ORIGINAL ARTICLE

Randomized double blind controlled study of ropivacaine versus bupivacaine in combined spinal epidural anesthesia

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ABSTRACT

Objectives: Ropivacaine and bupivacaine were compared in various combinations for orthopedic and obstetrics patients. We have compared the clinical efficacy of two combined spinal epidural drug regimens using equal volume of 0.75% isobaric ropivacaine to 0.5% hyperbaric bupivacaine intrathecally, and 0.125% of the plain drug along with epidural opioid for elective lower abdominal surgeries.

Methodology: 50 patients of ASA I or II of either sex, between 18 to 60 years of age scheduled for elective surgery under combined spinal and epidural anesthesia (CSEA) were randomly allocated into two groups. Bupivacaine group (B) received 3 ml of 0.5% bupivacaine intrathecally and 0.125% bupivacaine with fentanyl 2 μg/ml epidurally while Ropivacaine group (R), received 3 ml of 0.75% ropivacaine intrathecally and 0.125% ropivacaine with fentanyl 2 μg/ml epidurally. The two groups were compared for the onset of analgesia, onset of motor blockade, duration of analgesia, time for motor recovery and the haemodynamic variables.

Results: There were no significant haemodynamic changes in both the groups. The onset of motor block was similar in both groups (4 min) but the onset of sensory block was faster with group B patients (4 min) as compared to group R (6 min). The duration of analgesia and the time till the need for start of epidural infusion was longer in group B (221.60 ± 10.677 min) when compared to group R (198.40 ± 23.216 min). However, the time for regression of motor blockade was faster in group R (172.20 ± 10.712 min) as compared to group B (205.20 ± 13.423 min), facilitating early ambulation of the patients.

Conclusion: This study illustrates that both the regimens were comparable in terms of level of block, analgesia and haemodynamic stability. Intrathecal ropivacaine and epidural ropivacaine with fentanyl was shown to result in adequate level of block, complete analgesia and haemodynamic stability. The onset of analgesia however was faster in patients who received intrathecal bupivacaine.

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INTRODUCTION

Combined spinal epidural anesthesia (CSEA) combines the reliability of spinal anesthesia, its technical ease and rapid onset with flexibility of epidural anesthesia.[1] The advantage lies in its ability to combine the rapidity, density, and reliability of the subarachnoid block with the flexibility of continuous epidural block to titrate a desired sensory level, vary the intensity of the block, prolong the duration of anesthesia, and deliver postoperative analgesia.[2] Many local anesthetics have been used for CSEA in various strengths and volumes.[3] With the incidence of transient neurologic symptoms (TNS) being more with lidocaine, tetracaine and mepivacaine,[4-8] newer local anesthetics have been developed. Although both bupivacaine and ropivacaine possess similar structure, pharmacology, mechanism of action and physiochemical properties, cardiac toxicity is more with bupivacaine than its s-enantiomer, ropivacaine.[9]

It's a prospective, randomized, controlled double-blind study designed to compare the clinical efficacy of two regimen using equivolume of 0.75% isobaric ropivacaine to 0.5% hyperbaric bupivacaine intrathecally and 0.125% of the plain drug along with epidural opioid. Our objective

was to compare ropivacaine to bupivacaine for providing operative anesthesia and postoperative analgesia in major lower abdominal surgeries.

METHODOLOGY

This study was conducted over a period of 2 years (2009 - 2011) in Department of Anesthesiology & Critical Care, P.I.M.S, Pondicherry, a tertiary care institute after obtaining approval from the hospital ethics committee and informed consent from all participants. Fifty patients of both sexes, belonging to ASA I or II between 18-60 years of age undergoing elective lower abdominal surgery, were included in this study. They were randomly divided into two groups, each comprising 25 patients.

Group R: Patients received 3 ml of 0.75% isobaric ropivacaine intrathecally followed by 0.125% ropivacaine with 2 μg/ml of fentanyl for epidural infusion.

Group B: Patients received 3 ml of 0.5% hyperbaric bupivacaine intrathecally followed by 0.125% bupivacaine with 2 μg/ml of fentanyl for epidural infusion.

Patients with coagulation disorder, infection at injection site, spinal deformity, cardiac disease, mental disorder, neurological disease and uncontrolled hypertension were excluded.

Randomization was achieved by drawing a lot in the presence of a nurse, who prepared the study drug but was not involved in the study further. Patients in Group R received ropivacaine and Group B patients received bupivacaine. The observer making the recordings of haemodynamic parameters was blinded to group allocation of the subjects.

Pre-operative assessment was followed by administration of alprazolam 0.5 mg on the night before surgery and at 6:00AM on the day of surgery. Preloading was done with Ringer's lactate solution (10 ml/kg) over 30 minutes before the procedure and monitoring for non-invasive blood pressure (NIBP), heart rate (HR), peripheral oxygen saturation (SpO_2) and electrocardiography (ECG) started. Under aseptic conditions, with the patient in lateral position, L2-3 interspace was infiltrated with 3 ml of 2% lignocaine. Epidural space was located by loss of resistance to air technique with 18G Tuohy needle. An 18G epidural catheter (multi-orifice) was introduced into the epidural space. A test dose of 3 ml of 2% lignocaine with adrenaline (1:200,000) was administered through the catheter to rule out intravascular or intrathecal placement. Subarachnoid block was performed at L3-L4 space using 25G Quincke spinal needle. Patients in group R received 3 ml of 0.75% isobaric ropivacaine and those in group B received 3 ml of 0.5% hyperbaric bupivacaine. The epidural catheter was secured and patient was turned supine. Separate space technique was used for CSEA and the bevel of Tuohy needle was rotated cephalic before threading the multiorifice blunt end epidural catheter to reduce the risk of caudal placement of catheter.

Heart rate and noninvasive arterial blood pressure were recorded every 2 min for 10 min, then at 5-min interval till the end of the surgery. Sensory level assessed by pinprick and the degree of motor block was assessed according to the modified Bromage scale[10] at 2 min interval till highest level was achieved.

All patients were monitored for nausea, vomiting, respiratory depression, hypotension and bradycardia. Hypotension was defined as decrease in systolic blood pressure more than 20% from baseline which was treated with injection ephedrine hydrochloride 6-12 mg intravenously. Bradycardia was treated with injection atropine 10 μg/kg intravenously.

In the recovery room, assessment of pain was done using visual analog scale of 0 to 10 where 0 is 'no pain' and 10 is 'worst pain ever experienced' which was explained to the patient during pre anesthetic checkup.[11] Duration of effective analgesia is defined as the time to VAS score > 2, at which point the patients were receiving the test solution through the epidural catheter prepared by the nurse not involved in the study containing 0.125% ropivacaine with 2 μg/ml of fentanyl for the R group and 0.125% bupivacaine with 2 μg/ml of fentanyl for B group at a rate calculated as follows: [(height in centimeters-100) × 0.1].[12] Inj. tramadol 50 -100 mg was used as a rescue analgesic in the postoperative period.

Systolic blood pressure (SBP), diastolic blood pressure(DBP), heart rate (HR) and oxygen saturation (SpO_2) were observed at baseline, at spinal administration, at 2, 4, 6, 8, 10, 15, 20, 25, 30, 45, 60, 75, 90, 105, 120 min and continued in post-operative period at 6 hr, 12 hr, 18 hr and 24 hr. Bromage scale and level of sensory block at 2, 4, 6, 8 and 10 minutes was recorded. The time to achieve highest sensory level and a bromage score of 3, time to onset of pain (VAS score >2) and duration of motor blockade was also recorded.

Statistical analysis: The sample size was determined prior to study, based on the ability to detect a difference in the primary outcome variable i.e. duration of motor blockade; and pain score was assessed with VAS. With 25 patients in each group, there was 80% power and 0.05 probability.

Comparisons between the three groups were done with paired t-test and P (probability) value < 0.05 was considered statistically significant. Statistical analysis was done using the statistical software package SPSS Version 11.5.

RESULTS

All the enrolled patients completed the study successfully. No technical difficulty, block failure or inadvertent dural puncture was encountered. Both the groups were statistically comparable regarding age, weight and height,

gender distribution and ASA status (Table 1).

Table 1: Demographic characteristics of the patient

Characteristics	Group B (n=25) (Mean ± SD)	Group R (n=25) (Mean ± SD)	p value
Age (year)	41.68 ± 14.5	43.60 ± 12.04	X
Height (cm)	161.44 ± 5.2	159.60 ± 5.18	0.22
Weight (kg)	65.24 ± 9.4	63.80 ± 5.06	0.5
Sex (M:F)	14:11	07:18	0.08
ASA Grade 1 [N(%)] ASA Grade 2 [N(%)]	24(96) 1(4)	22(88) 3(12)	NA

ASA – American Society of Anesthesiologists, SD – standard deviation, p value ≤ 0.05 – significant.

The two groups were statistically comparable with respect to their systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR) and peripheral oxygen saturation (SpO_2). There was no incidence of any side effects in either of the groups. Although the onset of motor block was similar in both groups (4 min), the onset of action was faster with spinal bupivacaine and all patients in bupivacaine group achieved a bromage score of 2 within the 2nd min as compared to only 17 patients in ropivacaine group. Both groups attained a bromage score of 3 by the 4th min (Table 2).

Table 2: Comparison of study parameters in both groups

Characteristics	Group B (n=25) (Mean ± SD)	Group R (n=25) (Mean ± SD)	p value
Baseline HR (bears per min)	88.24 ± 11.35	85 ± 10.85	0.3
Baseline SBP (mmHg)	121.48 ± 11.47	119.88 ± 10.40	0.6
Baseline DBP (mmHg)	74.84 ± 10.86	74.28 ± 8.80	0.84
Time to achieve highest sensory level (min)	4	6	
Time to achieve Bromage score of 3 (min)	4	4	
Time to onset of pain(VAS > 2) (min)	221.6 ± 10.677	198.4 ± 23.216	0.001
Duration of motor blockade (min)	205.2 ± 13.423	172.2 ± 10.712	0.001

HR – Heart rate, SBP- systolic blood pressure, DBP - diastolic blood pressure, SD – standard deviation, p value ≤ 0.05 – significant.

The time to achieve maximum height of sensory block was faster in bupivacaine group with level T6 being reached within 4 minutes as compared to 6 minutes for ropivacaine group. The duration of analgesia and the time till the need for start of epidural infusion was longer in group B (221.60 ± 10.677 min) when compared to group R (198.40±23.216 min).However, the time for regression of motor blockade was faster in group R (172.20±10.712 min) as compared to group B (205.20±13.423 min), facilitating early ambulation of the patients (Table 2).

DISCUSSION

Ropivacaine is a long-acting local amide anesthetic with similarities in structure, pharmacology and pharmacokinetics to that of bupivacaine but it is a pure (S-isomer) enantiomer.[9] Increasing doses of ropivacaine were associated with an increased clinical effect.[13] The wider safety margin of ropivacaine allows the use of higher concentrations and doses compared with bupivacaine with less risk of systemic toxicity, ensuring better surgical anesthesia.[14]

We observed patients in ropivacaine group had a slower onset, shorter duration of motor block and a faster resolution of sensory block compared to the bupivacaine group. The duration of analgesia was longer in bupivacaine group. The onset of action was faster with spinal bupivacaine as all patients in bupivacaine group achieved a bromage score of 2 within the 2nd minute as compared to only 17 patients in ropivacaine group. Both groups attained a bromage score of 3 by the 4th minute. The time to achieve maximum height of sensory block was faster in bupivacaine group with level T6 being reached within 4 minutes as compared to 6 minutes for ropivacaine group. This is consistent with prior study.[15]

Mantouvalou et al.[16] compared plain ropivacaine, bupivacaine and levobupivacaine for lower abdominal surgery under spinal anesthesia and found a significantly faster motor blockade in bupivacaine group but here we have compared equivolume of hyperbaric bupivacaine with isobaric ropivacaine under CSEA and got faster motor block with bupivacaine.

Mc Namee et al.[17]compared 17.5 mg of plain ropivacaine with 17.5 mg of plain bupivacaine in patients undergoing total hip arthroplasty under spinal anesthesia. A more rapid postoperative recovery of sensory and motor function was seen in the ropivacaine group compared with the bupivacaine group. This was consistent with our findings, wherein patients in ropivacaine group had a faster recovery of sensory and motor function when compared to bupivacaine group.

Epidural ropivacaine causes less intense and shorter duration motor blockade as compared to bupivacaine[18] but same appears to be true for equal volumes of ropivacaine and bupivacaine intrathecally. The duration of analgesia and the time needed to start epidural infusion was longer in bupivacaine group which was 221.60±10.67 min, whereas that in ropivacaine group was 198.40±23.21 min.

At 0.125% concentration of the drug, we found ropivacaine and bupivacaine to be clinically indistinguishable because 0.125% ropivacaine with 2 μg/ml of fentanyl for epidural infusion was as effective as 0.125% bupivacaine with 2 μg/ml of fentanyl for post operative analgesia. There were no significant differences in patient satisfaction.[19]

The mean values of the systolic and diastolic blood pressures were also similar and any hypotension was treated with ephedrine boluses of 6mg intravenously. The incidence of hypotension was however negligible. The most commonly reported adverse events in our study are nausea and vomiting which were equally distributed between the two groups. Two patients (8%) in bupivacaine group had nausea and vomiting which were treated with 4 mg ondansetron intravenously. Only one patient (4%) in ropivacaine group had nausea, and didn't require the use of ondansetron. The incidence of pruritus was nil in our study however, pruritus was reported previously with bupivacaine and ropivacaine.[20] There was no incidence of urinary retention and respiratory depression.

CONCLUSION

We conclude that intrathecal ropivacaine and epidural ropivacaine with fentanyl results in adequate level of block, complete analgesia and hemodynamic stability. There was early regression of motor blockade without affecting the degree of analgesia thus facilitating early ambulation. The onset of analgesia, however, was faster in patients who received intrathecal bupivacaine. Hemodynamic parameters and patient's satisfaction levels appear to be clinically equivalent.

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Conflicts of Interest: None

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