Original Research Article

Comparison of unilateral and bilateral subarachnoid blockade for arthroscopic knee surgery

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Abstract

Introduction: spinal anaesthesia is the most common procedure for lower limb procedures in the field orthopedics. Limiting the spinal anaesthesia to surgical field can avoid the undesirable complications caused by conventional spinal anaesthesia.Material and methods: Two groups of patients are included as per physical status ASA I and II. Spinal anaesthesia is performed with 25G Quincke's needle and 0.5% hyperbaric bupivacaine is used. In Group UB, spinal anaesthesia was given with the patient in lateral position using 1.5 ml of hyperbaric bupivacaine and the lateral decubitus position was maintained for 10 min.In Group BB, spinal anaesthesia was given with the patient in lateral position using 2.5 ml of hyperbaric bupivacaine, and the patients was immediately turned to supine position, after subarachnoid injection**Results:** The demographic data were comparable in both groups. The sensory and motor onset time in group BB was shorter than group UB. The total duration of sensory and motor block was shorter in group UB. There were no failure of spinal anaesthesia in both groups. The complications was higher in group BB than group UB.**Conclusion**: Restricting the spinal anaesthesia block to the operated limb will help to achieve unilateral block. It provides adequate sensory and motor blockade adequate to perform the orthopedic surgery and also with stable hemodyanamics.

Keywords: unilateral; spinal anaesthesia; bupivacaine; lower limb.

Introduction

Arthroscopic knee surgery is common procedure in orthopedics. This operation includes both diagnostic and operative procedures. Spinal anesthesia is beneficial for most of these procedures. Hyperbaric bupivacaine routinely used for spinal anaesthesia. Unilateral spinal anaesthesia require low dose of hyperbaric bupivacaine to achieve an adequate motor and sensory block.Unilateral spinal anaesthesia was first performed in 1961 by Tanasichuk et al[1].. It has advantages over conventional bilateral spinal anaesthesia which includes fewer hemodynamic complications[2],faster recovery from the spinal anaesthesia and to avoid unnecessary complications. To achieve unilateral spinal anaesthesia following factors to be considered: type and gauge of the spinal needle, density of the local anaesthetic relative to the CSF, speed of administration of the solution[3], position of the patient and dose[4],concentration and volume of the anaesthetic solution.The purpose of this study was to compare the effects of different doses of hyperbaric bupivacaine like block characteristics, haemodynamic changes and complications following unilateral spinal anaesthesia and conventional bilateral spinal anaesthesia in arthroscopic knee surgery.

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Methods

This randomized prospective study was commenced after obtaining approval of the departmental dissertation committee and hospital ethics committee (IEC 620/2015). After obtaining a written informed consent, patients were enrolled for the study and were allocated into one of the two groups as per computer generated table of random numbers.

Sample size was calculated by taking standard deviation of recovery from sensory blockade, a difference of 16 minutes between two groups (from pilot study) conducted on 10 patients, (clinically significant difference between 2 groups was 16 minutes and level of significance is 5%). To obtain power of study of 80%, 70 patients were included in the study. The patients were divided in two groups of 35 patients in to group UB and group BB.

ASA – PS I and II, age 20-50 years and patients who were posted for arthroscopic knee surgery under subarachnoid block. (Arthroscopic debridement, meniscal repairs, ligament repairs were studied) were included in the study. Any patients who could not lie down in lateral position, coagulopathy, chronic use of sedatives , anemia, local skin infection and who required general anesthesia during surgery or a surgery requiring over 2 hours.

An intravenous (IV) access was secured, and then a 10mL/kg IV infusion of Lactated Ringer's solution was administered over 10 min. Standard monitoring was used throughout the study.

In group UB and group BB spinal anaesthesia was performed with the patient in lateral decubitus position at L3-L4 intervertebral space using 25 G Quinckes spinal needle under sterile condition. Once intrathecal placement had been confirmed the bevel end is turned towards the dependent position and 1.5 mL of hyperbaric bupivacaine 0.5% was injected in group UBand the lateral decubitus position was maintained for 10 min and in group BB 2.5 mL of 0.5% hyperbaric bupivacaine was injected and then patient was placed in the supine position.

Baseline Heart rate and blood pressure were recorded. After giving spinal anaesthesia BP was recorded every 5 minutes in both groups. If heart rate drops to less than 50 bpm was considered as bradycardia, was treated with IV glycopyrrolate 0.2 mg / atropine 0.6 mg (depending up on rapidity of fall in HR). Hypotension defined by decrease in blood pressure more than 25% below baseline and will be treated initially with fluid bolus of Ringer Lactate solution and if not responding, incremental doses of intravenous mephentermine 3 mg boluses was used.

The level of sensory block was determined bilaterally using loss of sensation to cold with an alcohol swab and motor blockade was assessed using modified Bromage scale[5]. These measurements were performed at 2 minute interval from time of spinal anaesthesia given till a maximum score was obtained.

Table 1: Modified bromage score

Score	Definition
0	No paralysis, able to flex hip/knee/ankle
1	Able to flex knee and ankle, unable to raise extended leg
2	Able to flex ankle, unable to flex hip and knee
3	Unable to flex hip, knee and ankle

The study data were analyzed using SPSS version 21.For statistical analysis student t-test and Chi square test was used and p value < 0.05 was considered as statistically significant.

Results

The demographics of both group were similar

Table 2: Demographic data

Variable	Groups		p value
	Group UB	Group BB	
Age (in years)	35.28 ± 8.9	32.05 ± 9.11	0.645
Weight (in kg)	69.7 ± 5.64	65.48 ± 8.44	0.045
Height(in meters)	1.6 ± 0.52	1.6 ± 0.56	0.839
BMI (kg/m^2)	26.06 ± 2.26	23.65 ± 2.97	0.66
M/F	23/12	30/5	0.093
ASA l/ll	31/4	34/1	

Table 3: Time of onset of Sensory and motor blockade.

	Group UB	Group BB	p value
Onset of block at T10(in minutes)	1.4 ± 0.32	1.6 ± 0.36	0.11
Time to reach highest level of sensory blockade (in minutes)	4.47 ± 1.3	2.44 ± 0.41	<0.01
Time of Onset of motor block(in minutes)	6.2 ± 0.73	3.11 ± 0.49	<0.01

Table 4: Duration of motor and sensory block.

variable	Group UB	Group BB	P value
Duration of sensory block(in minutes)	160 ± 9	219 ± 17.41	0.01
Duration of motor block(in minutes)	131.31 ± 9.91	166.57 ± 9.6	0.01

The peak level of sensory block in group UB was T6 and in group BB was T8 (p value= 0.001).This explains that in unilateral block has reached highest level of sensory block more than in bilateral block which was statistically significant. Sensory and motor block lasted longer in the bilateral group as compared to the unilateral group unilateral group (Table 4). An average Bromage score of 3 was achieved for motor block in both groups.

Table 5: complications

	Group UB	Group BB	P value
Hypotension	0	8	0.01
Bradycardia	0	6	0.01
Headache	2	4	0.5
Nausea/vomiting	0	5	0.01
Urinary retention	0	6	0.01

None of the patients in the unilateral group experienced nausea or vomiting. In the bilateral group, five patients had nausea and one of them experienced episodes of vomiting (p = 0.01). Two patients in the unilateral group and four patients in the bilateral group had headaches (p = 0.5). (Table 5)

Discussion

Spinal anaesthesia technique was first described by Tanasichuk et al in 1961 and introduced the concept of spinal hemianalgesia and was described as unilateral spinal anaesthesiain other studies. In lumbar and thoracic region the distance between left and right nerve roots is about 10-15 mm[6]which makes it possible to attain unilateral spinal anaesthesia. In this study all the patients studied across the two groups were comparable with respect to age, weight, height, BMI, and gender, so that these parameters did not influence the outcome of our study.In a study conducted by Esmaoglu et al[7], the time taken to reach maximum level of sensory blockade was 4.18 minutes which was comparable with this study (4.47 minutes). The time to reach the maximum level of sensory block is more in group UB as compared to

group BB, this differences in time is due to use of less drug volume in group UB which had taken time to spread to highest level when kept in lateral decubitus position.In this study the maximum level of sensory block achieved was T8 (T4-T10) in dependent side and L2 (T11-L3) in non-dependent side. This was comparable to study conducted by Borghi et al[8], compared the unilateral spinal anaesthesia with 4mg, 6mg, and 8 mg of 0.5% hyperbaric bupivacaine. They observed sensory block on the operative and non-operative sides was T10 (T12-T6) and <L2 in the 4 mg group, T8 (T12-T6) and <L5 in the 6 mg group, and T7 (T12-T5) and <T10 in the 8mg group. This shows that if more volume is used there is spread of local anaesthetic to higher sensory level.Seyyed Mostafa MoosaviTekye et al[9], studied on unilateral spinal anaesthesia and they had total sensory block duration of 157.12 ± 17.07 minutes. In this study the duration of sensory block was 160 ± 9 minutes, which was comparable to their study. From this we can conclude that the adequate analgesia for complication of surgery is being provided by low dose of local anaesthetic in unilateral block.Fanelli et al[10], compared two segment regression times between unilateral and conventional bilateral bupivacaine spinal block in outpatients undergoing knee arthroscopy with 8mg of hyperbaric bupivacaine. In the unilateral group, they used 8 mg of 0.5% hyperbaric bupivacaine in 50 patients in lateral decubitus position after spinal injection was maintained for 15 minutes. They found that two segment regressions of sensory level required 81 ± 25 minutes with bilateral block, and 99 ± 28 minutes with unilateral block. In this study two segment regression times was 52.74 ± 6.72 minutes in group UB and 69.80 ± 12.43 minutes in group BB. This explains that two segment regression depends on drug volume, duration of lateral decubitus position after giving spinal anaesthesia.Seyyed Mostafa Moosavi Tekye et al[9], had taken two groups with 1.5 ml of 0.5%hyperbaric bupivacaine kept in lateral decubitus position for 20 minutes and 2.5ml of 0.5% hyperbaric bupivacaine. The time taken to reach maximum score of motor blockade in unilateral group was 6.17 ± 1.5 minutes and in bilateral group was 4.35 ± 1.25 minutes.In this study the time to reach the maximum score of motor block was 6.2 ± 0.73 in group UB and group BB was 3.11 ± 0.49. This differences in time is due to use of less drug volume in group UB which had taken time to spread to achieve the dense motor block.Valanne et al[11], used 4 or 6 mg of bupivacaine to induce unilateral spinal anesthesia in 106 patients scheduled to undergo knee arthroscopy. While both doses were sufficient for sensory and motor block. Mean time taken to regression of motor function in 4mg and 6 mg group was 166 minutes and 199 minutes. In our study, the duration of motor blockade was 131.31 ± 9.91 minutes in group UB and in group BB was 166.57 ± 9.6 minutes. This concluded that less dose will have more rapid regression of motor function as compared to high dose. In this study the motor block in dependent and non-dependent limb in group UB was 0/0/6/29 and 32/4/0/0 as per Modified bromage scale (0/1/2/3). In group BB the modified bromage score was 3 in all 35 patients. Tapas Kumar Singh et al[12] conducted a study on 120 patients undergoing orthopaedic surgery of lower limb received 7.5 mg of 0.5% hyperbaric bupivacaine in one of the three groups. They observed the motor block in dependent and non-dependent was 1/0/5/34 and 30/5/4/1 respectively. This concludes that unilateral spinal anaesthesia will provide dense motor block to operative limb than the non-operative limb for completion of surgery in a period of time.Chohan and Afshanet al[13], administered unilateral spinal anesthesia prior to lower-limb surgery in elderly patients with ASA classification of III or IV (average age of 60). The authors found no significant hemodynamic changes. They used 1.1-1.8 ml of 0.5% hyperbaric bupivacaine 0.5%. In our study none of the patients in the unilateral spinal anesthesia group experienced hypotension, but eight patients in the bilateral group had hypotension. The cause behind no hypotension in unilateral spinal anaesthesia is due to asymmetric block of sympathetic innervation to blood vessels in lower limbs which prevents vasodilation.In this study, there was no bradycardia observed in the unilateral group, but in the bilateral group, six patients had bradycardia which was compared to a study conducted by Seyyed MostafaMoosaviTekye et al[9],they had taken two groups with 1.5 ml of 0.5%hyperbaric bupivacaine kept in lateral decubitus position for 20 minutes and 2.5ml of 0.5% hyperbaric bupivacaine. There was no bradycardia in unilateral group, but 5 patients had bradycardia in bilateral group. The reason behind this is due to use of less volume of drug in Group UB, which took more time for local anaesthetic to ascend in subarachnoid space, thus preventing bradycardia.Esmaoglue used 1.5 ml and 3 mlof hyperbaric bupivacaine 0.5% for unilateral and bilateral anesthesia respectively. He had three patients with nausea and vomiting in bilateral group and no patients had nausea and vomiting in unilateral group. In this study none of the patients in the unilateral group experienced nausea or vomiting. In the bilateral group, five patients had nausea. Headache after spinal anesthesia was reported in two and four patients in the unilateral and bilateral groups, respectively. In contrast, Pittoniet al[14], reported one patient with post dural puncture headache in the group using the 22-gauge Sprotte spinal needle. Esmaoglue, used 25G Quincke's spinal needle and injected1.5 cm^3 and 3 cm^3 of hyperbaric bupivacaine 0.5% for unilateral and bilateral anesthesia, respectively. He observed six and nine patients had headache in respective groups. This may be due to the type of needle used or the relatively young age of the patient population.In this study, there are six patients had urinary retention in group BB and none of the patients had urinary retention in group UB. Spinal anesthesia can disturb bladder function by disabling the micturition reflex. Kamphuiset al[15], reported that voiding disturbance continues until the nerve block has regressed to the third sacral root. Esmaoglue et al**,** observed no patients had urinary retention in unilateral spinal anaesthesia. Atef et al[16], reported no urinary retention after unilateral spinal anesthesia with 5 mg of hyperbaric bupivacaine, while in their study, after induction with 12.5 mg dosage, this complication observed in five percent of the subjects. So, it appears that a reduction in the bupivacaine dosage decreases the likelihood of urinary retention as well.

Conclusion

Unilateral spinal anaesthesia with a low dose (7.5 mg) of 0.5% hyperbaric bupivacaine induces sufficient sensory and motor block

The technique is therefore suitable for short duration of lower-limb surgery. This technique achieves stable hemodynamics.

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