International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Comparison of Intrathecal Isobaric Levobupivacaine with Hyperbaric Bupivacaine in Spinal Anesthesia for Lower Limb Orthopedic Surgeries

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Received: 26/08/2015 *Revised: 21/09/2015* *Accepted: 22/09/2015*

ABSTRACT

Background: Levobupivacaine is an S (-) enantiomer of bupivacaine having less cardiotoxic and central nervous system effects. Use of isobaric levobupivacaine in spinal anesthesia has recently been started.
Objective: To compare the anesthetic efficacy and safety of isobaric levobupivacaine versus hyperbaric bupivacaine in spinal anesthesia for lower limb orthopedic surgeries.
Materials and methods: 60 healthy patients were randomized into two groups of 30 each to receive intrathecal injection of 3ml 0.5% (15mg) of hyperbaric bupivacaine in group B and 3ml 0.5% (15mg) of isobaric levobupivacaine in group L. Both groups were compared regarding sensory- motor block characteristics, hemodynamic profile, adverse effects, supplemental analgesia and success rate.
Results: Both agents produced effective spinal anesthesia to accomplish surgery without supplementation in all 30 (100%) patients of group B and almost all (n=29, 97.6%) patients of group L. Peak sensory level was significantly higher in Group B (T6.2±1.25) than in group L (T9.33±1.65), $p < 0.001$. Sensory onset (time to T_{10}) was significantly faster in group B (7.67±1.49) than in group L (10.00±1.05), $p < 0.001$. All patients achieved Bromage score of 3 but motor onset was significantly faster in group B (8.8±1.23) than in group L (8.8±1.45), $p < 0.0001$. Both groups were comparable regarding SBP, DBP, HR, SpO_2. However incidence of hypotension and bradycardia was significantly more in group B than in group L. Duration of analgesia and sensory blockade were significantly longer in group B than group L, $p < 0.0001$ and $p = 0.0014$ respectively while motor blockade was comparable, $p = 0.21$.
Conclusion: Isobaric levobupivacaine offering effective sensory motor blockage and stable hemodynamic profile with significantly decreased cardiovascular and central nervous system toxicity is a suitable alternative to hyperbaric bupivacaine in spinal anesthesia for lower limb orthopedic surgeries. Nevertheless hyperbaric bupivacaine is recommendable for surgery requiring higher sensory blockade, longer duration and emergency operations.

Keywords: intrathecal, bupivacaine, levobupivacaine, orthopedic surgery, spinal anesthesia.

INTRODUCTION

Spinal anesthesia is easy inexpensive and preferable technique for lower limb orthopedic surgery, as it provides effective sensory and motor block with rapid onset, attenuation of stress response and less thromboembolic episodes. Bupivacaine is most commonly used local anesthetic agent

for spinal anesthesia. However the cases have been reported where unintended intravascular injection of bupivacaine during attempted neuraxial anesthesia resulted in sudden cardiac arrest which was refractory to resuscitation. [1,2] This motivated researchers to investigate about mechanism of local anesthetic toxicity and to develop alternative agents which have similar efficacy but better safety profile than bupivacaine. Scientists have taken the advantage of the fact that amide local anesthetics have a chiral centre and can exist as levo S (-) and dextro R (+) stereoisomers. The dextro form of local anesthetic was found to be more toxic than levo-form. [3] Since its introduction into the market in 1961, racemic bupivacaine has been marketed as equal mixture of its two enantiomers.

Ropivacaine was the first levo enantiomer introduced into the early 1990s, which had greater safety profile [4] than bupivacaine, but it was lesser potent [5] so could not become a reasonable alternative of bupivacaine in spinal anesthesia. Another levoisomer introduced recently is levobupivacaine which has drawn interest as it has almost equal potency [6] than bupivacaine and better safety profile. [7]

Initial studies of levobupivacaine are now appearing in literature confirming its comparable clinical efficacy with racemic bupivacaine in spinal anesthesia when it was used for lower limb orthopedic surgeries, [8] cesarean section, [9] transurethral resection of prostate, [10] lower abdominal surgery. [11] In all these studies, preparation of both bupivacaine and levobupivacaine were isobaric. Hyperbaric preparations of local anesthetic are preferred in spinal anesthesia as they produce more predictable and reliable sensory and motor block, with faster onset than a plain solution as observed for bupivacaine, [12] ropivacaine, [13] and levobupivacaine. [14]

Since commercial preparations of hyperbaric levobupivacaine are not available in India, addition of glucose to make it hyperbaric in every case in cumbersome and safety is also questioned.

Hyperbaric bupivacaine in spinal anesthesia is still a gold standard in our country; however, there is scarcity of data which show comparable efficacy of intrathecal isobaric levobupivacaine versus hyperbaric bupivacaine. [15-18]

Therefore we designed this study to compare sensory- motor block characteristics, hemodynamic profile and adverse effects of equivalent doses (15mg) of isobaric levobupivacaine and hyperbaric bupivacaine in spinal anesthesia for lower limb orthopedic surgery. Our ultimate objective is if isobaric levobupivacaine is found clinically effective, it can become a better alternative to hyperbaric bupivacaine in spinal anesthesia, because it has lower toxic effects on cardiovascular and central nervous system. [19]

MATERIALS AND METHODS

After taking approval from institutional ethics committee and informed written consent from the patients, present study was carried out in the Department of Anaesthesia between September 2014 and February 2015 at orthopedic operating theatre in RNT Medical College, Udaipur (Raj), India.

***Study design*:** A prospective, randomized, double blind, comparative (case: control) study.

***Study population*:** Sixty ASA I, II patients of both sex and aged between 18-65 yrs posted for elective lower limb orthopedic surgery under spinal anesthesia were enrolled in the study. We have not included hip and knee replacement surgeries as they are conducted in combined spinal and epidural technique in our institute. A

thorough preanesthetic evaluation and necessary investigations were carried out.

***Exclusion criteria*:** Patients who had contraindications for spinal anesthesia like - coagulation disorders, patient refusal, on anticoagulants, spinal deformity, allergic to amide local anesthetics and a significant history of drug or alcohol abuse, morbid obesity (body mass index >29 kg/m^2), diabetic, cardiovascular, neurologic, or other systemic illness, ASA grade III or more, musculoskeletal and psychiatric diseases that could make our technique difficult were excluded.

***Basis of sample size*:** Based on previous study (Vanna et al 2006), [17] to detect a difference of 3 minute in time to sensory onset to T10 between two groups,(isobaric levobupivacaine versus hyperbaric bupivacaine) at a power of 80% and confidence interval of 95%, a minimum sample size of 26 patients in each group was required. We enrolled 30 patients in each group to compensate for dropouts.

***Randomization and group allocation*:** Sixty study patients were randomized using sealed envelope technique into two groups of 30 each, depending on the drug regime used for spinal anesthesia as follows:

GROUP B (control group): received 3 ml of 0.5% hyperbaric bupivacaine (15 mg) [bupivacaine hydrochloride in dextrose injection 0.5% (4ml ampule), unijules life sciences ltd]

GROUP L (study group): received 3 ml of 0.5% plain (isobaric) levobupivacaine (15 mg) [levo-anawin 0.5% (4ml ampule), Neon laboratories limited, India]

To provide double blindness, study drugs were prepared by one anesthesiologist who was not further involved in the study. Another anesthesiologist who was not aware of group allocation gave spinal anesthesia and recorded data in all patients. The patient and surgeon were also not aware of group allocation.

***Spinal anesthesia technique*:** Following arrival in the preanesthetic room, intravenous access was established and an infusion of 500 ml Ringer lactate was commenced to preload the patient before spinal anesthesia. Standard monitoring was used throughout the operation with the help of a multiparamonitor having noninvasive blood pressure (NIBP), electrocardiograpy (ECG) and pulse oximetry (SpO2). Baseline blood pressure, heart rate and SpO2 were recorded. Patients were placed in sitting position and after taking full aseptic precautions, lumbar puncture was performed in L3/4 inter space in midline, using Quincke spinal needle of 25G. Correct needle placement was identified by free flowing cerebro- spinal fluid (CSF).The study drug was injected in subarachnoid space according to group allocation as 3 ml of 0.5% hyperbaric bupivacaine (15 mg)in group B and 3 ml of 0.5% plain (isobaric) levobupivacaine (15 mg)in group L. After the injection patient was placed supine. The end of intrathecal injection of study drug was termed as "time 0"for the purpose of subsequent patient assessment.

***Data recording*:** All data were recorded in a proforma by the anesthesiologist not aware of group allocation, Sensory block was measured by pin prick test [17] using 24 gauge hypodermic needle at 2,4,6,8,10,12 and 15 minutes after intrathecal injection to assess time to reach L1 level and T10 level , peak block height and time to reach peak block level. Loss of sensation to pinprick was considered as sensory block.

Sensory onset time was defined as time to T10, but time to L1 was also recorded as orthopedic surgeries can be carried out if L1 block was achieved.

Motor block was assessed using the modified Bromage scale [17] 0= able to lift the leg at the hip (no motor block), 1= able to flex the knee and ankle but not able to lift the leg at hip (partial motor block), 2=able

to move foot only (almost complete motor block) and 3= unable to move even the foot (complete motor block). Motor block was also assessed at 2, 4, 6, 8, 10, 12 and 15 minutes after SAB.

Maximum motor block (maximum Bromage score), and onset time of motor block (time to reach maximum Bromage score) was also recorded. Complete motor block was defined as a Bromage score of 3.

Intraoperative heart rate (HR) and peripheral oxygen saturation (SpO2) was monitored continuously and non - invasive blood pressure (NIBP) was recorded initially at 2 minute interval for first 10 min, thereafter every 5 minutes till the end of surgery. Intraoperative fluid and blood transfusion were given as per losses and maintenance required.

Hypotension was defined as fall in systolic blood pressure (SBP) of less than 100 mmHg and was treated with injection of 6 mg mephentermine IV and fluids. Bradycardia was defined as fall in HR less than 60 beats per min and was treated with atropine 0.4 mg IV bolus.

Incidence of intraoperative hypotension, bradycardia, nausea, vomiting, pruritus, hypoxia (SpO2 <90%) or other side effects were noted, and treated accordingly. Duration of surgery was defined as time of start of surgery to last suture.

Outcome of spinal anesthesia: If peak sensory level is achieved at L1 and Bromage score of 2 or 3 was achieved in 15 min of SAB, the surgery was allowed to start and case was considered as successful spinal block. If above criteria were not achieved, general anesthesia was given and case was declared as failed and excluded from further data analysis.

If surgery was started under spinal anesthesia and patient complained of intraoperative pain, anesthesia was supplemented with ketamine 1 mg/kg and if needed propofol infusion (50-100mcg/kg/min). Any complaint by surgeon regarding relaxation was also noted and treated with supplementation.

Success (clinical efficacy) of spinal block was assessed four grade scale:

- "Completely successful" if no supplementation required.
- "Almost successful" if single dose ketamine 1 mg/kg supplementation given.
- "Partially successful" if multiple dose ketamine or propofol infusion was given.
- "Failure" if converted to GA.

"Adequate" spinal block included "completely successful" and "almost successful" cases. Success rate was calculated as percentage of cases achieving "adequate" spinal block.

In postoperative phase, for recovery characteristics, sensory and motor block were checked every 30 minutes till sensory regression to S1 (normal sensation at lateral side of foot) and Bromage score returns to zero (complete motor recovery). Vital parameters (HR, NIBP, and SpO2) were also noted at the same intervals.

Duration of analgesia was defined as time of first complaint of postoperative pain and rescue analgesia in the form of tramadol 100 mg IV was given as per institutional protocol Time to regression to S1 (duration of sensory block) and time to return of Bromage score 0(duration of motor block) in minutes were noted, and study was declared complete.

***Statistical analysis*:** The data were entered into MS excel and analyzed by using SPSS version 17.0 Quantitative data were presented as arithmetic mean, standard deviation, and analyzed by using Student t test or analysis of variance (ANOVA) as per need. Qualitative data were presented as number (proportion or %) and analyzed with Chi square test. $p<0.05$ was considered as statistically significant.

Patient distribution according to age, sex, ASA grade, type of surgeries, peak sensory level, maximum Bromage score, incidence of side effects, success rate, patient and surgeon complaints were presented as number (proportion) and compared with Chi square test .Peak sensory level was also presented as mean ±SD and median (range) and compared with t test. All time durations like sensory and motor onset time, duration of sensory motor block, and duration of analgesia were presented as mean±SD and compared using t-test. Hemodynamic variables like, BP, HR, SpO2 were presented as mean±SD and compared using ANOVA.

RESULTS

Both groups were comparable regarding age, sex, ASA grade, type of surgery, duration of surgery and preoperative vital parameters (table 1).

Block characteristics: (table 2) *Sensory* onset was significantly faster with hyperbaric bupivacaine as compared to isobaric levobupivacaine, as shown by difference in time to onset to L1 (5.60 ± 0.81 min in group B, 8.07 ±1.44 min in group L, p <0.001), onset to T10 (6.00±1.05 min in group B, 9.07±1.01 min in group L, p <0.001), and onset to peak sensory level (7.67±1.49 min in group B, 10 min±1.05 in group L, p <0.001).

Table 1: Demographic characteristics

Variables		**Group L (n=30) Isobaric levobupivacaine**	**Group B (n=30) Hyperbaric bupivacaine**	**P value**
Age (yrs)		42.86±19.8	41.30±11.6	p=0.7
Sex	**Female**	18 (60%)	19 (63.3%)	p=0.7
	Male	12 (40%)	11 (37.3%)	
ASA grade	**I**	18 (60%)	15 (50%)	p=0.7
	II	13 (40%)	15 (50%)	
Type of surgery				p=0.5
Fracture I/T femur		8 (26.67%)	6 (20.0%)	
Fracture leg bone		8 (26.67%)	13 (43.33%)	
Fracture shaft femur		11 (36.67%)	10 (33.33%)	
Flexion deformity knee		1 (3.33%)	0 (0%)	
Knee biopsy		0 (0%)	1(3.33%)	
Malunion tibia		1 (3.33%)	0 (0%)	
Swelling left knee		1 (3.33%)	0 (0%)	
Duration of surgery		**108±13.30 min**	**106±14.08 min**	**P=0.5739**

Data are presented as mean±SD or n (%) as appropriate

Table 2: Comparison of sensory motor block characteristics in two groups

Variables	**Gp L (n=30) Isobaric levobupivacaine**	**Gp B (n =30) Hyperbaric bupivacaine**	**P value**
Peak sensory level			
Mean ± SD	T9.33±1.65	T6.2±1.25	<0.001
Median (Range)	T 10 (T8-L1)	T6 (T4-T8)	
Time to L1 (min)	8.07 ±1.44	5.6±0.81	<0.001
Time to T10 (min)	9.17±1.01	6.00±1.05	<0.001
Time to peak sensory level (min)	10.00±1.05	7.67±1.49	<0.001
Maximum Bromage score	3	3	
Time to maximum Bromage score (min)	8.8±1.45	6.73±1.23	<0.0001
Duration of analgesia (min)	130±16.2	155±14.6	<0.0001
Duration of sensory blockade (min)	188±32	217±35	0.0014
Duration of motor blockade (min)	205±37	216±30	0.21

Data are presented as mean±SD or median range as appropriate

All patients of both groups achieved target sensory level of L1 which was necessary to start lower limb orthopedic surgery. Mean value of peak sensory level was significantly higher in group B (T6.2±1.25) as compared to group L (T9.33±1.65), P=0.001. Peak sensory level ranged from T8-L1 (median T10) in group L

as compared to T4-T8 (median T6) in group B. Patient distribution according to peak sensory level achieved is shown in Figure 1.

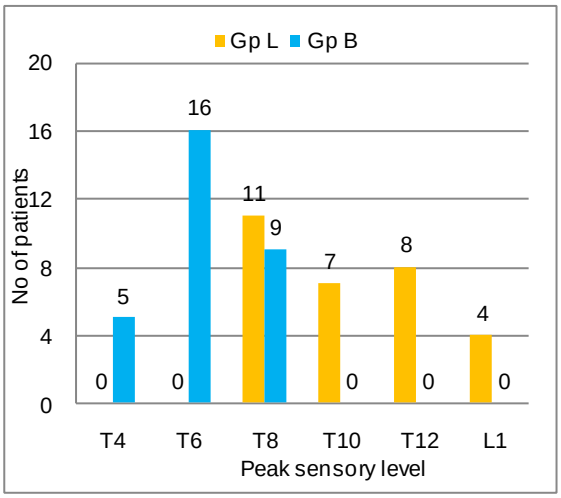

Fig 1: Patient distribution according to peak sensory level

All patients of both groups achieved maximum Bromage score of 3, signifying complete motor block. Motor onset in terms of time to achieve maximum Bromage of 3 was significantly faster with hyperbaric bupivacaine (6.73±1.23 min) as compared to isobaric levobupivacaine (8.8±1.45 min), p<0.001.

Duration of analgesia was significantly longer in group B (155±14.6) as compared to group L (130±16.2 min), P<0.0001

Duration of Sensory block was significantly longer in group B (217±35 min) as compared to group L (188±32 min), P = 0.0014

Duration motor block was also longer in group B (216±37min) as compared to group L (205±35 min) however it could not reach statistical significance, p = 0.21.

Hemodynamic profile: There was no significant difference in mean value of pulse rate (Fig 2), systolic BP, diastolic BP(Fig 3), and peripheral oxygen saturation in two groups throughout the study period ,p>0.05. Only adverse effect observed during study were hypotension [30 % (n=9) in group B, 6.67% (n=2) in group L, p=0.02] and bradycardia [10 %(n=3) in group B] which too occurred as a single episode and could easily be treated with a single dose of mephentermine (6mg) and atropine (0.4mg) respectively

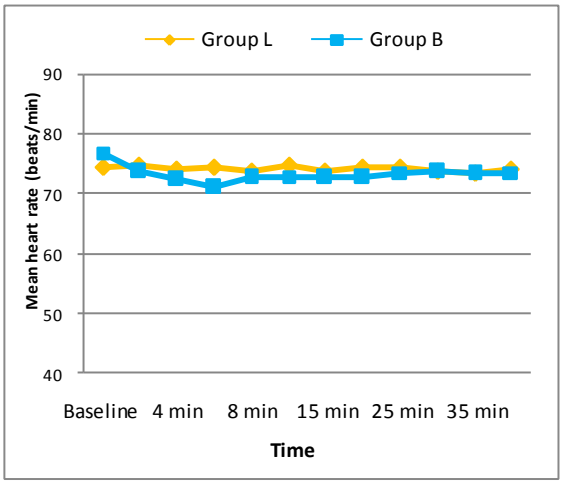

Fig 2: Comparison of mean heart rate in both groups

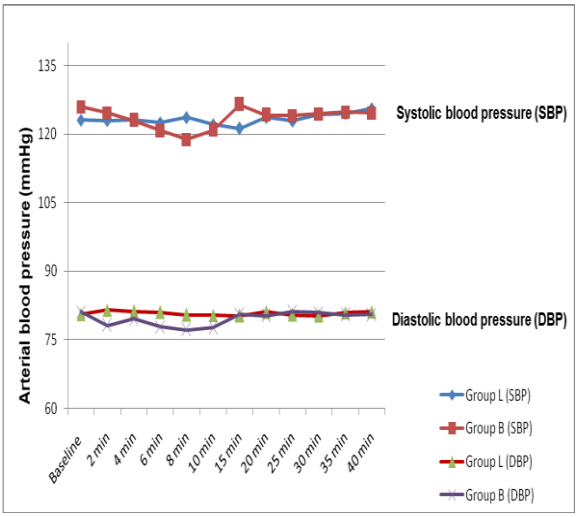

Fig 3: Comparison of mean SBP and DBP in both groups

***Supplemental analgesia*:** In group B all 30 (100%) patients, surgery was completed in spinal anesthesia without supplementation as compared to 29(96.79%) patients in group L in whom no supplementation was required. In group L only 1 (3.3%) patient complained of pain 5 min after skin incision and ketamine 1mg/kg was given and rest of the surgery was completed without further

supplementation. In this case peak sensory level was L_1. None of the cases in both groups were converted to GA. Rate of supplementation was comparable in two groups p=0.3.

***Success rate (clinical efficacy of spinal block)*:** Incidence of "completely successful" spinal block (no supplementation) was 100% (n=30) in group B and 97.6% in group L. Incidence of "almost successful" spinal (single dose supplementation) was 3.3% (n=1) in group L. Success rate in terms of incidence of "adequate spinal" block which includes completely successful and almost successful cases was 100% in both groups.

DISCUSSION

Present study indicated that intrathecal administration of 15 mg isobaric levobupivacaine was well tolerated and provided effective spinal anesthesia for lower limb orthopedic surgery.

One point to highlight is that orthopedic surgeries require L1 sensory level, which was achieved by all the patients with both isobaric levobupivacaine and hyperbaric bupivacaine which led to 100% success rate in both groups in present study.

It has been reported that peak sensory level achieved with isobaric levobupivacaine was around T8 as observed by Glaser et al, [20] Fattorini et al, [21] Vellosillo et al [22] etc. Similarly in our study peak sensory level ranged from T8-L1 with median value of T10 in group L while it ranged from T4-T8 with median value of T6 in group B. This difference was attributed mainly to different baricity of the solutions used.

Isobaric levobupivacaine was found effective for surgeries requiring level of T10 or below like TURP, [10] lower limb orthopedic surgeries, [8] lower abdominal surgeries. [11,18] On contrary Sanansilp et al [14] compared 3ml of 0.5% isobaric levobupivacaine versus hyperbaric levobupivacaine for total abdominal hysterectomy (TAH) and peak sensory level was T8 and T4 respectively. Success rate (defined in terms of surgery completed without supplementation) was 40% versus 90% respectively. They documented that isobaric levobupivacaine is not suitable for TAH requiring sensory level of T4/T6. However, vaginal hysterectomy could easily be carried out in spinal anesthesia using isobaric levobupivacaine because they require sensory level of T10. [23]

Solakovic et al [12] compared isobaric bupivacaine versus hyperbaric bupivacaine in various surgeries. They also reported that isobaric solutions in SAB are effective for surgeries requiring T10 or below.

Hyperbaric solutions are considered more reliable for upper abdominal surgeries or surgeries requiring T4/T6 as TAH. Hyperbaric solution spread according to gravity towards dependent portion of kyphosis at T4 when the patient laydown regardless of height of the patient and this pooling may facilitate a "one dose fits all approach". Though it may cause more episodes of hypotension and bradycardia. [24] Isobaric levobupivacaine was found effective for caesarean section [15,16] as spread of spinal anesthetic was found to be more cephalic due to gravid uterus achieving desired T4/T6 level.

We observed in our study that as compared to equivalent doses of hyperbaric bupivacaine, spinal anesthesia with isobaric levobupivacaine had slower onset of sensory-motor blockage (approximately 3 min delay), a lower peak block height (median T10 versus T6) and shorter block duration (approximately 30 min difference). Hemodynamic stability was more with isobaric levobupivacaine as showed by high incidence of hypotension (30% in group B versus 6.6% in group L) and bradycardia

with hyperbaric bupivacaine (10% in group B versus 0% in group L).

Similar to our study Vanna et al [17] compared 2.5ml of hyperbaric bupivacaine 0.5% with 2.5 ml of isobaric levobupivacaine 0.5% in spinal anesthesia for TURP surgeries. Onset to T10 was faster with hyperbaric bupivacaine (7.3 ±3.6 min) as compared to isobaric levobupivacaine (10.0 ±4.3 min), though it could not reach statistical significance p=0.22. Demarzio [15] et al and Gulen et al [16] also reported faster onset, higher peak sensory level and longer duration of block with hyperbaric bupivacaine as compared to isobaric levobupivacaine in cesarean.

Higher peak sensory level and faster onset with hyperbaric bupivacaine as compared to isobaric levobupivacaine observed in our study and others [15-18] could be attributed to two factors. Firstly, the difference in baricity of the two agents used. Baricity is measure of the relative density of local anesthetic solution when compared with CSF. Local anesthetics which have baricity ranging from 0.9990 to 1.0010 are considered isobaric. [25]

Local anesthetics are made hyperbaric by adding glucose which increases its mass density, Hyperbaric solutions are generally preferred in spinal anesthesia, because they tend to spread according to gravity, could achieve higher peak sensory level with faster onset. On contrary in a study by Helmi et al [26] comparing isobaric versus hyperbaric bupivacaine (4ml) it was found that isobaric bupivacaine produced more rapid onset [group I (4.8±2.2 min) versus group B (7.5±2.2 min)] and higher level of blockage T6(4-10) in group I versus T8 (T4-10) in group B]. Several reports have shown that isobaric bupivacaine spread unexpectedly cephalad, even after a reasonable time is allowed for fixation, thus causing late complication of hypotension and bradycardia due to high block. [27,28] It was explained that all plain anesthetic solutions are actually hypobaric in C.S.F, resulting in excessively high spread. [29] In contrast, isobaric levobupivacaine was found different in this aspect, its block levels were distributed to a narrow range and did not spread to higher levels as observed in various studies [15,17,24] including ours. Gori et al [24] clarified this finding in detail. They described that specific gravity of isobaric levobupivacaine is very close to C.S.F, it acts indifferently to gravitational forces, both immediately after injection and later on, therefore, intrathecal isobaric levobupivacaine does not spread unexpectedly high and levels of sensory block are unaffected by change in patient position. This might be advantage over plain bupivacaine which tends to spread unexpectedly high.

Another factor contributing to slower onset, lower block height and shorter block duration observed with isobaric levobupivacaine as compared to hyperbaric bupivacaine is structural difference of two agents which results in their potency difference as shown by minimum local analgesic concentration (MLAC) model. Lacasse et al [30] demonstrated that S enantiomers levobupivacaine is 13% less potent than bupivacaine. Camorica et al [31,32] reported that analgesic potency ratio of levobupivacaine/ bupivacaine is 0.81 (95% C.1 0.9 - 0.94) [31] and motor block potency ratio is 0.71 (95% C.1 0.51 – 0.98) [32]

If levobupivacaine and bupivacaine are compared in spinal anesthesia using same baricity solution then effect of potency difference can be better observed clinically.

Vellosillo et al (2014) [22] found out that sensory onset time was significantly shorter for isobaric bupivacaine 1.5(1-10 min) when compared with isobaric levobupivacaine 3(1-2 min), p= 0.018. Fattorini et al (2006) [21] also reported

sensory onset time of 9±5 min with isobaric bupivacaine as compared to 12±6 min with isobaric levobupivacaine.

Similarly when hyperbaric preparations of levobupivacaine and bupivacaine were compared by Alley et al (2002) [33] they reported sensory onset of 18±6 min v/s 15±9 min p=0.30 for levobupivacaine and bupivacaine respectively. Subasi et al [34] reported onset time of 305±110 sec with hyperbaric bupivacaine v/s 345±134 sec with hyperbaric levobupivacaine, p=0.279.

All these studies show comparatively faster onset with bupivacaine as compared to levobupivacaine

In our study Bromage score of 3 signifying complete motor blockage was achieved by both the agents, indicating comparable motor block. Previous all studies comparing levobupivacaine and bupivacaine [8-11] also reported that motor block by two agents are similar.

Our study also confirmed that levobupivacaine and bupivacaine have a similar tolerability profile. As expected, a decrease in systolic blood pressure and bradycardia attributable to sympathetic block accompanying spinal anesthesia were the most common adverse effects. In spinal anesthesia, an effective block is achieved with small dose regimes, and the potential for systemic toxicity is small. However if unintentional intravascular injection occurs the drug with minimum toxicity should be preferred. Cardiovascular toxicity of local anesthetics results in either direct myocardial depression, or arrhythmogenicity.

Evidence suggests that levobupivacaine may provide greater safety margin than bupivacaine for direct depression of myocardial contractility and production of malignant arrhythmias in humans, [35] as has also been observed in animal studies. [18,19]

In our study incidence of hypotension and bradycardia was higher with hyperbaric bupivacaine, as compared with isobaric levobupivacaine which is mainly due to more cephalic spread of hyperbaric solutions.

Similarly previous studies when isobaric versus hyperbaric preparations of bupivacaine [12,36] or levobupivacaine [14] were compared incidence of hypotension and bradycardia was more with hyperbaric solution and it was attributed to hyperbaricity It is well documented that hyperbaric solutions produce higher peak levels but may be associated with higher episodes of hypotension and bradycardia. [24]

But when isobaric levobupivacaine was compared with isobaric bupivacaine [21,22] or hyperbaric bupivacaine with hyperbaric levobupivacaine [33,34] no significant difference in incidence of hypotension was observed this could be due to same baricity of the solution.

No cases of cardiac depression or central nervous system toxicity caused by vascular absorption or direct intravascular injection of local anesthetic occurred in present study.

Our study clearly shows that isobaric levobupivacaine in spinal anesthesia could be enrichment within the anesthetic arena and being less cardiotoxic [35] it may be a reasonable alternative to racemic bupivacaine.

Limitation of our study is that it was conducted in lower limb orthopedic surgeries which can be done if target L1 sensory level is achieved. The results of our study suggest that both agents were found effective for these types of surgeries. As peak sensory level ranged from T8-L1 in isobaric levobupivacaine spinal anesthesia which implies that if surgeries requiring higher peak sensory level were included success rate could have been different. In

spite of above limitations some careful conclusion can be drawn.

CONCLUSION

We conclude that isobaric levobupivacaine is a suitable alternative to hyperbaric bupivacaine in spinal anesthesia for lower limb orthopedic surgeries as it offers effective sensory motor blockage and stable hemodynamic profile. In addition this novel drug levobupivacaine may offer the advantage of significantly decreased cardiovascular and central nervous system toxicity. Nevertheless hyperbaric bupivacaine is more recommendable for surgery that requires higher level of sensory blockage, longer duration, as well as emergency operations where a delay in starting surgery cannot be permitted.

We suggest that studies should be conducted in future in which comparison of isobaric levobupivacaine versus hyperbaric bupivacaine should be done in various type of surgeries in a single study where target peak sensory level is different like lower limb orthopedic surgeries (L1), inguinal and urological surgeries (T10), gynecological - obstetric surgeries (T4-T6). This will give exact picture of success rate of isobaric levobupivacaine to guide us in which type of surgeries, isobaric levobupivacaine, having better safety profile can be used in spinal anesthesia as an alternative to hyperbaric bupivacaine.

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How to cite this article: Naithani U, Malleshappa K, Madhanmohan et al. Comparison of intrathecal isobaric levobupivacaine with hyperbaric bupivacaine in spinal anesthesia for lower limb orthopedic surgeries. Int J Health Sci Res. 2015; 5(10):73-84.

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