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Original Research Article

Comparison of the Efficacy of 0.5% Isobaric Levobupivacaine and 0.5% Hyperbaric Bupivacaine for Spinal Anaesthesia in Lower Limb Orthopaedic Surgeries

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Abstract

Aim: In the literature there are different contradictory findings on clinical efficacy of isobaric levobupivacaine in spinal anaesthesia. Our aim was to compare the effectiveness of isobaric levo-bupivacaine to commonly used hyperbaric bupivacaine in achieving sensory and motor blocks in lower limb orthopaedic surgeries under spinal anaesthesia.

Methods: Eighty patients posted for lower limb orthopaedic surgeries were randomly divided into two groups receiving equivalent doses of hyperbaric bupivacaine (Group B) and isobaric levo-bupivacaine(Group L) for spinal anaesthesia. Time taken to achieve sensory and motor blocks, as well as the time for block regression for two segments for sensory block and the return of motor block was assessed.

Results: There was no significant difference regarding onset and duration of sensory block among the two groups. Onset of motor block was earlier and duration of motor block was prolonged in in Group B compared to group L which was statistically significant.

Conclusion: Levo-bupivacaine is comparable to bupivacaine in achieving adequate anaesthesia when administered intrathecally in lower limb orthopaedic surgeries.

Keywords: Isobaric, Levobupivacaine, Bupivacaine, Lower Limb Orthopaedic Surgeries.

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Introduction

Bupivacaine is a racemic mixture of dextro (D)-isomer and levo (L)-isomer. The dextro-isomer of bupivacaine is more cardiotoxic as compared to the levo-isomer. In 1979, a study reported an increased incidence of bupivacaine induced cardiac toxicity during regional anaesthesia. An important aspect of this toxicity is that it involves a significant degree of stereospecificity with the S-isomer showing significantly less cardiac depression effect than the R-isomer.[1]Levobupivacaine is an amide local anaesthetic that is the isolated S (-) enantiomer of racemic bupivacaine.[2] Levobupivacaine has less cardiotoxic and central nervous system effects in comparison with bupivacaine.[3] Levobupivacaine appears to be a reasonable alternative for racemic bupivacaine in light of lesser cardiotoxicity. Clinical studies comparing levobupivacaine and racemic bupivacaine in epidural and infiltration anaesthesia shown that both are equally effective.[4]However, levobupivacaine has not entirely replaced bupivacaine in clinical practice. Moreover, the experience of intrathecal anaesthesia with isobaric levobupivacaine is still contradictory and not well documented.[5] Hence, the purpose of this study was to assess the quality and duration of sensory and motor blockade of isobaric levobupivacaine and its side effects, when compared to intrathecal bupivacaine during lower limb orthopaedic surgeries.

Methods

This prospective, double-blind, randomized comparative study was conducted in 80 patients after approval of the Institutional Ethical Committee and written informed consent. Patients aged between 18 and 65 years of either sex with American Society of Anaesthesiologists (ASA) physical status I-II, scheduled for elective lower limb orthopaedic surgeries were included. Patients with hypertension, ischemic heart disease,

coagulation disorders or on anticoagulant therapy and local infection at the site of the puncture were excluded from the study. The selected patients were randomly allocated into two groups of 40 each by a random number table, prepared by another anaesthetist outside the operating room, namely, group B (3 mL of 0.5% hyperbaric bupivacaine)and group L (3 mL of 0.5% isobaric levobupivacaine). With the patient in sitting position, intrathecal anaesthesia was performed under aseptic conditions using 25 G Quincke's needle with a midline approach at L4-L5. The patients were turned supine immediately after the injection. Thereafter, hemodynamic parameters like pulse rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and peripheral oxygen saturation (SpO_2), were recorded every two minutes for the first 20 minutes, five minutes for the next 30 minutes, and every 10 minutes thereafter until the end of surgery. Assessment of sensory blockade was tested for pain by pinprick test using a hypodermic needle on each side of the midclavicular line, and the time of onset, highest level of sensory blockade, time for two-segment regression of sensory level, and duration of sensory block were noted. Motor blockade was assessed using the modified Bromage scale[6] and the time of onset, and duration of motor blockade were recorded. Postoperatively, the quality of analgesia was evaluated for pain using the visual analog scale (VAS)[6] and was assessed every 30 minutes until VAS > 4, and supplementary rescue analgesia was given at VAS > 4. IV infusion of paracetamol 15mg/kg was given as rescue analgesic. Occurrence of nausea and vomiting, shivering, hypoxia (SpO_2 < 90%), dry mouth, bradycardia, hypotension, or respiratory depression was recorded to know undesirable side effects. Hypotension (fall of systolic blood pressure (SBP) > 20% of baseline or MAP < 65 mmHg) was treated with injection ephedrine 6 mg IV increments. Bradycardia (heart rate (HR) < 60 beats/minute) was treated with injection atropine 0.6 mg IV. Nausea and vomiting were treated with injection ondansetron 4 mg IV. Shivering was treated with warm drapes and warm intravenous fluids. Data were collected using a pre-approved proforma and tabulated using the Microsoft Office® Excel software (Microsoft Corp., Redmond, WA, USA). The Statistical Package for the Social Sciences (SPSS) version 24 software for Windows (IBM SPSS Statistics, Armonk, NY, USA) was used for carrying out the statistical analysis. Mean and standard deviation (mean±SD) were used to reflect quantitative variables, whereas frequency and percentage were used to reflect qualitative variables (including age, weight, height, body mass index (BMI), and ASA physical status). The analysis was considered significant when the P value was less than 0.001.

Results

There was no significant difference in the demographic data among both groups. Mean time needed for sensory blockade at T6 was 158.40±41.89 sec in group B and 172.8±44.78sec in group L and was statistically not significant (P value=0.1000) (fig 1)

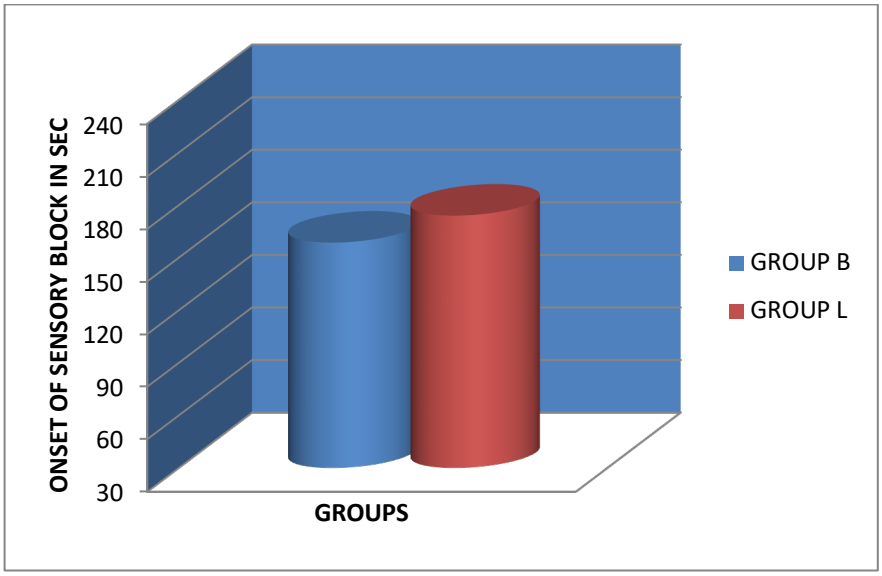

Figure 1: Onset of sensory block in both groups

Time to 1st analgesic request was 158.80±15.31min in group B and 157.50±13.22 min in group L (P value-0.65) which was not statistically significant. (fig 2)

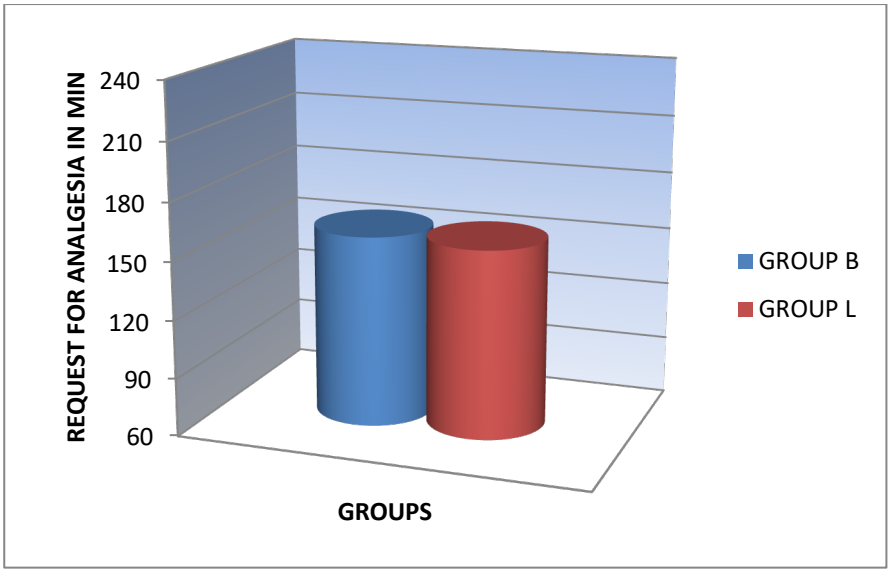

Figure 2: Time to 1st analgesic request in both groups

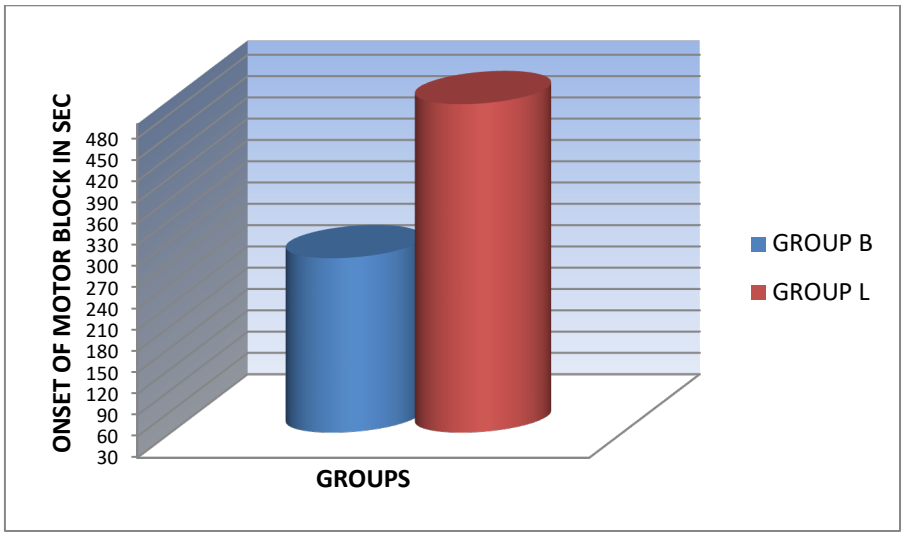

Figure 3: Onset of motor block in both groups

The mean time for onset of motor blockade was 275.70±67.42 sec in group B and 492.80±53.87 sec in group L respectively. This was statistically significant. (P<0.001) (fig 3)

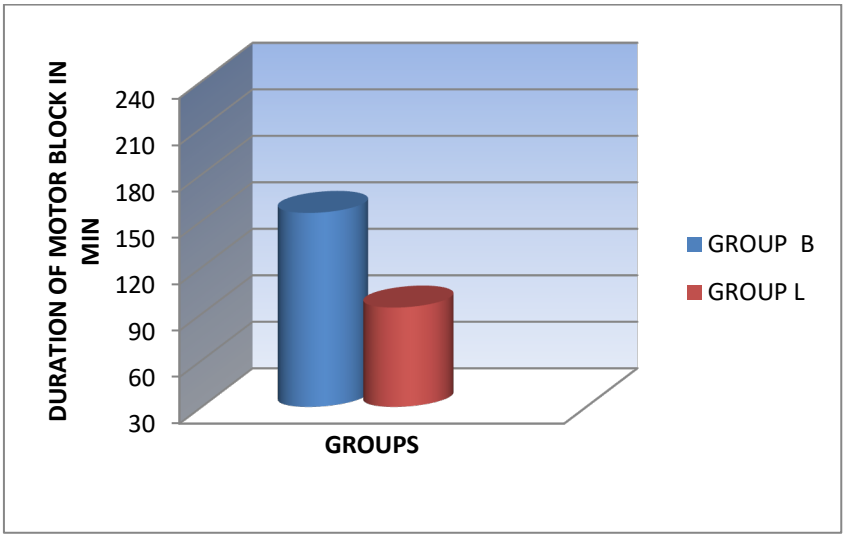

Figure 4: Duration of motor block in both groups

Mean duration of motor blockade was 155.20±14.95 min in group B compared to 94.10±8.31 min in group L. This was statistically significant. (P <0.001)(fig 4) Figure 5 shows the incidence of side effects.

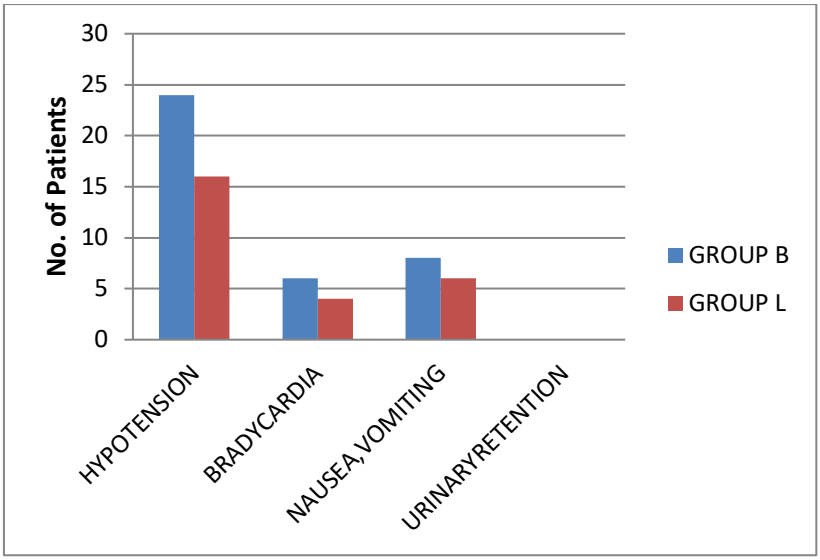

Figure 5: Incidence of side effects

Discussion

Spinal anaesthesia has been used in many surgical procedures due to its benefit for awake patients, rapid onset of action, ease of placement, low stress response, lesser side effects, and lower hospital stay.[7] The selection of local anaesthetic agents for spinal anaesthesia depends on various factors, including their efficacy in providing both intraoperative anaesthesia and postoperative analgesia, while minimizing central and cardiovascular system side effects. Bupivacaine, a long-acting local anaesthetic in the amino amide class, is commonly used in peripheral nerve blocks, and epidural, and spinal anaesthesia. However, bupivacaine is associated with potential cardiovascular side effects due to its slow dissociation from sodium channels.

This has led to the development of local anaesthetics with similar properties to bupivacaine but with fewer cardiovascular and neurotoxic effects. Levobupivacaine, an enantiomer of bupivacaine, has been shown to have a comparable pharmacokinetic profile but with a lower risk of cardiotoxicity and neurotoxicity. Additionally, levobupivacaine demonstrates a faster protein binding rate, which contributes to a reduced degree of toxicity.[8]We found that there was no significant difference regarding onset and duration of sensory block among the two groups. Onset of motor block was earlier and duration of motor block was prolonged in Group B compared to group L which was statistically significant. Our data is in agreement with a study by Gautier et al.[9]Similar data were obtained by del-Rio-Vellosillo et al. who reported that surgical satisfaction with intraoperative analgesia was 92.9% for bupivacaine and 83.9% for levobupivacaine for anaesthesia during knee arthroscopy.[10] It should be noted that we increased the dose of levobupivacaine and bupivacaine from 12.5 to 15 mg in comparison with the del-Rio-Vellosillo et al. study, but the effectiveness of levobupivacaine was not increased relative to this study. But in a study of Fattorini et al, there was no difference in the development of sensory motor block.[11] Piacherski V et al[12] in their study found 83.7% efficacy of levobupivacaine and 72.9% efficacy of hyperbaric bupivacaine compared with isobaric bupivacaine (100%) when administered intrathecally in equal volumes and amounts. The slowest development of sensory and motor block was noted in levobupivacaine. The longest postoperative analgesia was observed for isobaric bupivacaine and levobupivacaine. It should be noted that the data of different authors on the efficacy of levobupivacaine and hyperbaric bupivacaine are contradictory. Goyal et al [13]in their study concluded that intrathecal isobaric levobupivacaine-fentanyl combination is a good alternative to hyperbaric bupivacaine-fentanyl combination in caesarean surgery as it is less effective in motor block as it maintains hemodynamic stability at higher sensorial block levels. Cuvas et al [14] in their study concluded that both bupivacaine and levobupivacaine are effective and safe for use in subarachnoid anaesthesia for pilonidal cyst/sinus operations performed in the prone position. Singh et al[15] in their study concluded that levobupivacaine is an effective alternative to bupivacaine for patients undergoing unilateral inguinal hernia surgery. It has a shorter duration of sensory and motor block, allowing earlier mobilization in daycare surgeries, and a lower incidence of intraoperative

hypotension. Verma et al[16] in his study concluded that hyperbaric levobupivacaine provided faster block onset and offset, improved satisfaction, better hemodynamic stability, and quicker recovery. It is a safe and effective anaesthetic choice for laparoscopic cholecystectomy, offering predictable block spread and fewer adverse effects compared to isobaric levobupivacaine. It is necessary to perform further similar studies for evaluation of the effects and duration of anaesthesia provided by levobupivacaine in longer surgical procedures.

Conclusion

Isobaric intrathecal levobupivacaine (0.5%) provided excellent quality of anaesthesia without hemodynamic instability in patients undergoing lower limb orthopaedic surgery when compared with hyperbaric bupivacaine. Hence, isobaric levobupivacaine can be a safer alternative to bupivacaine for lower limb orthopaedic surgeries under spinal anaesthesia.

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