Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2018/234

Original Article

A Comparative Study between Bupivacaine 0.5% and Ropivacaine 0.75% in Epidural Analgesia in Patients Undergoing Elective Lower Abdominal and Lower Limb Surgeries

G Shravan Kumar[1], R Shanthan Kumar[2], Laxmi Kanth[3], M Srinath[4]

[1]Associate Professor, Department of Anaesthesiology and Intensive Care, Kakatiya Medical College, Mahatma Gandhi Memorial Hospital, Warangal, Telangana, India, [2]Associate Professor, Kakatiya Medical College, Warangal, Telangana, India, [3]Junior Resident, Department of Anaesthesiology and Intensive Care, Kakatiya Medical College, Mahatma Gandhi Memorial Hospital, Warangal, Telangana, India

Abstract

Background: Regional anesthesia is noted for its simplicity, safety, and effectiveness. Although spinal anesthesia provides an efficient block, it has some limitations. Epidural anesthesia is one of regional techniques for lower abdominal and lower limb surgeries. Bupivacaine is the drug of choice for providing effective epidural analgesia. Ropivacaine is new long-acting local anesthetic with similar chemical structure but with less cardiotoxicity and central nervous system toxicity. We did a prospective randomized control study to compare between two groups - 20 ml of 0.75% ropivacaine (isobaric) and 20 ml 0.5% bupivacaine (isobaric) for epidural anesthesia in lower abdominal and lower limb surgeries in adults aged 18–60 years.

Aim: The study aimed to compare in two groups - 20 ml of 0.75% ropivacaine (isobaric) and 20 ml 0.5% bupivacaine (isobaric) for epidural analgesia in lower abdominal and lower limb surgeries in adults.

Design: This was a prospective randomized control study**.**

Methods: The study population was randomly divided into 2 groups with 30 patients in each group. Study Group R - received 20 ml of 0.75% ropivacaine (isobaric) by epidural route study Group B - received 20 ml of 0.5% bupivacaine (isobaric) by epidural route and compared (1) onset of sensory and motor block, (2) highest level of sensory block, (3) degree of motor blockade (using Modified Bromage scale), (4) duration of motor blockade, (5) duration of sensory analgesia, (6) hemodynamic changes heart rate, blood pressure, and respiratory rate, and (7) side effects if any

Results: Nearly 0.75% ropivacaine has a shorter duration of motor block when compared with 0.5% bupivacaine. The onset of sensory and motor blocks, highest level of sensory block, degree of motor block, and duration of sensory analgesia are similar to that of bupivacaine. The hemodynamic changes and side effect profile of ropivacaine are also not significantly different from that of bupivacaine.

Conclusion: Based on the present clinical comparative study, we conclude that ropivacaine can be used as a safe alternative to bupivacaine for epidural anesthesia in lower abdominal and lower limb surgeries. The shorter duration of motor block with ropivacaine suggest that it could be effectively used for early mobilization of patients in the post-operative period.

Key words: Bupivacaine, Epidural analgesia, Onset of motor block, Onset of sensory block, Ropivacaine

Access this article online

www.ijss-sn.com

Month of Submission : 06-2018
Month of Peer Review : 07-2018
Month of Acceptance : 08-2018
Month of Publishing : 08-2018

INTRODUCTION

Regional anesthesia is noted for its simplicity, safety, and effectiveness. Anesthesia with an efficient block, having least onset time and which can be prolonged with least complications is one of the challenges faced by the anesthesiologist.

Corresponding Author: : Dr. Repalle Shanthan Kumar, H. No: 5-12-22, Hanuman Nagar, University Road, Hanamkonda, Warangal-506 009, Telangana, India. , Telangana, India. Mobile: +91-9885054263. E-mail: shanthanrepalle@yahoo.com

Although spinal anesthesia provides an efficient block, it has some disadvantages such as height of block cannot be controlled, duration of block is constant and cannot be prolonged, and it is associated with complications such as post-dural puncture headache and neurological sequelae.

Epidural anesthesia is one of the regional techniques for lower abdominal, lower limb, pelvic, and vascular surgeries where complications are very less compared to spinal anesthesia. Furthermore, there is no limitation for the duration of surgery if an epidural catheter is in place. It can also be used as a modality for post-operative pain relief.

Bupivacaine has been the drug of choice in providing effective epidural anesthesia followed by post-operative analgesia for a considerable time.

Ropivacaine is a new, long-acting local anesthetic which is chemically homologous with bupivacaine and mepivacaine.[1] It is similar to the "S" enantiomer of bupivacaine, except that a propyl group is present in place of butyl group on the piperidine ring's tertiary nitrogen atom.[2]

Ropivacaine exhibits less cardiotoxicity and central nervous system (CNS) toxicity. It produces effective analgesia as that of bupivacaine and that motor block appears to regress considerably more rapidly than sensory block.[2] This makes ropivacaine potentially well suited for administration through the epidural route for epidural anesthesia.[1]

Hence, this is prospective randomized control study to compare in two groups - 20 ml of 0.75% ropivacaine (isobaric) and 20 ml 0.5% bupivacaine (isobaric) for epidural anesthesia in lower abdominal and lower limb surgeries in adults aged 18–60 years.

Aims and Objectives of the Study

This was a prospective randomized control study to compare the following factors in two groups - 20 ml of 0.5% bupivacaine (isobaric) and 20 ml of 0.75% ropivacaine (isobaric) for epidural analgesia in lower abdominal and lower limb surgeries in adults aged 18–60 years, with respect to:

- Onset of sensory and motor block
- Highest level of sensory block
- Degree of motor blockade (using Modified Bromage scale)
- Duration of sensory analgesia
- Hemodynamic changes - heart rate, blood pressure, and respiratory rate at various time intervals
- Side effects if any.

METHODS

This study was conducted on patients undergoing elective lower limb and lower abdominal surgeries in M.G.M Hospital, attached to Kakatiya Medical College, Warangal, during the academic year from December 2012 to July 2014.

After Ethical Committee approval and written informed consent, 60 patients aged between 18 and 60 years undergoing elective lower limb and lower abdominal surgeries were selected.

Inclusion Criteria

The following criteria were included in the study:

- Age group of 18–60 years
- ASA Grade I or II
- Patients undergoing elective surgeries.

Exclusion Criteria

The following criteria were excluded from the study:

- ASA Grades III and IV
- Infection at the site of injection
- Coagulopathy or anticoagulation
- Congenital abnormalities of lower spine and meninges
- Active disease of CNS
- History of allergy to local anesthetics.

The selection of the patients was done randomly. A detailed preanesthetic evaluation including history, general physical examination, systemic examination, and spine examination for deformity was performed.

Routine investigations such as hemogram, total leukocyte cells, differential leukocyte cells, erythrocyte sedimentation rate, bleeding time, clotting time, random blood sugar, blood urea, serum creatinine, urine for albumin, sugar and microscopy, HIV and HBsAg, electrocardiogram, and chest X-ray (if required) were done. Patient's weight and height was also recorded before surgery.

- The study population was randomly divided into 2 groups with 30 patients in each group.
- Study Group R - received 20 ml of 0.75% ropivacaine (isobaric) by epidural route
- Study Group B - received 20 ml of 0.5% bupivacaine (isobaric) by epidural route.

The following parameters were observed and recorded:

Onset of Sensory Block

The onset of sensory block was tested by pin-prick method using a 27 gauge hypodermic needle. The time of onset was taken from the time of injection of drug into epidural space to loss of pinprick sensation.

Onset of Motor Block

The time interval between administration of drug into epidural space and the patient's inability to lift the straight extended leg (Modified Bromage scale 1) was recorded as onset time for motor block.

Highest Level of Sensory Block

The highest level of sensory blockade was assessed by pinprick method using a hypodermic needle. The highest dermatomal level blocked was noted and recorded after the onset of motor block

Degree of Motor Block

This was assessed by Modified Bromage scale.

Modified Bromage Scale[3]

0 - Able to raise leg straight, full flexion of knees and feet.
1 - Inability to raise leg, just able to flex knees, and full flexion of feet.
2 - Unable to flex knees, but some flexion of feet possible.
3 - Unable to move legs or feet.

Duration of Motor Block

The duration of motor block was taken from time of injection to complete regression of motor block (ability to lift the extended leg, i.e., Modified Bromage scale - 0).

Duration of Sensory Analgesia

Duration of sensory analgesia was noted and recorded from the onset of sensory block to complete return of sensation to pinprick.

Hemodynamic Changes

Patients were monitored for heart rate, blood pressure, and respiratory rate at 0, 5, 10, 15, 20, 25, 30, 45, 60, 90, 120, and 180 min after administration of epidural block.

Side Effects

Side effects such as nausea, vomiting, backache, retention of urine, and respiratory depression were observed for, recorded and treated accordingly.

Statistical Analysis[4,5]

The following list of formulae was used for analyzing the data:

1. Airthmetic mean $= \frac{\text{Sum of all the values}}{\text{No. of values}} = \frac{\Sigma x}{n}$

2. Standard deviation $= SD = \sqrt{\Sigma \frac{(X - X)^2}{n-1}}$

3. Student's unpaired t-test, $t = \frac{\text{Difference of means}}{\text{S.E of difference of means}}$

4. Fisher's exact test

Cases	T1	T2	Total
Abnormal	A	B	A+B
Normal	C	D	C+D
	A+C	B+D	N=A+B+C+D

$$\text{Fisher's test} = \frac{(A+B)!\ (C+D)!\ (A+C)!(B+D)!}{N!A!B!\ C!D!}$$

OBSERVATIONS AND RESULTS

The study sample comprised 60 patients aged between 18 and 60 years belonging to ASA Grade I and II, posted for elective lower abdominal and lower limb surgeries. 30 of them (Group R) received 20 ml of 0.75% ropivacaine (isobaric), and the others (Group B) received 20 ml of 0.5% bupivacaine (isobaric) for epidural anesthesia.

The demographic data such as age, gender, and weight were compared, and there was no statistically significant difference between the two groups as shown in Tables 1-3

Age

Table 1: Mean age

Age (Years)	*n* (%)	
	0.75% ropivacaine (Group R)	0.5% bupivacaine (Group B)
18–29	6 (20)	6 (20)
30–39	12 (40)	9 (30)
40–49	8 (27)	7 (23)
50–59	4 (13)	8 (27)
	30 (100)	30 (100)
Mean±SD	36.3±10.0	39.2±11.8
*P** value, significance	0.29 NS	

*Student's unpaired

Sex Distribution

Table 2: Sex distribution

Sex	*n* (%)	
	0.75% ropivacaine (Group R)	0.5% bupivacaine (Group B)
Male	15 (50)	17 (57)
Female	15 (50)	13 (43)

Weight

Table 3: Weight distribution

Parameter	Mean±SD		Mean difference	*P** value, Sig.
	0.75% Ropivacaine (Group R)	0.5% Bupivacaine (Group B)		
Weight (kg)	53.8±5.6	54.6±5.8	0.80	0.59 NS

*Student's unpaired *t*-test

Onset of Sensory Block

The mean time for onset of sensory block in ropivacaine group (Group R) was 10.2 ± 1.6 min and 10.8 ± 1.5 min in bupivacaine group (Group B) [Table 4]. The onset of sensory block in Group B was delayed by only few seconds than Group R ($P = 0.30$), so the difference was not statistically significant.

Onset of Motor Block

The mean time for onset of motor block in ropivacaine group (Group R) was 29.5 ± 3.0 min and in bupivacaine group (Group B) it was 28.9 ± 3.4 min [Table 5]. There was no significant difference between the groups ($P = 0.44$).

Highest Level of Sensory Block

In patients of ropivacaine group (Group R), 60% attained T6 level, 33% attained T7 level, and 7% attained T10 levels. In bupivacaine group (Group B) also, 60% attained T6 levels, followed by 27% attaining T7 level and 10% attaining T10 level [Table 6]. This implied that there was no difference in the highest level of sensory block achieved in both groups. ($P = 0.7$)

Degree of Motor Block

The degree of motor block was tested by Modified Bromage scale. On comparison, it was found that in ropivacaine group (Group R) there were 4 patients (13%) who had Grade 2 block and 26 patients (87%) who had Grade 3 block. In bupivacaine group (Group B), 3 patients (10%) had Grade 2 block, and 27 patients (90%) had Grade 3 block [Table 7]. The percentage distribution of patients who had Grade 2 and Grade 3 block was similar in both the groups.

Duration of Motor Block

The mean duration of motor block in ropivacaine group (Group R) was 241.7 ± 22.8 min, whereas in bupivacaine group (Group B) it was 282.3 ± 21.0 min. $P < 0.001$, indicating that the difference was highly significant [Table 8]. This implied that the duration of motor blockade in ropivacaine Group R was significantly lower than the bupivacaine Group B.

Duration of Sensory Analgesia

The mean duration of sensory analgesia in ropivacaine group (Group R) was 389.7 ± 16.5 min. In bupivacaine group (Group B), the mean duration was 391.1 ± 15.1 min [Table 9]. The duration of sensory analgesia in Group B was prolonged by only a few minutes than Group R ($P = 0.72$), so the difference was not statistically significant.

Hemodynamic Parameters

Hemodynamic parameters such as pulse rate, systolic blood pressure (SBP), and diastolic blood pressure (DBP) were compared at 0, 510, 15, 20, 25, 30, 45, 60, 90, 120, and 180 min and found no statistically significant difference between the two groups with respect to changes in the mean PR, mean systolic blood pressure SBP, and DBP.

Pulse Rate

The mean pulse rate was compared between the two groups at 0, 5, 10, 15, 20, 25, 30, 45, 60, 90, 120, and 180 min [Table 10]. There was no significant difference between the ropivacaine and bupivacaine group with respect to pulse rate when recorded at these time intervals.

SBP

The mean SBP changes over the time intervals between the Ropivacaine (Group R) and bupivacaine group (Group B) were compared. It was found that the SBP did not differ between the two groups [Table 11].

DBP

As with the SBP, the mean DBP changes over the time intervals between ropivacaine (Group R) and bupivacaine (Group B) groups were similar. The difference was not statistically significant [Table 12].

Respiratory Rate

The mean respiratory rate at 0, 5, 10, 15, 20, 25, 30, 45, 60, 90, 120, and 180 min in ropivacaine group was compared

Table 4: Time of onset of sensory block

Parameter	Mean±SD		Mean difference	*P** value, Sig.
	0.75% Ropivacaine (Group R)	0.5% Bupivacaine (Group B)		
Onset of sensory block (min)	10.2±1.6	10.8±1.5	0.57	0.30 NS

*Student's unpaired *t*-test

Table 5: Time of onset of motor block

Parameter	Mean±SD		Mean difference	*P** value, Sig.
	0.75% ropivacaine (Group R)	0.5% bupivacaine (Group B)		
Onset of motor block (min)	29.5±3.0	28.9±3.4	0.63	0.44 NS

*Student's unpaired *t*-test

to that of bupivacaine group. The difference was not statistically significant at any of the time intervals with respect to respiratory rate [Table 13].

Side Effects

In ropivacaine group (Group R), 7% patients had hypotension, 3% had nausea, and 3% had vomiting. In bupivacaine group (Group B), 10% patients had hypotension, 7% had nausea, and 3% had vomiting. There was no significant difference between the two groups with regard to these side effects [Table 14].

DISCUSSION

Epidural anesthesia is widely practiced regional anesthesia technique for many lower abdominal and lower limb surgeries. When compared to spinal anesthesia, advantages of epidural anesthesia lie in its decreased frequency of hypotension, no limitation on duration of surgery, and effective post-operative analgesia.

Table 6: Highest level of sensory block

Highest level of sensory block	*n* (%)	
	0.75% ropivacaine (Group R)	0.5% bupivacaine (Group B)
T6	18 (60)	18 (60)
T7	10 (33)	8 (27)
T8	0 (0)	1 (3)
T10	2 (7)	3 (10)

X^2=1.4, *P*=0.7 NS

Table 7: Degree of motor block

Degree of motor block	*n* (%)	
	0.75% Ropivacaine (group R)	0.5% Bupivacaine (Group B)
Grade 0	0 (0)	0 (0)
Grade 1	0 (0)	0 (0)
Grade 2	4 (13)	3 (10)
Grade 3	26 (87)	27 (90)

X^2=0.48, *P*=0.6 NS

The local anesthetic drugs currently available for epidural anesthesia offer a varied degree of efficacy, from drugs of low potency such as Procaine to much potent drugs such as etidocaine and bupivacaine. Unfortunately, as the potency of local anesthetics increases so does their toxicity. Bupivacaine, one of the most widely utilized local anesthetics, has been the subject of intense investigation because of reports of sudden cardiovascular collapse in some patients.[6-8]

Ropivacaine (LEA-103) is a new amino-amide local anesthetic agent similar in structure to bupivacaine. Ropivacaine is prepared as the s-isomer rather than a racemic mixture such as bupivacaine. Previous studies involving the isomers of local anesthetics suggest that the systemic toxicity of the *S*-isomer of various compounds may be less than that of racemic preparations. Pharmacologic studies in isolated nerves[9] and intact animals have indicated that ropivacaine possesses an anesthetic profile similar to that of bupivacaine but with less potential for cardiotoxicity than bupivacaine.[10,11]

This study aimed to compare the effects of 0.75% ropivacaine (isobaric) with that of 0.5% bupivacaine (isobaric) for epidural anesthesia in elective lower abdominal and lower limb surgeries. Our study design consisted of 60 patients aged between 18 and 60 years, ASA physical Status I and II undergoing epidural anesthesia for lower abdominal and lower limb surgeries. They were randomly divided into two groups. Group R (ropivacaine group) patients received 20 ml of 0.75% ropivacaine and Group B (bupivacaine group) received 20 ml of 0.5% bupivacaine through the epidural route. The following parameters were observed:

1. Sensory and motor blockade - Onset, duration, and highest level of sensory blockade
2. Degree of motor blockade
3. Recovery parameters - Time for complete sensory and motor recovery
4. Hemodynamic changes over various time intervals.

Table 8: Duration of motor block

Parameter	Mean±SD		Mean difference	*P** value, sig.
	0.75% Ropivacaine (group R)	0.5% Bupivacaine (Group B)		
Duration of motor block (min)	241.7±22.8	282.3±21.0	40.600	<0.001 HS

*Student's unpaired *t*-test

Table 9: Duration of sensory analgesia

Parameter	Mean±SD		Mean difference	*P** value, sig.
	0.75% Ropivacaine (Group R)	0.5% Bupivacaine (Group B)		
Duration of sensory analgesia (min)	389.7±16.5	391.1±15.1	1.433	0.72 NS

*Student's unpaired *t*-test

Table 10: Pulse rate comparison

Pulse rate	Mean±SD		Mean difference	*P** value	Sig.
	0.75% Ropivacaine (group R)	0.5% Bupivacaine (Group B)			
0 min	74.6±4.8	75.6±5.1	0.97	0.46	NS
5 min	86.8±5.5	87.9±5.2	1.03	0.46	NS
10 min	89.9±4.0	92.4±4.2	2.43	0.03	NS
15 min	90.1±4.1	91.6±5.0	1.57	0.19	NS
20 min	83.4±5.1	86.4±6.0	2.93	0.05	NS
25 min	79.6±4.1	80.2±5.6	0.67	0.60	NS
30 min	77.8±3.6	78.9±4.9	1.07	0.34	NS
45 min	77.5±3.3	78.5±4.4	1.00	0.32	NS
60 min	76.7±1.9	77.0±2.5	0.30	0.60	NS
90 min	76.0±1.7	76.1±2.3	0.13	0.80	NS
120 min	75.3±1.7	75.6±2.3	0.33	0.53	NS
180 min	74.5±2.1	75.3±2.5	0.83	0.17	NS

Student's unpaired *t*-test

Table 11: SBP comparison

SBP (mm/Hg)	Mean±SD		Mean difference	*P** value	Sig.
	0.75% Ropivacaine (group R)	0.5% Bupivacaine (Group B)			
0 min	119.6±7.4	118.7±7.8	0.93	0.63	NS
5 min	113.5±7.6	111.6±6.4	1.87	0.31	NS
10 min	110.4±8.5	107.4±6.5	3.00	0.13	NS
15 min	105.8±8.1	102.5±8.0	3.30	0.12	NS
20 min	107.5±7.7	103.5±7.1	4.07	0.06	NS
25 min	108.6±7.6	105.1±6.7	3.53	0.06	NS
30 min	110.3±7.0	107.5±6.7	2.87	0.11	NS
45 min	111.5±6.8	108.7±6.7	2.73	0.12	NS
60 min	112.3±6.8	110.2±7.1	2.13	0.24	NS
90 min	113.9±7.2	111.3±6.9	2.57	0.16	NS
120 min	114.4±6.0	112.3±6.7	2.07	0.22	NS
180 min	115.5±5.7	113.6±6.9	1.93	0.24	NS

Student's unpaired *t*-test. SBP: Systolic blood pressure

Table 12: DBP comparison

DBP (mm/Hg)	Mean±SD		Mean difference	*P** value	Sig.
	0.75% Ropivacaine (group R)	0.5% Bupivacaine (Group B)			
0 min	74.9±6.1	75.3±5.8	0.47	0.76	NS
5 min	70.9±5.5	70.9±4.8	0.07	0.96	NS
10 min	68.2±5.5	68.9±5.3	0.67	0.63	NS
15 min	65.5±6.4	65.4±6.3	0.13	0.94	NS
20 min	65.7±4.6	65.6±5.3	0.13	0.92	NS
25 min	65.9±5.0	66.3±4.7	0.40	0.75	NS
30 min	68.3±5.5	67.8±5.7	0.53	0.71	NS
45 min	69.6±6.1	69.0±6.3	0.60	0.71	NS
60 min	71.0±5.7	70.1±5.7	0.87	0.56	NS
90 min	72.4±6.1	71.7±5.9	0.73	0.64	NS
120 min	73.7±5.3	72.5±5.9	1.20	0.41	NS
180 min	72.9±5.3	72.1±5.7	0.73	0.61	NS

DBP: Diastolic blood pressure

In the present study, the patients studied in both the groups did not vary much with respect to age, sex, or weight. Majority of patients were in the age group between 18 and 60 years, with mean age of 36.3 ± 10.0 years in Group R and 39.2 ± 11.8 years in Group B. The mean sex distribution and the mean weight in both groups were also identical. These parameters were matched in both the groups to avoid changes in the intraoperative and post-operative outcome of patients.

Onset of Sensory and Motor Blockade

In our study, the mean time for onset of sensory block in the ropivacaine group was 10.2 ± 1.6 min and 10.8 ± 1.5 min in bupivacaine group. The mean time for onset of

Table 13: Respiratory rate comparison

Respiratory rate	Mean±SD		Mean difference	*P** value	Sig
	0.75% Ropivacaine (group R)	0.5% Bupivacaine (Group B)			
0 min	14.3±1.3	14.1±1.1	0.13	0.67	NS
5 min	14.4±1.2	14.4±1.2	0.03	0.92	NS
10 min	15.1±1.3	15.1±1.3	0.03	0.92	NS
15 min	14.8±1.2	14.9±1.2	0.10	0.75	NS
20 min	15.0±0.8	15.0±0.9	0.07	0.77	NS
25 min	14.8±0.8	14.9±0.9	0.07	0.76	NS
30 min	14.4±1.1	14.5±1.1	0.10	0.72	NS
45 min	15.0±1.0	15.0±1.0	0.03	0.90	NS
60 min	15.0±1.1	14.9±1.0	0.13	0.62	NS
90 min	15.0±0.9	14.9±0.8	0.10	0.65	NS
120 min	14.6±0.9	14.6±0.9	0.07	0.78	NS
180 min	14.5±0.9	14.5±0.9	0.00	1.00	NS

Table 14: Side effects

Side effects	*n* (%)		*P** value, sig.
	0.75% Ropivacaine (group R)	0.5% Bupivacaine (Group B)	
Nausea	1 (3)	2 (7)	NS
Vomiting	1 (3)	1 (3)	-
Hypotension	2 (7)	3 (10)	NS

*Fisher, exact test

motor block in ropivacaine group was 29.5 ± 3.0 min, and in bupivacaine group, it was 28.9 ± 3.4 min. There was no statistically significant difference with regard to onset of sensory and motor block between the groups.

Brockway *et al.*,[2] who conducted a study comparing 0.5%, 0.75%, and 1% ropivacaine with 0.5% and 0.75% bupivacaine found no significant differences in the onset time of sensory or motor block.

Finucane *et al.*[12] found no clinical difference in the onset of sensory or motor block when comparing 0.5%, 0.75%, and 1% ropivacaine with 0.5% bupivacaine for epidural anesthesia in patients undergoing an abdominal hysterectomy.

Katz *et al.*[13] also conducted a double-blind comparison study of 0.5% bupivacaine with 0.75% ropivacaine administered epidurally. They found no difference in the onset of sensory or motor blockade similar to our results.

Wolff *et al.*[14] found no difference in onset of sensory or motor block when comparing 0.5%, 0.75%, and 1.0% ropivacaine or 0.5% bupivacaine administered extradurally in patients undergoing elective hip surgery.

Brown *et al.*[15] designed a randomized, double-blind study to compare the clinical effectiveness of ropivacaine and bupivacaine in patients undergoing lower-extremity surgery. They also found no difference in onset of sensory or motor block.

The above findings were similar to that of our study. Thus, we can conclude that there is no variation in the onset of sensory or motor blockade between 0.75% ropivacaine and 0.5% bupivacaine when administered through epidural route.

Highest Level of Sensory Block

Highest level of sensory block was assessed by pinprick method using a blunt needle after the onset of motor block. In our study, patients of ropivacaine group attained the following level of sensory block: 60% attained T6 level, 33% attained T7 level, and 7% attained T10 levels. In bupivacaine group also 60% attained T6 levels, followed by 27% attaining T7 level, and 10% attaining T10 level. This implied that the sensory block level achieved by both groups was similar.

Brockway *et al.*[2] conducted a study comparing 0.5%, 0.75%, and 1% ropivacaine with 0.5% and 0.75% bupivacaine. They found the mean upper limit of sensory block to be T6.

Katz *et al.*[13] conducted a double-blind comparison study of 0.5% bupivacaine with 0.75% ropivacaine administered epidurally. They found the median sensory block height to be between T4 for bupivacaine and T5 for ropivacaine. The higher block compared to our study could be related to the higher volume of the drug used in their study.

From the above studies, we can conclude that the highest level of sensory block is similar between ropivacaine and bupivacaine. These findings are similar to our study.

Degree of Motor Blockade

The degree of motor block was tested by Modified Bromage scale. In our study, there was no difference in the degree of the motor block between the two groups.

Brockway *et al.*,[2] Finucane *et al.*,[12] Katz *et al.*,[13] and Wolff *et al.*[14] found the degree of motor blockade assessed by Modified Bromage scale to be Grade 3 in both the ropivacaine and bupivacaine group. This finding was similar to our study.

Duration of Motor Block

Duration of motor blockade was assessed from the time of administration of the drug to complete motor recovery (Bromage scale - 0). In our study, the mean duration of motor block in ropivacaine group was 241.7 ± 22.8 min, whereas in bupivacaine group it was 282.3 ± 21.0 min. This difference was statistically significant ($P < 0.001$)

Brockway *et al.*,[2] compared 0.5%, 0.75%, and 1% ropivacaine 15 ml with 0.5% and 0.75% bupivacaine 15 ml in 110 patients and found no a significant difference in onset, spread or duration of the sensory block when similar concentrations were compared. However, ropivacaine produced a slower onset, shorter duration, and less intense motor block than bupivacaine.

Wolff *et al.*[14] studied 126 patients undergoing elective hip surgery; they received 20 ml of 0.5%, 0.75%, and 1.0% ropivacaine or 0.5% bupivacaine extradurally in a double-blind design. Similar to our study, they found that return of motor function was earlier with ropivacaine compared to bupivacaine.

From the above studies, we can conclude that the duration of motor block is shorter with ropivacaine than bupivacaine.

Duration of Sensory Analgesia

In our study, the mean duration of sensory analgesia in ropivacaine group was 389.7 ± 16.5 min. In bupivacaine group, the mean duration was 391.1 ± 15.1 min, indicating that there was no difference in the duration of sensory analgesia among the two groups.

In studies conducted by Brockway *et al.*[2] Finucane *et al.*,[12] Katz *et al.*[13] Wolff *et al.*,[14] and Brown *et al.*[15] it was found that there was no significant difference in duration of sensory analgesia when comparing ropivacaine with bupivacaine.

Hemodynamic Changes (Heart Rate and Blood Pressure)

In our study, the two groups did not differ significantly with respect to heart rate at any time interval. There were no episodes of bradycardia in either group. The changes in mean SBP and DBP at any time interval were statistically and clinically insignificant. 2 patients in ropivacaine group experienced hypotension, whereas 3 patients experienced hypotension in bupivacaine group. Hypotension was corrected by small doses of inj. ephedrine.

In the study conducted by Brockway *et al.*,[2] the SBP and DBP decreased by about 20% from the baseline values over the first 20 min, whereas the heart rate tended to increase over first 15 min and thereafter decrease to slightly less than the baseline. This was similar to our study. There was no significant difference between the two groups.

A study by Wolff *et al.*[14] comparing extradural ropivacaine and bupivacaine in hip surgery showed that systolic and diastolic arterial pressures decreased in all groups. Treatment with ephedrine or atropine was required more often in the 0.75% ropivacaine group and in the 1% ropivacaine group compared with the 0.5% ropivacaine group and the 0.5% bupivacaine group.

Finucane *et al.*[12] and Brown *et al.*[15] found that the cardiovascular changes with respect to heart rate and blood pressure were similar in both bupivacaine and ropivacaine group.

From the above discussion, we can conclude that epidural administration of ropivacaine produces similar changes in hemodynamic parameters as that of bupivacaine. These findings are similar to our study

Respiratory Rate

None of our patients experienced respiratory depression, and the mean RR between both the groups was statistically insignificant.

Our study found no changes in the respiratory rates between the two groups which corroborated with the other studies conducted by Brockway *et al.*,[2] Finucane *et al.*,[12] Katz *et al.*,[13] Wolff,[14] and Brown *et al.*[15]

Side Effects

In ropivacaine group, 7% patients had hypotension, 3% had nausea, and 3% had vomiting. In bupivacaine group, 10% patients had hypotension, 7% had nausea, and 3% had vomiting, indicating no significant difference between the two groups with regard to these side effects.

Brockway *et al.*[2] found similar number of side effects in each group, the most common being backache (23%) followed by nausea (14%) and vomiting (2%).

The most common adverse events reported in the study conducted by Finucane *et al.*[12] were nausea, vomiting, hypotension, headache, and backache.

The reported side effects in the above studies were similar in both groups as were noticed into our study.

CONCLUSION

Based on the present clinical comparative study, we conclude that isobaric 0.75% ropivacaine, when administered through epidural route, provides adequate anesthesia for lower abdominal and lower limb surgeries and has a shorter duration of motor block when compared with 0.5% bupivacaine.

The onset of sensory and motor blocks, highest level of sensory block, degree of motor block, and duration of sensory analgesia are similar to that of bupivacaine, with no significant differences between the two groups with respect to hemodynamic changes.

Hence, ropivacaine can be used as a safe alternative to bupivacaine for epidural anesthesia in lower abdominal and lower limb surgeries. The shorter duration of motor block with ropivacaine suggest that it could be effectively used for early mobilization of patients in the post-operative period.

REFERENCES

1. Whitehead E, Arrigoni B, Bannister J. An open study of ropivacaine in extradural anaesthesia. Br J Anaesth 1990;64:67-71.
2. Brockway MS, Bannister J, McClure JH, McKeown D, Wildsmith JA. Comparison of Extradural ropivacaine and bupivacaine. Br J Anaesth 1991;66:31-7.
3. Vincent JC, editor. Spinal anesthesia-principles. Principles of Anesthesiology. 3rd ed. USA: Lea and Febiger; 1993. p. 1514-5.
4. Kaplans. Biostatistics. 3rd ed. Florida: Kaplans; 1999.
5. Park K. Preventive and Social Medicine. 24th ed. Madhya Pradesh: Banarsidas Bhanot Publishers; 2017.
6. Concepcion M, Arthur GR, Steele SM, Bader AM, Covino BG. A new local anesthetic, ropivacaine: Its epidural effects in humans. Anesth Analg 1990;70:80-5.
7. Edde RP, Deutsch S. Cardiac arrest after interscalene brachial plexus block. Anesth Analg 1977;56:446-7.
8. Albright G. Cardiac arrest following regional anesthesia with etidocaine or bupivacaine. Anesthesiology 1979;51:285-7.
9. Rosenberg PH, Heinonen E. Differential sensitivity of A and C nerve fibres to long acting amide local anaesthetics. Br J Anaesth 1983;55:163-7.
10. Akerman B, Hellberg IB. Primary evaluation of the local anaesthetic properties of the amino amide agent ropivacaine (LEA-103). Acta anaesthesiol scand 1988:32;571-8.
11. Moller RA, Covino BG. Cardiac electrophysiological effects of a new long-acting local anaesthetic agent (LEA-103). Anesthesiology 1986;65:3A-A183.
12. Finucane BT, Sandler AN, McKenna J, Reid D, Milner AL, Friedlander M, *et al*. A double blind comparison of ropivacaine 0.5%, 0.75%, 1% and bupivacaine 0.5%, injected epidurally in patients undergoing abdominal hysterectomy. Can J Anaesth 1996;43:442-9.
13. Katz JA, Jefferey AK, Donna K. A double blind comparison of 0.5% Bupivacaine and 0.75% ropivacaine administered epidurally in humans. Reg Anesth 1990;15:250-2.
14. Wolff AP, Hasselstrom L, Kerkkamp HE, Gielen MJ. Extradural ropivacaine and bupivacaine in hip Surgery. Br J Anaesth 1995;74:458-60.
15. Brown DL, Carpenter RL, Thompson GE. Comparison of 0.5% ropivacaine and 0.5% bupivacaine for epidural anesthesia in patients undergoing lower-extremity surgery. Anesthesiology 1990;72:633-6.

How to cite this article: Kumar GS, Kanth L, Srinath M. A Comparative Study between Bupivacaine 0.5% and Ropivacaine 0.75% in Epidural Analgesia in Patients Undergoing Elective Lower Abdominal and Lower Limb Surgeries. Int J Sci Stud 2018;6(5):126-134.

Source of Support: Nil, Conflicts of Interest: None declared