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ORIGINAL ARTICLE

A comparison between intrathecal isobaric levobupivacaine 0.5% and isobaric ropivacaine 0.5% in lower limb surgeries: a prospective, randomized, double blind study

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ABSTRACT

Background & Objectives: Levobupivacaine and ropivacaine are the two recently introduced local anesthetics alternatives to bupivacaine in clinical practice. The present study has been conducted to compare the efficacy of intrathecal isobaric levobupivacaine 0.5% and isobaric ropivacaine 0.5% in terms of sensory and motor blockade characteristics, intraoperative hemodynamics stability and side effects if any.

Methodology: A prospective randomized double blind study was conducted in 60 ASA grade I-II patients in age groups of 18-60 years undergoing lower limb surgeries. Patients were divided in 2 groups of 30 patients each. Group L received 3 ml isobaric levobupivacaine 0.5%, whereas patients in Group R received 3 ml isobaric ropivacaine intrathecally. Patients were assessed for onset and duration of sensory and motor blockade, intraoperative hemodynamic parameters and side effects.

Results: There was no difference in demographic data, onset and peak effect of sensory and motor block in both groups ($p > 0.05$). Duration of sensory and motor block and time to two segment regression were significantly longer in Group L than Group R ($p < 0.001$). Intraoperative hemodynamic parameters showed no statistical significance in both groups without any appreciable side effects.

Conclusion: We conclude that both levobupivacaine and ropivacaine are effective with stable hemodynamics without significant side effects when used intrathecally. Ropivacaine has shorter duration of sensory and motor blockade than levobupivacaine.

Key words: Isobaric; Levobupivacaine; Ropivacaine; Anesthesia, Spinal

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INTRODUCTION

Bupivacaine is a long acting local anesthetic, available as a racemic mixture of its enantiomers dextrobupivacaine and levobupivacaine. It has been the gold standard for intrathecal use in spinal anesthesia for many years.[1] Bupivacaine has been associated with cardiotoxicity when used in large concentration or when accidentally administered intravascularly.[2] Levobupivacaine and ropivacaine are the two recently introduced alternatives to bupivacaine in clinical practice. Levobupivacaine is the pure s(-) enantiomer of racemic bupivacaine. It

produces equivalent sensory block but shorter duration of motor block than intrathecal bupivacaine.[3] It has a lower risk of cardiovascular toxicity than bupivacaine because of its negative inotropism and less affection for cardiac sodium channels.[4] Ropivacaine is another enantiomer with less cardiovascular toxicity than bupivacaine, which also produces equivalent sensory block but shorter duration of motor block than intrathecal bupivacaine.[5,6] Both these drugs are available as isobaric solutions in India. As both these drugs have been recently introduced in India, very few studies have been done for their intrathecal use. Thus we decided to compare the efficacy of intrathecal isobaric Levobupivacaine 0.5% and isobaric ropivacaine 0.5% in lower limb orthopedic surgeries in terms of sensory and motor blockade characteristics, intraoperative hemodynamic stability and side effects.

METHODOLOGY

After obtaining approval from the institutional ethical committee and written informed consent, sixty patients of American Society of Anesthesiologists (ASA) physical status I to II of both genders, aged 18-60 years, scheduled for elective lower limb orthopedic surgeries in spinal anesthesia were enrolled for this prospective, randomized, double blind study over a period of one year. Patients with clinically significant coagulopathy, allergy to local anesthetics, infection in the lumbar region, preexisting neuromuscular, severe cardiovascular, or pulmonary disease, renal or hepatic disorder, history of drug abuse and refuse to give consent were excluded from the study. Patients were randomized according to computer generated random number table into two equal groups of thirty patients each. Patients of Group L received 3ml isobaric levobupivacaine 0.5% and patients of Group R received 3 ml isobaric ropivacaine 0.5% intrathecally. The study drug solutions were prepared by resident anesthesiologist who was not involved for data collection of the patients and volume of the drug solutions were similar to maintain the blindness of the study. The anesthesiologist performing the block was also blinded to the study groups and all observations were done by the same investigator. Patients were admitted before the day of surgery and fasting of 6 hour was ensured. On arrival in operation theatre, intravenous access was established, ringer lactate solution was infused at the rate of 6-8 ml/kg, monitors were attached and baseline parameters like mean blood pressure, oxygen saturation, ECG and heart rate were recorded. Premedication was given in form of inj glycopyrrolate 0.2 mg, inj. ranitidine 50 mg and inj. ondansetron 4 mg IV. Patient was placed in sitting position for spinal anesthesia. Under all aseptic and antiseptic precautions, painting and draping of the lumbosacral area was done. After skin infiltration with 2% lignocaine, 23G spinal needle was inserted in L3/4 inter vertebral space. Correct needle placement was identified by free flow of CSF and then 3 ml of study drug solution was injected over 10 sec. Patient was turned to supine posit ion soon after the injection. Surgery was started after establishment of block adequate for surgery. Assessment of sensory block was done by using pin prick method. Sensory blockade was assessed every 1 min for 5 min, every 5 mins for 30 mins and then every 30 min till end of surgery. Onset of sensory blockade (time interval from intrathecal injection to L1 level) in min, highest sensory level achieved, time to achieve highest sensory level and two segment regression time from highest sensory level were recorded. Motor block was assessed using BROMAGE grade (Grade 0 - no motor block, Grade 1 - unable to flex hip, Grade 2 - unable to flex knee, Grade 3 - unable to flex ankle). Onset of motor block (time interval from intrathecal injection to Bromage grade1) maximum motor block achieved, time to achieve maximum motor block, duration of motor block (time interval from onset of motor block to regression of motor block to Bromage Grade 0) were recorded. Vital parameters like pulse rate, mean blood pressure, ECG and oxygen saturation were monitored. Recordings were done before giving the block and then at 1, 3, 5, 10 and 15 min after giving spinal anesthesia and then every 15 min till the end of surgery. Patients were monitored for various perioperative complications like bradycardia (defined as pulse rate less than 20% of pre procedure value or < 50 beats/min. It was treated with Inj Atropine 0.6mg iv.), hypotension (systolic blood pressure less than 20% of pre procedure value or $< 80/60$ mmHg was considered as hypotension and was treated with IV fluids, oxygen and inj. ephedrine 5 mg IV bolus.), respiratory depression (decrease in respiratory rate < 10 / min or SpO2 to less than 90% was defined as hypoxia and treated with supplemental oxygen if required) nausea and vomiting and urinary retention.

Statistical analysis: Before the study was carried out, a power analysis indicated that 23 patients per group would be required to detect a 10% difference in hemodynamics parameters. The α error was set at 0.05 and β error at 0.9. Thus sample size of $n=30$ per group was considered for our study. All qualitative data were analyzed using Chi Square test and quantitative data using Student's t-test. All statistical analysis was made using SPSS version 10.0 for windows (Statistical Package for Social Science). All data was presented as Mean $\pm$ SD (Standard

Deviation). P > 0.05 was regarded as nonsignificant, p < 0.05 was regarded as statistically significant and p < 0.01 was taken as highly significant.

RESULTS

The groups were comparable with respect to age, sex distribution, ASA physical status, weight and duration of surgery time (Table 1).

Onset of sensory block was 3.2 ± 1.5 min in Group L compared to 3 ± 1.2 min in Group R (p > 0.05). Height of sensory block at 20 mins was comparable in both the groups. Time to two segment regression was slower in Group L (60 ± 7.15 min) compared to Group R (47 ± 4.14 min). This difference was statistically highly significant (p < 0.001) (Table 2).

The mean time for onset of motor block in Group L was 3.6 ± 1.8 min compared to 3.3 ± 1.2 min in Group R (p > 0.05). Both the groups were comparable in terms of achieving partial and complete motor block (p > 0.05). The mean duration of motor block was longer in Group L, 170 ± 16.4 min when compared to Group R which was 140 ± 10.1 min. This difference was statistically highly significant (p < 0.001) (Table 3).

There was no statistically significant difference among the vital parameters, e.g. heart rate, mean blood pressure, oxygen saturation and respiratory rate between both groups.

The incidence of side effects was not statistically significant in both the groups (p > 0.05) (Table 4).

Table 1: Demographic profile in both the groups

Parameter	Group L (n=30)	Group R (n=30)	p value
Age (years)	30.6 ± 10.0	31.1 ± 10.2	> 0.05
Sex Male Female	 26 (86.67%) 4 (13.33%)	 24(76.67%) 6(23.33%)	
ASA I II	 26(86.67%) 4(13.33%)	 27(90.0) 3(10.0)	
Weight (kgs)	63.8 ± 6.7	65.5 ± 6.6	
Duration of surgery (in min)	82 ± 21.03	84 ± 18.26	

Values are expressed as mean ± Standard Deviation

Table 2: Sensory blockade characteristics

Parameter	Group L (n=30)	Group R (n=30)	p value
Onset of sensory block (min)	3.2 ± 1.5	3 ± 1.2	> 0.05
Height of sensory block at 20 mins [T10:T8:T6:T4]	6:10:11:3	4:12:12:2	> 0.05
Time to two segment regression (min)	60 ± 7.15	47 ± 4.14	< 0.001

Table 3: Motor blockade characteristicsT

Block parameter (min)	Group L	Group R	p value
Onset of motor block	3.6 ± 1.8	3.3 ± 1.2	> 0.05
Partial motor block(Modified Bromage Grade 2)	6.6 ± 2.2	6.4 ± 1.34	> 0.05
Complete motor block (Modified Bromage Grade 3)	9.3 ± 3.1	9.2 ± 1.9	> 0.05
Duration of motor block	170 ± 16.4	140 ± 10.1	< 0.001

Table 4: Intra-operative side effects

Side effect	Group L N (%)	Group R N (%)	p value
Hypotension	3 (10.0)	4(13.3)	> 0.05
Bradycardia	1 (3.3)	0(0)	
Nausea	2(6.7)	3(10.0)	
Vomiting	0(0)	1(3.3)	
Shivering	1(3.3)	1(3.3)	
Breathlessness	0(0)	0(0)	

DISCUSSION

Spinal anesthesia with hyperbaric bupivacaine 0.5% is a popular method. New long acting local anesthetics, pure S-enantiomers of bupivacaine, levobupivacaine and ropivacaine in 1990s have recently been introduced for clinical use. The claimed benefits of these are reduced cardiac toxicity on overdose and more specific effects on sensory rather than motor fibres.[2,3]

It has been found that isobaric local anesthetics are ideal for surgeries below T10 level of block and high volumes are required for surgeries above T10. In our study we selected patients posted for lower limb orthopedic surgeries requiring a blockade below T10. All the patients in our study were given spinal anesthesia in sitting position considering patient comfort and a fact that level of sensory block after intrathecal administration of isobaric local anesthetics is unaffected by the patient position.[7] Levobupivacaine is claimed to be equipotent to racemic bupivacaine and ropivacaine is shown to be 2/3 times as potent as racemic bupivacaine. According to a study conducted by Glaser et al.5 using single shot spinal anesthesia for hip replacement surgery, there was no significant difference in the minimum local

anesthetic dose of isobaric levobupivacaine (11.7 mg) and that of ropivacaine (12.8 mg) as assessed by the up and down method of Dixon. The mean total dose of levobupivacaine required to complete surgery was 15.2 mg (3 ml) and 15.5 mg (3.1 ml) for ropivacaine. Hence in our study, we used the dose 15 mg i.e. 3 ml of 0.5% solution.

In our study, mean time for onset of sensory block was similar in both the groups which was in accordance with results observed by many researchers.[9-11] The lesser lipid solubility of ropivacaine may cause this drug to penetrate the large myelinated A fibers more slowly than the levobupivacaine.[4]

The highest sensory level attained at 20 min after induction was similar in both the groups that was T4 level. Our study results were in accordance with that of R. Parpaglioni et al. and Fasciolo A et al.[12,13] Vanna et al. observed maximum sensory level for levobupivacaine was T8.[14] This may be because they used smaller volume of drug than our study.

In our study, the time to two segment regression of sensory block (60 ± 7.15 min) was longer in Group L than in Group R (47 ± 4.14 min). The difference was statistically highly significant ($p < 0.001$). Our results are in accordance with earlier studies.8-11 Fasciolo et al.[13] and Mehta A et al.8 found that the duration of sensory blockade for levobupivacaine was 145 ± 28 mins and 189.4 ± 42.9 mins respectively and that for ropivacaine was 122.47 ± 25.4 min and 144.32 ± 32.1 min respectively. The difference in results in these studies may be because of different parameters used for calculating duration.

The mean time for onset of motor block, time to achieve partial and complete motor block were similar in both the groups. The duration of motor block in Group L (170 ± 16.4 min) was longer than in Group R (140 ± 10.1 min). The difference was statistically highly significant ($p < 0.001$) Casati A et al.[9] found that the duration of motor block in levobupivacaine group was 210 ± 63 min while 166 ± 42 min in ropivacaine group. Cappelleri G et al.10 also found that longer duration of motor block in Group L (148-201 min) than in Group R (136-154 min). Studies found that blockade lasted significantly longer with levobupivacaine which might be attributable to a greater intrinsic vasoconstrictor potency of levobupivacaine.[7,15]

In both the groups, intraoperative hemodynamics and side effects were comparable. In our study, only one patient developed bradycardia which was treated with 0.6 mg inj atropine IV in Group L. In Group L, 3 patients developed hypotension, 2 developed nausea, while in Group R, 4 patients developed hypotension, 3 patients had nausea and one patient developed vomiting.

CONCLUSION

We concluded that both intrathecal isobaric levobupivacaine 0.5% and isobaric ropivacaine 0.5% are equally effective and safe with stable hemodynamics. Levobupivacaine has prolonged duration of sensory and motor blockade which is better for prolonged surgeries. Ropivacaine has shorter duration of blockade which is preferred for faster recovery and ambulation in day care surgeries.

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Author's contribution:

KAB: Concept, study designing, manuscript preparation

IAP: Data collection, statistical analysis, manuscript preparation

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