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Original Research Paper

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COMPARISON OF THE EFFICACY OF INTRATHECAL ISOBARIC ROPIVACAINE AND BUPIVACAINE IN KNEE ARTHROSCOPY: A RANDOMIZED CONTROLLED TRIAL

Dr. Anoop Agarwal — Department of Anaesthesia, NAMO Medical Education & Research Institute And Shri Vinoba Bhave Civil Hospital (SVBCH), government multi-speciality hospital located in Silvassa, Dadra and Nagar Haveli, India

Dr. Vijal Patel — Department of Anaesthesia, NAMO Medical Education & Research Institute And Shri Vinoba Bhave Civil Hospital (SVBCH), government multi-speciality hospital located in Silvassa, Dadra and Nagar Haveli, India

Dr Himanshu Menat — Department of Anaesthesia, NAMO Medical Education &Research Institute And Shri Vinoba Bhave Civil Hospital (SVBCH), government multi-speciality hospital located in Silvassa, Dadra and Nagar Haveli, India

ABSTRACT A study conducted between two groups to compare intrathecal isobaric Ropivacaine & Bupivacaine in post operative recovery in patients undergoing arthroscopic knee surgery.ASA grade 1&2 patients were randomized into two groups to receive 2ml plain solution either 0.5% bupivacaine (Group B) or 0.75% ropivacaine (Group R).In the intraoperative period,onset,efficacy,duration and regression of sensory and motor block were noted in both the groups at regular intervals. Above mentioned two groups are compared for pain score,recovery profile,analgesic requirement and complications postoperatively. Analysis was performed using Chi-square test and Student's t-test. Onset and duration of sensory and motor block was significantly more (P = 0.001) with bupivacaine as compared to ropivacaine.

KEYWORDS : Bupivacaine, isobaric, knee arthroscopy, ropivacaine, subarachnoid block

INTRODUCTION

The changing trend of surgical practice from an inpatient to outpatient convention has urged us to modify our anesthetic technique to suit the ambulatory setting. The primary goal of ambulatory anesthesia is rapid recovery leading to early patient discharge with minimal side effects. Elective knee arthroscopic surgery is one such procedure where the patient can be mobilized within a few hours after surgery. Spinal anesthesia and short general anesthesia (GA) are the commonly used techniques for this procedure. Subarachnoid block (SAB) with a local anesthetic not only makes the patient insensible to the pain of tourniquet, incision, and surgery but also it makes the surgeon comfortable by providing adequate muscle relaxation. Spinal anesthesia is gradually gaining momentum over GA in arthroscopic knee surgery due to lesser postoperative morbidity and hospital stay. Ropivacaine is an amide local anesthetic with similar structure, physiochemical properties and mechanism of action as compared with bupivacaine. It produces similar sensory block at equipotent doses and a shorter duration of motor block (50%–67% that of bupivacaine).[3] Ropivacaine provides an improved safety profile due to reduced neurotoxic and cardiotoxic potential. We hypothesized that intrathecal isobaric 0.75% ropivacaine (15 mg) would be comparable to isobaric 0.5% bupivacaine (10 mg) for the efficacy of anesthesia and analgesia, and in addition would provide a better postoperative recovery profile and readiness for discharge.

MATERIALS AND METHODS

Ninety adult patients belonging to the American Society of Anaesthesiologist physical status Classes 1 and 2, in the age group of 18–65 years, weighing between 50 and 75 kg with height ranging from 150 to 180 cm, scheduled to undergo elective knee arthroscopy under SAB were included in the study. Patients who were unable to understand the procedure and those with contraindications to regional anesthesia were excluded from the study. After a thorough preoperative evaluation, patients were premedicated with oral alprazolam 0.25 mg at night and 2 h before surgery. In the operating room, standard monitoring was established and preoperative vital parameters (heart rate [HR], blood pressure (BP), oxygen saturation, and electrocardiogram) were recorded. Intravenous (IV) access was secured, and 500 ml of Ringer's lactate was infused as co-loading fluid. Patients were randomized to one of two groups using computer-generated random allocation chart-Group R: Ropivacaine group (n = 45) received intrathecal injection of 2 ml of 0.75% plain ropivacaine (15 mg); Group B: Bupivacaine group (n = 45) received intrathecal injection of 2 ml of 0.5% plain bupivacaine (10 mg). Patients were placed in the lateral decubitus position with the operative side uppermost. Under all aseptic precautions, a SAB was performed in L2–L3/L3–L4 interspace using a 25G quincke spinal needle. Patient assessment and observations were recorded by the blinded researcher in the operation theater as well as in the recovery room. Patients were placed supine immediately after the procedure, and the operating table was maintained horizontal. Time of intrathecal injection was noted, and vital parameters were monitored at 5 min intervals till the end of surgery. A fall in systolic BP <80 mmHg or 20% below the baseline was treated with fast IV fluids and ephedrine 5 mg IV, and a fall in HR <50/min was treated with atropine 0.6 mg IV. One patient had to be administered GA and was excluded from the study as the onset of the sensory block did not occur even 20 min after intrathecal injection of isobaric ropivacaine.

Sensory block was assessed by the loss of sensation to pinprick using a 25G needle along the mid-axillary line bilaterally every 2 min till two consecutive readings remained the same (i.e., when highest cephalad spread of sensory block had occurred), after which it was assessed at 10 min intervals till the end of surgery. The onset of sensory block at L1 was noted and the surgeon was allowed to start the surgery. Maximum upper level of sensory block and time required to achieve it and time to two segment regression and descent of sensory block till S_2 were noted. Duration of sensory block was determined from the time of onset of block till the patient demanded the first rescue analgesic. Motor block was assessed

using Modified Bromage Scale (ranging from 1- complete motor block to 6- no weakness at all) every 2 min till two consecutive readings remained the same (i.e., the highest level of motor block was achieved), after which it was assessed every 10 min till the end of surgery. Maximum degree of motor block, time to onset of the maximum degree of motor block, total duration of motor block (from initial onset until complete recovery), and total duration of complete motor block were noted. Maximum degree of motor block, time to onset of the maximum degree of motor block, total duration of motor block (from initial onset until complete recovery), and total duration of complete motor block were noted.

Statistical Analysis

Chi-square test or Fisher's exact test was used to compare categorical variables such as sensory block, motor block, the maximum level of sensory and motor block, and unpaired *t*-test was used for quantitative variables such as HR and BP.

RESULTS

The demographic profile of patients was comparable between the groups. Duration of surgery and tourniquet time were also found to be similar Table 1. Patient characteristics and duration of surgery

Variables	Group R	Group B	*P*
Age (years)	27.98	26.61	0.462
Sex (male:female)	40:5	38:7	0.535
Height (cm)	166.2	166.13	0.543
Weight (kg)	66.53	67.4	0.241
BMI	24.0794	24.4721	0.372
Duration of surgery, mean±SD (min)	62.5±13.4	66.9±3.75	0.129
Tourniquet time, mean±SD (min)	70.29±13.7	75.2±14	0.097

Group R=Ropivacaine group, Group B=Bupivacaine group, SD=Standard deviation, BMI=Body mass index

On comparing the hemodynamic parameters, no significant difference in mean HR was found between the groups. Mean systolic BP was significantly less at 50 (P = 0.004), 90 (P = 0.006), and 100 (P = 0.023) minutes; and mean diastolic BP was significantly less at 70 min (P = 0.049) after intrathecal injection in Group B as compared to Group R [Figure 1].

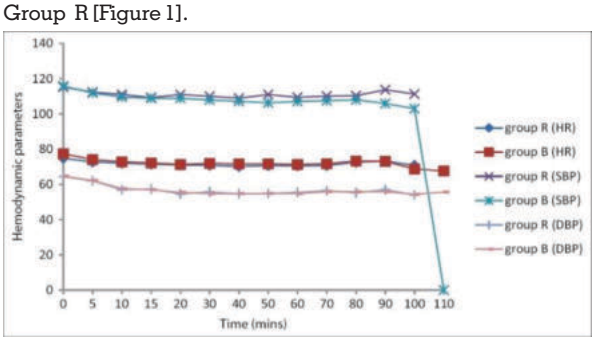

Figure 1

Hemodynamic parameters including HR, SBP, DBP. Dark blue line represents HR for Group R patients, brown line represents HR for Group B patients, purple line represents SBP for Group R patients, sky blue line represents SBP for Group B patients, light blue line represents DBP for Group R patients, pink line represents DBP for Group B patients. There was no clinically significant change in hemodynamic parameters after intrathecal injection, both within and between the groups. HR = Heart rate (beats/min), SBP= Systolic blood pressure (mmHg), DBP= Diastolic blood pressure (mmHg). Group R = Ropivacaine group, Group B= Bupivacaine group

Meantime of onset of sensory block at L1 was significantly shorter (Group B -4.04 ± 3.12 min, Group R - 6.14 ± 5.09 min; P=0.025) and duration of sensory block was significantly longer (Group B - 284.64 ± 32.33 min, Group R -257.57 ± 39.12 min; P= 0.001) with bupivacaine. The mode and median of maximum upper level of sensory block were at T8 in both the groups and the number of patients who attained this block was significantly more with bupivacaine (37.4%) as compared to ropivacaine (22%) (P=0.017). There was no significant difference between groups in the meantime to onset of the maximum sensory block, time for two segment regression and time for the descent of sensory block till S2 [Table 2].

Characteristics of sensory block

	Mean±SD		*P*
	Group R	Group B	
Maximum sensory block - T8 (percentage of patients)	22	37.4	0.017
Time of onset at L1 (min)	6.14±5.09	4.04±3.12	0.025
Time of onset of maximum sensory block (min)	15.41±9.31	12.62±3.66	0.724
Time for 2 segment regression (min)	29.43	28.13	0.591
Time for regression till S2 (min)	244.75	248.07	0.612
Duration of sensory block (min)	257.57±39.12	284.64±32.33	0.001

Group R=Ropivacaine group, Group B=Bupivacaine group, SD=Standard deviation

A greater number of patients in the bupivacaine group had a better degree of motor block at 2 min (P = 0.01), 4 min ($P \leq 0.001$), 10 min ($P \leq 0.001$), and 20 min (P = 0.006) after intrathecal injection. Duration of motor block was significantly longer with bupivacaine as compared to ropivacaine (250.07 ± 34.81 min vs. 222.11 ± 41.78 min; P = 0.001). There was no significant difference in the number of patients who attained maximum motor block, time to onset of the maximum motor block and total duration of the complete motor block between the groups [Table 3]. Quality of motor block as assessed by the surgeon and the quality of intraoperative analgesia as assessed by the patient was adequate, and there was no statistically significant difference between the groups.

Characteristics of motor block [Table 3].

	Mean±SD		*P*
	Group R	Group B	
Maximum motor block (MBS 1) (percentage of patients)	95	97	0.603
Time for onset of maximum motor block (min)	18.50±11.77	12.53±4.32	0.066
Duration of motor block (min)	222.11±41.78	250.07±34.81	0.001
Duration of complete motor block (min)	108.21±25.03	115.14±36.00	0.301

Group R=Ropivacaine group, Group B=Bupivacaine group, MBS 1=Modified Bromage Scale 1, SD=Standard deviation

postoperatively, VAS score was significantly more in Group R at 1 h (P = 0.039) and 6 h (P= 0.011) at rest and in Group B at 4 h both at rest (P = 0.001) and on movement ($P \leq 0.001$). A significantly greater number of patients in Group R needed 2 analgesic doses on the first postoperative day (33.33% vs. 11.11%; P= 0.011) [Table 4].

Postoperative pain, complications and discharge scores

Postoperative variables	Mean±SD		*P*
	Group R	Group B	
VAS (mean±SD)			
1 h	Rest: 0.32±0.67	Rest: 0.11±0.44	0.039
	Movement: 0.62±1.02	Movement: 0.81±0.87	0.258
4 h	Rest: 3.25±1.94	Rest: 4.64±1.76	0.001
	Movement: 4.05±2.18	Movement: 5.76±1.79	<0.001
6 h	Rest: 2.95±1.45	Rest: 2.56±1.85	0.011
	Movement: 3.64±1.53	Movement: 3.44±1.88	0.136
2 analgesic doses on POD1 (%)	33.33	11.11	0.011
Delayed voiding of urine (%)	13.33	0	0.022
Time taken for 1st voiding of urine (min)	255.34	270.23	0.028
Time taken to achieve PADSS ≥9 (min), mean±SD	189.00±34.10	208.019±30.36	0.591

Group R=Ropivacaine group, Group B=Bupivacaine group, VAS=Visual analogue scale, POD1=Postoperative day 1, PADSS=Postanesthetic discharge scoring system, SD=Standard deviation

The incidence of delayed voiding of urine was significantly more with ropivacaine (13.33% vs. 0; $P = 0.022$), whereas the mean time taken for first voiding of urine was significantly longer with bupivacaine (270.23 min vs. 255.34 min; $P = 0.028$). No other significant complications were noted. There was no significant difference in the time taken to achieve readiness for discharge from PACU between the groups (Group B - 208.19 ± 30.36 min, Group R - 189.00 ± 34.10 min; $P = 0.591$) [Table 4].

CONCLUSIONS

Isobaric ropivacaine provides a longer onset and shorter duration of sensory and motor block, with a higher complication rate and greater postoperative analgesic requirement as compared to isobaric bupivacaine. Therefore, isobaric bupivacaine may be preferred over isobaric ropivacaine in knee arthroscopy, especially in cases of an anticipated longer duration of surgery.

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