	90.0	5.3	87.9	4.2	0.174
120 min	91.0	5.1	89.0	4.5	0.207
180 min	84.8	4.6	89.1	4.7	0.005
240 min	84.4	4.6	89.6	4.8	0.001
300 min	84.9	3.7	89.9	5.4	0.002
360 min	85.9	3.5	90.0	4.7	0.003

Two groups showed significant differences in mean arterial pressure both in the initial period and towards the end of the period. Lesser mean arterial pressures were observed in subjects of the Bupivacaine group than in subjects of the Ropivacaine group.

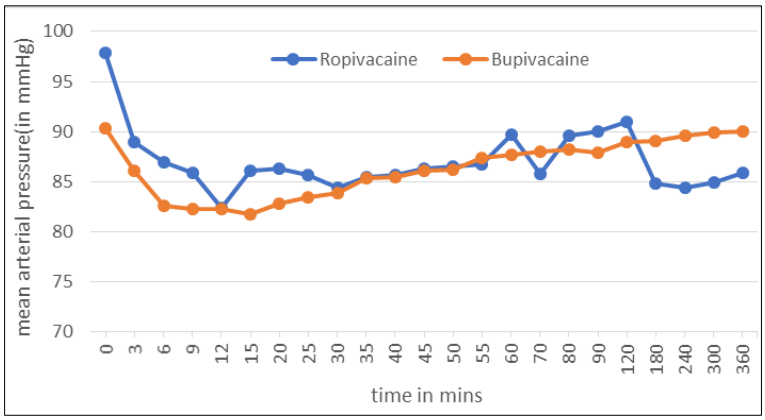

Fig 9: Comparison of mean arterial blood pressure between the two study groups at various points of time (n=60)

Discussion

Ropivacaine is a pure enantiomer and long-acting amide local anesthetic. Its lipid solubility is low making it less likely to penetrate large myelinated motor fibers which relate to the blocking of nerve fibers involved in the transmission of pain (Aδ and C fibers) to a greater degree, compared to that of controlling motor functions (Aβ fibers). This feature is useful when the motor blockade is undesirable [7].

Sanchez *et al.* in 2009 compared the effects of intrathecal isobaric Ropivacaine (IR) versus isobaric Bupivacaine (IB) in a dose ratio of 3:2 in non-ambulatory urologic and orthopedic surgery. They concluded that the motor blockade was shorter in the IR Group (226.4 ± 22.3 min) when compared to the IB Group (266.5+/- 29.5) $p < 0.001$ [8]. Similarly, we noted that motor block duration was shorter in the Ropivacaine group when compared to the Bupivacaine group.

Spinal adjuvants decrease the dose of local anesthetics. Dexmedetomidine provides stable hemodynamics, minimal side effects, and good quality intraoperative and postoperative analgesia [9]. Whiteside and others observed that the mean time of onset of motor block was 10 min and 15 min and the total duration of motor block was around 180 min and 90 min with a similar dose of hyperbaric Bupivacaine (15mg) and Ropivacaine (15mg) respectively [10]. We found the total duration of motor blocks in group B and group R was around 312±35.25 and189.45 ±24.65 respectively. Duration of motor block increased with the addition of adjuvant Dexmedetomidine.

We noted that the ropivacaine group had good sensory block than bupivacaine, a shorter time to first micturition, and a favorable recovery profile of motor blockade. These features are beneficial for ambulatory surgery.

Conclusion

Spinal anesthesia for lower abdominal and lower limb surgeries with intrathecal 0.75% Ropivacaine H with dexmedetomidine has delayed onset, with a shorter duration of action on both motor and sensory nerve roots when compared to 0.5% Bupivacaine H with dexmedetomidine. The Ropivacaine group experienced fewer complications like hypotension and bradycardia. Compared to the bupivacaine group, better alternative for spinal anesthesia in the geriatric population. With a shorter recovery profile, Ropivacaine is a useful agent for Spinal Anesthesia for the intermediate duration of surgeries and for ambulatory surgeries.

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Conflict of interest: None.

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