ORIGINAL RESEARCH

Comparative evaluation of low dose hyperbaric versus hypobaric levo bupivacaine for lower limb surgeries under unilateral spinal anaesthesia

[1]Dr. Asha Anand, [2]Dr. Angelina K Rekhi, [3]Dr. Amartej Singh Sohal

[1,3]Associate Professor, [2]Assistant Professor, Department of Anesthesia, Punjab Institute of Medical Sciences, Jalandhar, Punjab, India

Corresponding Author
Dr. Angelina K Rekhi
Assistant Professor, Department of Anesthesia, Punjab Institute of Medical Sciences, Jalandhar, Punjab, India

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ABSTRACT

Background: In our study we compared hyperbaric and hypobaric levobupivacaine in unilateral spinal anesthesia for lower limb surgeries. **Methods:** This prospective randomized trial was conducted on 60 patients with ASA 1-111scheduled for lower limb surgeries. In Group1, hyperbaric levobupivacaine was used whereas in group 11 hypobaric levobupivacaine was used for unilateral spinal anesthesia.Patients in hyperbaric group were placed with operative side down whereas in hypobaric group patients were placed with operative side up during spinal injection. Lumbar puncture was performed in L3-L4 interspace. Efficacy of the blockade, hemodynamic stability, onset of anesthesia,offset time and patient satisfaction were compared between the two groups. **Results:** In hyperbaric group 26 patients (87%) had unilateral anesthesia whereas in hypobaric group 27 patient (90%) had unilateral spinal anaesthesia. Maximum sensory blockade (T10) and the time to achieve this (10 mins) was same in both the groups. Time for 2 segment regression was 76.4±5.2 mins in hyperbaric group whereas in hypobaric group it was 64.2±48 minutes($p<0.05$).Duration of anaesthesia was 210±12 mins in hyperbaric group and 170±14 mins in hypobaric group. Haemodynamic parameters throughout the surgery were comparable between the two groups. **Conclusion:** We found early resolution of the blockade and better patient satisfaction with hypobaric levobupivacaine.

Keywords: Unilateral spinal anesthesia, hyperbaric levobupivacaine, hypobaric levobupivacaine

INTRODUCTION

Unilateral spinal anesthesia has its inherent advantages, especially in patients coming for day care surgeries or those with limited pulmonary and/or cardiovascular reserve. The merits of unilateral spinal anesthesia are greater haemodynamic stability, decreased chances of urinary retention, swift recovery and greater patient satisfaction.[1,2,3] Low dose along with slow speed of administration in the lateral positioning is required for unilateral distribution in spinal anesthesia.[4,5] The difference in density between the cerebrospinal fluid(CSF) and local anesthetics solutions is the main factor for restricting the distribution of the drug in the subarachnoid space.[6] Unilateral spinal block can be achieved by administering a hypobaric or hyperbaric solution in the subarachnoid space with the patient in the lateral decubitus position so that the anesthetic agent gets settled above (hypobaric)or below (hyperbaric) the saggital plane.[7] Injection rate should be slow, as fast injection may cause turbulence and pressure changes resulting in erratic distribution of drug whereas slow injection favours distribution of drug depending upon baricity and gravity producing desired effect.. The proper way of achieving unilateral blockade is with the low dose and the low flow, patient should be kept in the lateral decubitus position for 10-15 minutes.[9,10,11,12]

Hyperbaric bupivacaine is usually used for unilateral spinal anesthesia. This can be performed with the patient in lateral position and the side to be operated should be down. Unilateral spinal anesthesia with hypobaric bupivacaine is given in the lateral position with the side to be operated upwards. This helps patients in making proper position for spinal anaesthesia and also there is no need of turning back of patient to start the surgery. So in this prospective study we compared low dose of hyperbaric and

hypobaric bupivacaine for unilateral spinal anaesthesiain terms of efficacy of the blockade, haemodynamic stability, anesthesia onset and offset time and patient satisfaction.

MATERIAL AND METHODS

After getting approval from the Ethical Committee of the institution we got our study registered in CTRI(CTRI/2020/03/023717). Patient consent was taken after explaining the procedure to them.The present study was conducted on 60 patients of either sex, ASA grade I-III, aged between 18-65 years posted for unilateral lower limb surgeries. Procedures lasting for maximum duration of 60 minutes were included. Patient with hypovolemia, preexisting neurological diseases, coagulation disorders, administration of thromboprophylaxis less than eight hours prior to the surgery,Infection at the puncture site, patients with agitation And delirium wereexcludedfrom the study

Patients were divided into two groups of 30 each using computer generated list of random numbers

Group I: Hyperbaric levobupivacaine

Patients received 2.0 ml (10mg) of 0.5% hyperbaric levobupivacaine for subarachnoid block

Group II: hypobaric bupivacaine

Patientsreceived 2 ml of 0.25% hypobaric levobupivacaine (10 mg) for subarachnoid block

(Preparation was done from 10 mg = 2.0 mL 0.5% isobariclevobupivacaine with 2.0.mLof distilled water).

Patients were kept NPO for six hours prior to the procedure.Before the anesthesia, a peripheral venous cannula was placed for hydration with 0.9% normal saline or Ringer's lactate and to administer any medications during the procedure. Standard monitors ie ECG, pulse oximeter, and non-invasive blood pressure were applied

Thepatients in the Hypobaric group were placed on thenon operativeside down whereas the patients in the Hyperbaric groupwere placed with operative side down . After cleaning and draping the, the skin of the puncture site was infiltrated with 2% lidocaine. The dural puncture was performed at the L3-L4 space, with a 26GQuincke needle .When there was free flow of CSF, 2.0ml of 0.5% hyperbaric, or 4.0 ml (10 mg)of 0.25% hypobaric levobupivacaine was injected . The bevel of the needle was directed to the side to be operated upon. Patients remained in the same position for 10 minutes before being placed in the the surgical position. Every patient received oxygen (1 - 2 L.min-1) by simple face mask.

Assessment of sensitive and motor blockades was done by an observer who was blinded to the study groups. The level of the sensitive blockade was defined as a lack of pinprick recognition, while the motor blockade was determined by the modified Bromage scale:

0 = moving the inferior limbs freely;

1 = unable to raise extended limbs;

2 = unableto bend the knees;

3 =unable to move the ankles.

Motor and sensory blockades were assessedbilaterally at 5,10,15 and 20 minutesafter the anesthesia and at the conclusion of the procedure. Maximum sensory blockade level on the operative side and the time taken to achieve it was noted. Unilateral spinal anesthesia defined as loss of pinprick sensation at or above T10 and complete motor blockade on the operative side; and no motor blockade and no loss of sensation to pin prick on opposite side. The time from maximum sensory block to 2 segment regression were noted.The duration of anesthesia was determined by the time of administration of spinal anesthesia and the first analgesic requirement. Haemodynamic parameters were evaluated at two minute intervalsfor the first 10 minutes after the administration of the anesthetic and then after every 5 minutes till the completion of surgery.If systolic blood pressure showed a reduction greater than 30% of baseline values, it was initially treated bycrystalloids. If the patientdid not respond, 3 mg of mephentaramine was administered and the dose was repeated until BP comes within normal limit. Bradycardia (reduction of heart rate below 50 beats/min) was treated with the administration of atropine 0.6 mg. Supplemental intravenous analgesia was administered if the patient complains of pain or discomfort.

Upon leaving the surgical room, patients were requested to record their opinion about the technique employed. Thechoices included good, satisfactory and bad.

Data was recorded and analysed using appropriate statistical tests. Chi square test was used to analyse the qualitative data and quantitative data was analysed using ANOVA test. $P < 0.05$ considered significant

RESULTS

Sixty patients were included in the study depending upon the inclusion and exclusion criterion. In Group I hyperbaric levobupivacaine was used whereas in group II hypobaric levobupivacaine was used for unilateral spinal anesthesia

Patient demographic data and duration of surgery are shown in tableI. There were statistically nosignificant difference found between the age, height, weight or duration of surgery.($p>0.05$).

DEMOGRAPHIC DATA

Demographic Parameters		**Group-I**	**Group-II**
Age		45±10.2	42.4±9.6
Sex	Male	30	28
	Female	20	22

Weight(kg)	66.6±12.6	64±10.8
Height(cm)	162.6±4.8	165.8±3.6
Duration of Surgery(min)	54.12±4.64	5.302±362

Sensory level achieved was compared between the two groups as shown in table 2. In hypobaric group maximum level was achieved upto T10 in 29 patients and only 1 patient has sensory level achieved uptoT8. In hyperbaric group 3 patients achieved sensory level upto T8 and in 1patient sensory level uptoT6 achieved.

Table 2 Comparison of sensory level achieved between the groups

Time(minutes)	Sensory level	Hyperbaric group	Hypobaric group
5 minutes	T12	12	25
	T10	15	3
	T8	3	0
10 minutes	T12	1	2
	T10	27	28
	T8	2	0
15 Minutes	T10	26	30
	T8	3	1
	T6	1	0

THE SPINAL EFFICACY PARAMETERS

In hyperbaric group 26 patients (87%) had unilateral anesthesia whereas in hypobaric group 27 patients (93%) had unilateral spinal anesthesia asshown in table**3**. Data on intergroup comparison was non-significant.

Maximum sensory blockade achieved was T10 in both the groups.

The time to achieve the maximum sensory blockade was 10 minutes in both the groups.

Time for 2 segment regression was 65.4±5.2 mins in hypobaric group whereas in hyperbaric group it was 58.2±4.8 minutes($p<0.05$).Duration of anaesthesia was 210±12mins in hyperbaric group and 170±14 mins in hypobaric group. On intergroup comparison result was statistically significant ($p>0.05$)

Table 3 Spinal efficacy parameters

Parameter	Group I Hyper baric	GroupII Hypobaric	P value
Maximum sensory blockade	T10	T10	
Time to achieve maximum sensory blockade	10 minutes	10 minutes	
Time to 2 segment regression	65.4±5.2 minutes	58.2±4.8 minutes	P<0.05
Duration of anesthesia	210 ± 12 minutes	170 ±14 mins	P<0.05
Unilateral spinal anesthesia	26	27	p>0.05

In terms of haemodynamic parameters there were no significant difference observed in both the groups.
Also in our study all the surgeries were successfully completed under spinal anesthesia .

DISCUSSION

In this prospective randomized study we found that 10 mg of both hyperbaric and hypobaric levobupivacaine can be used effectively for unilateral spinal anesthesia with minimal haemodynamic alterations and side effects. The benefit of hypobaric levobupivacaine was greater patient satisfaction and faster regression of motor and sensory block.

During spinal anaesthesia complications rateincreases as the doses of local anaesthetics increases.[13] So interest in unilateral spinal anesthesia is increasing because of the reduced amount of local anaesthetics used during this technique and better haemodynamic stability.[14] But very small doses increase the chances of failure of the blockand also shortens the duration of the block.[15]We use 10 mg of levobupivacaine as in various previous studies this dose has been used successfully for unilateral lower limb surgeries without any haemodynamic side effects.[15] Levobupivacaine which is an S-enantiomer of racemic bupivacaine , has better cardiovascular and neurotoxicity profile as compared to bupivacaine now is being used in spinal anesthesia.[16]Routinely hyperbaric levubupivacaine is usuallyused forneuraxial blockade in lower limb surgeries causing considerable discomfort in lateral position with fractured limb on dependent site while administering the spinal block. If anesthesia is administered with hypobaric solution patient need not lie on painful side while positioning. So we compared hyperbaric and hypobaric levobupivacaine in terms of unilateral blockade, haemodynamic stability,anesthesia onset and offset time and patient satisfaction.

Kaya et al compared low dose hypobaric and hyperbaric levobupivacaine in unilateral spinal anesthesia and reported that 7.5 mg hyperbaric or

hypobaric bupivacaine provided adequate unilateral spinal anesthesia and good haemodynamic stability for short duration lower extremity surgery. In our study we also had similar findings .[17]However unilateral spinal anesthesia was more frequent in the hyperbaric group of their study whereas in our study more unilateral anaesthsia achieved in hypobaric group 27 patients(90%) as compared to hyperbaric group 26patients(87%) though non- significant.

Imbelloni, et al compared isobaric, hyperbaric and hypobaric bupivacaine for unilateral spinal anesthesia. In their study they randomly divided 150 patient into three groups to receive 5mg of bupivacaine(hyperbaric,isobaric or hypobaric bupivacaine.The authors concluded that spinal anesthesia with hypoabaric and hyoerbaricpresented higher frequency of unilateral anesthesia.[18] In their studysensory blockade was exclusively unilateral in 31 pt in isobaric group,42 patient in hyperbaric group and 45 patient in hypobaric group .Although we used levobupivacaine the unilateral sensory blockade was high and comparable in both hypobaric and hyperbaric group. In hyper group 26 patients (87% had unilateral anaesthesia and in hypo group 27 Pt(90%)had unilateral anesthesia .

In another study by Wason et al in which they compared low dose bupivacaine hyperbaric, near isobaric and hypobaric bupivacaine for spinal anesthesia in pt undergoing knee arthroscopy they concluded that degree of motor block and duration of subarachnoid block was similar with low1.2 ml or high volumev3.4 ml though the block was more unilateral with hypobaric and hyperbaric than isobaric group .[19] though we didn't compared isobaric but both hypobaric and hyperbaric bupivacaine resulted in unilateral block

Limitation of our study was that we used different volume of anaesthetic solution but various studies found that found that total amount of local anaesthetic solution plays a major factor in intrathecal drug spread wheras variation in volume and concentration plays a minor factor. [20,21]

CONCLUSION

We found that both hyperbaric and hypobaric levobupivacaine can be used to provide adequate unilateral spinal anaesthesia with good haemodynamic stability. However early resolution of the blockade and better patient satisfaction occurred with hypobaric levobupivacaine

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