DOI: https://doi.org/10.61841/3vgrzv48 Publication URL: https://jarmhs.com/index.php/mhs/article/view/595

COMPARATIVE STUDY OF ISOBARIC 0.5% LEVOBUPIVACAINE COMBINED WITH 50MCG FENTANYL VERSUS ISOBARIC RACEMIC MIXTURE OF 0.5% BUPIVACAINE COMBINED WITH 50MCG FENTANYL IN LUMBAR EPIDURAL ANAESTHESIA FOR ELECTIVE INFRAUMBILICAL SURGERY

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To Cite This Article: Kumar, S. ., Mondal, U. ., Suba, O. ., & Ghosh, A. K. . (2026). COMPARATIVE STUDY OF ISOBARIC 0.5% LEVOBUPIVACAINE COMBINED WITH 50MCG FENTANYL VERSUS ISOBARIC RACEMIC MIXTURE OF 0.5% BUPIVACAINE COMBINED WITH 50MCG FENTANYL IN LUMBAR EPIDURAL ANAESTHESIA FOR ELECTIVE INFRAUMBILICAL SURGERY. Journal of Advanced Research in Medical and Health Science (ISSN 2208-2425), 12(1), 16-24. https://doi.org/10.61841/3vgrzv48

ABSTRACT

Background: *Levobupivacaine, the S-enantiomer of bupivacaine, has been developed to provide a similar quality of regional anaesthesia with a better safety profile and potentially more favourable sensory–motor differentiation. This study compared isobaric 0.5% levobupivacaine plus fentanyl with isobaric 0.5% racemic bupivacaine plus fentanyl for lumbar epidural anaesthesia in elective infraumbilical surgery.*

Methods: *In this prospective, randomized, double-blind study, 56 ASA I–II adults (19–60 years) scheduled for elective infraumbilical surgery under lumbar epidural anaesthesia were allocated to one of two groups (n = 28 each). Group B received 15 mL of 0.5% racemic bupivacaine with fentanyl 50 µg; Group LB received 15 mL of 0.5% levobupivacaine with fentanyl 50 µg. Sensory onset (time to T10), duration of sensory block (two-segment regression), onset and duration of motor block (Modified Bromage Scale), time to first rescue analgesia, and haemodynamic parameters (heart rate and mean arterial pressure) were recorded. Adverse events were noted. Data were analysed with a significance level of $p < 0.05$.*

Results: *Demographic characteristics were comparable between groups. Sensory onset was similar (6.26 ± 0.87 min in Group B vs 6.55 ± 0.62 min in Group LB; $p = 0.166$), but the duration of sensory block was significantly longer with levobupivacaine (195 ± 8.86 vs 180 ± 10.98 min; $p = 0.00003$). Motor block developed faster and lasted longer with bupivacaine (onset 15.83 ± 0.95 vs 16.46 ± 0.94 min; $p = 0.0198$; duration 193.75 ± 8.56 vs 185 ± 9.27 min; $p = 0.0007$). Two patients in Group LB did not develop complete motor block. Time to first rescue analgesia was significantly prolonged in Group LB (282.67 ± 9.95 vs 248.21 ± 12.99 min; $p < 0.001$). Group B showed more pronounced early decreases in heart rate and mean arterial pressure, with six patients requiring atropine compared to one in Group LB.*

Conclusion: *Epidural isobaric 0.5% levobupivacaine with fentanyl provides comparable onset but longer sensory analgesia, shorter and less intense motor block, and better haemodynamic stability than racemic 0.5% bupivacaine with fentanyl for infraumbilical surgery. Levobupivacaine appears to offer a more favourable balance between efficacy, motor sparing and cardiovascular safety in this setting.*

KEYWORDS: *Levobupivacaine; Bupivacaine; Epidural anaesthesia; Infraumbilical surgery; Fentanyl; Sensory block; Motor block; Haemodynamic stability; Postoperative analgesia.*

INTRODUCTION

Spinal and epidural anesthesia are well-established regional anesthetic techniques commonly employed for procedures involving the lower abdomen and lower limbs [1,2]. Among them, epidural anesthesia is considered highly adaptable and widely used in clinical practice. Numerous studies have demonstrated its ability to reduce postoperative morbidity and mortality [3]. Epidural anesthesia and analgesia involve the administration of local anesthetic agents into the epidural space through an epidural needle or catheter, producing blockade of spinal nerves as they pass through this space after emerging from the spinal cord. The proposed mechanisms of action include direct effect of the anesthetic on the spinal nerves within the epidural space or gradual diffusion into the subarachnoid space with subsequent blockade of nerve roots.

A major advantage of epidural analgesia is precise control over both the level and duration of blockade. Because local anesthetics and adjuvants can be administered through an epidural catheter either as a continuous infusion or intermittent top-ups, this technique is highly suitable for providing prolonged postoperative analgesia, an important benefit compared with spinal anesthesia. To minimize toxicity associated with conventional local anesthetics, stereoisomeric formulations have been developed. The levo-isomers are associated with reduced toxicity and prolonged analgesic action [4-5].

Levobupivacaine hydrochloride (LB), the levo-isomer of racemic bupivacaine (B), belongs to the amide local anesthetic group. Differences in pharmacokinetics between the two indicate a longer duration of action with LB, making it suitable for surgical, obstetric, and postoperative pain applications. Pharmacokinetic comparisons of LB with racemic B and dextro-bupivacaine following intravenous, epidural, and brachial plexus administration have shown no significant differences when equivalent doses are used [6-7]. Both B and LB provide longer analgesic duration than many other local anesthetics, reducing the need for repeat injections. They also offer a favorable sensory-to-motor block ratio. While some studies report that LB produces a significantly longer sensory block than B at comparable doses [8], others have found comparable sensory duration with less motor blockade when using LB [9].

Although bupivacaine is generally safe, its cardiotoxic potential is higher than that of other local anesthetics, such as lidocaine, especially in cases of intravascular injection or rapid systemic absorption, as seen with Bier blocks [10]. Bupivacaine exists as two enantiomers: levobupivacaine and dextro-bupivacaine in a 50:50 mixture. Development of LB as a standalone agent is supported by evidence of stereospecific differences in nerve conduction blockade, particularly affecting the cardiovascular system. If absorbed systemically, both cardiovascular and central nervous system effects may occur. Preclinical and clinical data consistently demonstrate a superior safety profile for LB compared with racemic bupivacaine [11-14], with equivalent doses producing less toxicity in both animal models and human subjects [15].

In the present study, 56 patients will be randomly assigned into two equal groups of 28 each. Group B will receive epidural isobaric 0.5% bupivacaine 15 ml (75 mg) with fentanyl 50 µg (1 ml), for a total volume of 16 ml. Group LB will receive epidural isobaric 0.5% levobupivacaine 15 ml (75 mg) with fentanyl 50 µg (1 ml), total volume 16 ml. The duration of sensory and motor blockade will be evaluated, along with heart rate, systolic and diastolic blood pressures, and mean arterial pressure at regular intervals throughout the perioperative period.

The objectives of the present study are to determine the duration of sensory block and motor block, evaluate hemodynamic changes during the intraoperative period, and observe any untoward effects occurring during the operative or postoperative period with appropriate management.

MATERIAL AND METHODS

This prospective, randomized, double-blind study was conducted in the operating theatres and postoperative recovery areas of the Gynecology, Orthopedics, General Surgery, Plastic Surgery and Urology departments at IPGME & R, S.S.K.M. Hospital, Kolkata, over a period of fourteen months from September 2012 to October 2013. The study population consisted of fifty-six adult patients belonging to the American Society of Anesthesiologists (ASA) physical status I and II, who were scheduled to undergo elective infra-umbilical surgery under lumbar epidural anesthesia. The principal problem evaluated in this study was the duration of motor and sensory blockade produced by the study drugs.

All patients were screened during the pre-anaesthetic assessment, and only those aged between 19 and 60 years, with a body mass index between 18.5 and 29.9 kg/m² and of either sex, were included. Patients with known contraindications to epidural anesthesia such as infection at the site of injection, coagulopathy, significant neurological or psychiatric disorders, cardiac disease, hemodynamic instability, sepsis, or deformity of the vertebral column were excluded. Other exclusions included refusal to participate, known allergy to bupivacaine or fentanyl, chronic analgesic, antiplatelet or anticoagulant therapy, and pregnancy. Each patient underwent thorough pre-operative evaluation, including a detailed history, physical examination, neurological assessment, airway evaluation, and assessment of height and weight. Routine hematological investigations, a 12-lead ECG and chest radiograph were obtained. All patients received oral diazepam 10 mg and ranitidine 150 mg the night before surgery and were maintained fasting for eight hours.

After approval from the institutional ethics committee and obtaining written informed consent, patients were randomly allocated into two equal groups of twenty-eight each. Group B received 15 mL of 0.5% racemic bupivacaine with 50 µg fentanyl, while Group LB received 15 mL of 0.5% levobupivacaine with 50 µg fentanyl. The syringes were prepared to be identical, ensuring that both the patient and the observer remained unaware of group allocation. On arrival in the operating theatre, an intravenous line was secured using an 18-gauge cannula and 10–15 mL/kg of lactated Ringer's solution was infused over one hour. Standard monitors including continuous electrocardiography, pulse oximetry, and

non-invasive blood pressure measurement were applied.

Epidural anesthesia was administered with the patient in the sitting position. The L3-L4 or L4-L5 interspace was infiltrated with 1% lignocaine, following which the epidural space was identified with an 18-gauge Tuohy needle using the loss-of-resistance technique. An epidural catheter was introduced, leaving 4 cm within the epidural space. A test dose of 3 mL of 2% lignocaine with adrenaline was given to rule out intrathecal or intravascular placement. In the absence of adverse signs after five minutes, the study drug was administered incrementally, with 5 mL injected every 15 seconds and an interval of two minutes between injections, to complete the total volume in 4 minutes and 45 seconds. The patient was subsequently made supine and surgery commenced after at least thirty minutes.

Sensory blockade was assessed using pin prick sensation with a blunt 22-gauge needle. The onset of sensory block was defined as the time taken to achieve sensory level at the T10 dermatome, and the duration was defined as two-segment regression of sensory level. Sensory block was evaluated at five-minute intervals until onset, followed by thirty-minute intervals intraoperatively and postoperatively until rescue analgesia was required. Motor block was assessed using the Modified Bromage Scale at thirty-minute intervals, and its duration was defined as the time taken for regression from Grade 3 to Grade 2. Hemodynamic parameters including heart rate and mean arterial pressure were recorded every fifteen minutes during the first hour, every thirty minutes up to three hours, and subsequently hourly until rescue analgesia.

Pain scores were assessed using a Visual Analogue Scale ranging from 0 to 100 mm, where 0 represented no pain and 100 represented the worst imaginable pain. Rescue analgesia was administered whenever the VAS score exceeded 40 or on patient request, using 8 mL of 0.125% bupivacaine. The endpoint of the study was defined as the time of first request for rescue analgesia.

The primary outcome measure used for sample size estimation was the difference in the duration of sensory blockade. A difference of 25 minutes, with a standard deviation of 40 minutes, was assumed to be clinically relevant. With an 80% power and 5% level of significance, a minimum of twenty-eight patients per group was required. All data were entered into Microsoft Excel and analyzed using Statistica version 6 (Tulsa, Oklahoma, USA). Continuous variables were presented as mean and standard deviation, and a p-value of less than 0.05 was considered statistically significant.

RESULTS

Demographic Characteristics

Age, sex distribution, height, BMI and ASA physical status were comparable between Group B and Group LB. There were no statistically significant differences between the two groups in any of the demographic parameters.

Table 1: Demographic Characteristics Table

Parameter	Group B	Group LB	p-value
Mean Age (years)	39.75	40.50	0.784
Male (%)	57.14	46.43	0.593
Female (%)	42.86	53.57	0.593
Mean Height (cm)	165.08	162.43	0.2911
Mean BMI (kg/m²)	24.41	24.43	0.978
ASA I (%)	57.14	39.29	0.284
ASA II (%)	42.86	60.71	0.284

The mean age of patients in Group B was 39.75 years, and in Group LB it was 40.50 years. The p-value of 0.784 indicates that the difference in mean age between the two groups is not statistically significant. This means both groups were comparable in terms of age, and any observed variation is likely due to chance rather than a real group difference.

In Group B, males constituted 57.14% and females 42.86%, while in Group LB, males were 46.43% and females 53.57%. The p-value of 0.593 shows that the sex distribution between the two groups was not significantly different. Therefore, both groups had a similar proportion of male and female participants, indicating that gender was evenly balanced and not a confounding factor.

Group B had a mean height of 165.08 cm, whereas Group LB had a mean height of 162.43 cm. The p-value of 0.2911 indicates no statistically significant difference in height between the groups. Thus, both groups were similar in their average height, and any small differences are likely due to normal variation rather than a true difference.

The mean BMI in Group B was 24.41 kg/m² and in Group LB it was 24.43 kg/m². With a p-value of 0.978, this difference is clearly not statistically significant. The BMI values were almost identical between the two groups, showing that both groups were comparable with respect to body mass index.

Among Group B participants, 57.14% were ASA I and 42.86% were ASA II, while Group LB had 39.29% ASA I and 60.71% ASA II. The p-value of 0.284 indicates that the distribution of ASA physical status scores between the two groups did not differ significantly. Therefore, both groups were similar in baseline physical status, ensuring clinical comparability.

Table 2: Comparison of Mean Arterial Pressure (MAP) Between Group B and Group LB

Parameter	Group B (mmHg)	Group LB (mmHg)	p-value
MAP at baseline (0 min)	91 ± 13	87.5 ± 9.5	0.099
MAP at 15 min	80 ± 20	86.5 ± 11	0.020
MAP at 30 min	80 ± 20	87 ± 8	0.008
MAP at 45 min	82 ± 19	83 ± 10.5	0.597
MAP at 60 min	84 ± 18	82 ± 12.5	0.619
MAP at 90 min	83 ± 16.5	80 ± 8.5	0.348
MAP at 120 min	82 ± 17.5	80 ± 8	0.552
MAP at 150 min	82.5 ± 19	82 ± 7	0.823
MAP at 180 min	86 ± 15.5	83.5 ± 6.5	0.608
MAP at 240 min	86.5 ± 10.5	85.5 ± 7.5	0.499
MAP at 300 min	89 ± 14	85.5 ± 8.5	0.122
Maximum MAP	114	100	–
Minimum MAP	49	64	–

Mean arterial pressure (MAP) values were recorded at baseline and at multiple intervals following epidural administration. At baseline (0 minutes), Group LB demonstrated a slightly lower MAP compared to Group B (87.5 ± 9.5 vs. 91 ± 13 mmHg), although this difference was not statistically significant. However, at 15 minutes and 30 minutes after drug administration, Group B showed a significantly lower MAP than Group LB ($p = 0.020$ and $p = 0.008$ respectively). This early decrease in MAP was clinically relevant, as several patients in Group B required treatment with atropine. Beyond 30 minutes, the MAP trends of both groups ran parallel, without statistically significant differences at subsequent time points.

Over the duration of observation, MAP gradually stabilized in both groups. Group B showed a mild upward trend after 150 minutes, reaching a maximum MAP of 114 mmHg, whereas Group LB reached a maximum of 100 mmHg. Minimum MAP readings were lower in Group B (49 mmHg) when compared to Group LB (64 mmHg), further supporting the observation that Group B experienced greater hemodynamic depression, particularly during the early period following epidural block.

Overall, although both groups exhibited similar hemodynamic stability later in the observation period, Group LB demonstrated superior cardiovascular stability during the first 30 minutes, reflected in fewer interventions and higher MAP values compared to Group B.

Figure 1: Comparison of Mean Arterial Pressure Between Group B & Group LB

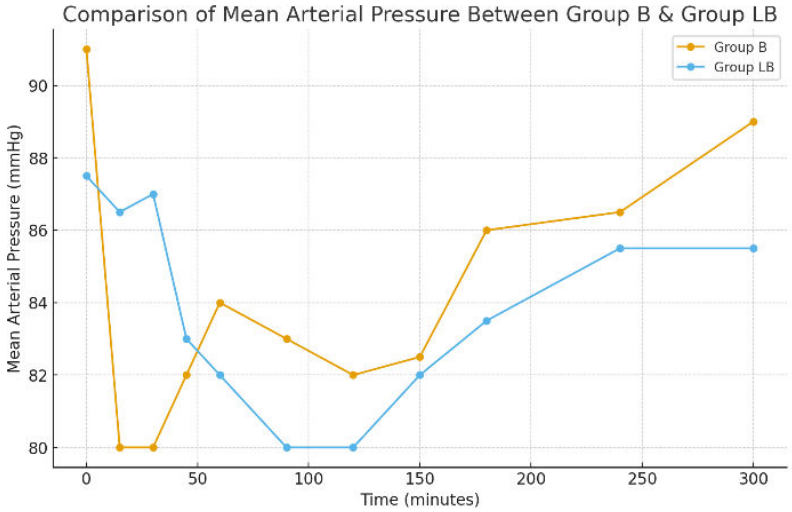


Table 3: Comparison of Heart Rate (HR) Between Group B and Group LB

Parameter	Group B (bpm)	Group LB (bpm)	p-value
HR at baseline (0 min)	81.5 ± 14.5	86.5 ± 12	0.224
HR at 15 min	78 ± 14.5	84.5 ± 12.5	0.001
HR at 30 min	88 ± 20	87 ± 8	0.332
HR at 45 min	76 ± 20	80 ± 10.5	0.025
HR at 60 min	75 ± 19	81 ± 12.5	0.045
HR at 90 min	86 ± 9	80 ± 9	0.458
HR at 120 min	76.5 ± 17	82 ± 9.5	0.022
HR at 150 min	77 ± 14.5	83.5 ± 8.5	0.005
HR at 180 min	83 ± 11.5	83.5 ± 7.5	0.118
HR at 240 min	84 ± 9	84 ± 10.5	0.183
HR at 300 min	82 ± 7.5	85 ± 12	0.230
Maximum HR	105	107	–
Minimum HR	42	57	–

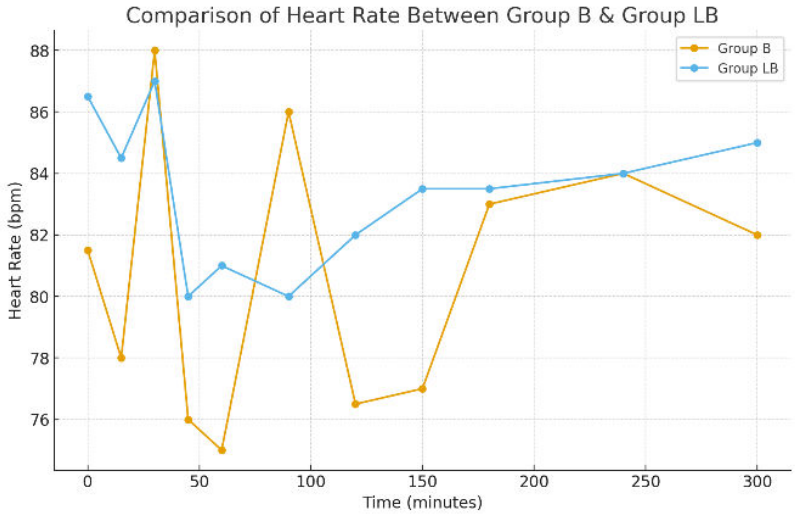
Heart rate (HR) was recorded at baseline and at regular intervals following epidural administration. At baseline, both groups showed comparable values, with Group B at 81.5 ± 14.5 bpm and Group LB at 86.5 ± 12 bpm, and the difference was not statistically significant (p = 0.224). However, at 15 minutes after the block, a significant drop in HR occurred in Group B (78 ± 14.5 bpm), whereas HR in Group LB remained higher (84.5 ± 12.5 bpm), yielding a significant difference (p = 0.001). This early bradycardic response continued at several time points.

At 45 minutes and 60 minutes, Group B continued to show significantly lower heart rates compared to Group LB (p = 0.025 and 0.045, respectively). These results suggest that patients in Group B were more prone to bradycardia following epidural administration. In contrast, Group LB maintained relatively stable HR values around 80–83 bpm across most time points, demonstrating a more consistent hemodynamic profile.

Statistically significant differences were again noted at 120 minutes (p = 0.022) and 150 minutes (p = 0.005), where Group LB maintained higher HR compared with Group B. Beyond 180 minutes, the two groups began to converge, and no significant differences were observed at 180, 240 or 300 minutes. Maximum and minimum values also highlighted this trend, with Group B demonstrating a wider range (42–105 bpm) compared to Group LB (57–107 bpm), indicating overall greater variability and more pronounced bradycardic episodes in Group B.

Overall, Group LB demonstrated superior cardiovascular stability, with fewer fluctuations in HR and fewer episodes of bradycardia, consistent with the lower atropine requirement observed in that group.

Figure 3: Comparison of Heart Rate Between Group B & Group LB



Sensory Block Characteristics

ONSET AND DURATION OF SENSORY BLOCK

Table 4: Sensory Block Onset and Duration

Parameter	Group B	Group LB	p-value
Onset (min)	6.26 ± 0.87	6.55 ± 0.62	0.166
Duration (min)	180 ± 10.98	195 ± 8.86	0.00003

Maximum Sensory Block Height

Table 5: Maximum Block Height (Dermatomes)

Level	Group B (%)	Group LB (%)	p-value
T5	25	21.43	0.987
T4	42.86	42.86	
T3	28.57	32.14	
T2	3.57	3.57	

Motor Block Characteristics

ONSET AND DURATION OF MOTOR BLOCK

Table 6: Motor Block Onset and Duration

Parameter	Group B	Group LB	p-value
Onset (min)	15.83 ± 0.95	16.46 ± 0.94	0.0198
Duration (min)	193.75 ± 8.56	185 ± 9.27	0.0007

Time to First Analgesic Requirement

Table 7: Time to Initial Analgesia Requirement

Group	Mean Time (min)	p-value
B	248.21 ± 12.99	0.0000
LB	282.67 ± 9.95	

Sensory Block Characteristics

ONSET AND DURATION OF SENSORY BLOCK (TABLE 4)

The onset of sensory block was defined as the time taken to achieve a sensory level at the T10 dermatome. The mean onset time was similar between the two groups, with Group B demonstrating a slightly faster onset (6.26 ± 0.87 minutes) compared to Group LB (6.55 ± 0.62 minutes). The difference, however, was not statistically significant ($p = 0.166$), indicating that both levobupivacaine and racemic bupivacaine produced sensory anesthesia at comparable rates.

In contrast, the duration of sensory block showed a highly significant difference between the two groups. Group LB exhibited a markedly longer duration of sensory block (195 ± 8.86 minutes) as compared to Group B (180 ± 10.98 minutes), and this difference was statistically significant ($p = 0.00003$). These findings suggest that levobupivacaine provided a more prolonged sensory analgesic effect than racemic bupivacaine while maintaining a similar onset profile.

MAXIMUM SENSORY BLOCK HEIGHT (TABLE 5)

The distribution of maximum sensory block height achieved following epidural administration was similar in both groups. The most commonly attained dermatome level was T4, reached by 42.86% of subjects in both groups. Slightly fewer patients achieved blockade up to the T3 level (28.57% in Group B and 32.14% in Group LB), and a smaller proportion reached T5 (25% in Group B and 21.43% in Group LB). Only 3.57% of patients in each group attained a T2 level. Statistical analysis confirmed that there was no significant difference in the distribution of sensory block height between the two groups ($p = 0.987$). This demonstrates that both drugs produced a comparable cephalad spread of sensory anesthesia.

MOTOR BLOCK CHARACTERISTICS

ONSET AND DURATION OF MOTOR BLOCK (TABLE 6)

Motor block onset was defined as the interval from epidural injection until complete lower limb paralysis, corresponding to a Modified Bromage score of 3. The onset of motor block was significantly faster in Group B (15.83 ± 0.95 minutes) compared with Group LB (16.46 ± 0.94 minutes), with a p-value of 0.0198. These findings indicate that racemic bupivacaine produced motor blockade more rapidly than levobupivacaine.

Duration of motor block, defined as the time from Bromage 3 returning to Bromage 2, was significantly longer in Group B (193.75 ± 8.56 minutes) compared to Group LB (185 ± 9.27 minutes), with a p-value of 0.0007. Notably, motor block did not develop at all in two patients in the LB group, whereas every patient in the bupivacaine group experienced complete motor block. These results suggest that levobupivacaine has a motor-sparing profile, producing a shorter and less intense motor block compared with racemic bupivacaine, while still maintaining effective sensory anesthesia.

TIME TO FIRST ANALGESIC REQUIREMENT (TABLE 7)

Time to first analgesic request was significantly longer in Group LB. Patients receiving levobupivacaine required rescue analgesia at a mean of 282.67 ± 9.95 minutes, whereas those in Group B required analgesia earlier, at 248.21 ± 12.99 minutes. The difference was statistically highly significant (p = 0.0000). These findings align with the longer duration of sensory block observed in Group LB and confirm that levobupivacaine provides more prolonged postoperative analgesia compared with racemic bupivacaine.

DISCUSSION

In this randomized, double-blind study we compared isobaric 0.5% levobupivacaine with 50 µg fentanyl to isobaric 0.5% racemic bupivacaine with 50 µg fentanyl for lumbar epidural anaesthesia in elective infraumbilical surgery. The two groups were demographically comparable, so the observed differences can be attributed mainly to the study drugs. Our principal findings were: (i) similar onset of sensory block but a significantly longer duration of sensory analgesia with levobupivacaine, (ii) slightly slower onset and shorter duration of motor block with levobupivacaine, (iii) more stable haemodynamics with fewer atropine interventions in the levobupivacaine group, and (iv) a significantly delayed requirement for postoperative rescue analgesia with levobupivacaine.

The pattern of block characteristics in our study is in line with previous work comparing levobupivacaine and racemic bupivacaine in the epidural space. Casimiro et al. reported comparable onset but a trend towards prolonged sensory block and good surgical conditions with levobupivacaine–fentanyl for lower limb surgery, [16,17] and Shaheen et al. also found that levobupivacaine provided effective epidural anaesthesia with slightly longer sensory duration than bupivacaine for major abdominal procedures [18]. Several Indian studies using epidural levobupivacaine 0.5% for lower abdominal and lower limb surgery have shown similar results, with comparable onset of sensory block but modest prolongation of its duration and a relatively shorter or less intense motor block compared with bupivacaine [19–23]. Our findings, particularly the longer sensory duration and shorter motor block with levobupivacaine, are consistent with this literature and support the concept of a more favourable sensory–motor separation.

Time to first rescue analgesia in our study was significantly longer in the levobupivacaine group, which mirrors the extended sensory block. Epidural levobupivacaine has been shown to provide prolonged postoperative analgesia and reduced supplemental opioid requirements in hysterectomy and other lower abdominal surgeries when compared with bupivacaine at similar concentrations and with fentanyl as a common adjuvant [21,22]. The trend towards longer and more satisfactory analgesia with levobupivacaine has also been demonstrated in obstetric practice. Studies of labour epidural and combined spinal–epidural techniques have reported effective and sustained analgesia with levobupivacaine–opioid mixtures, with acceptable motor function and maternal satisfaction comparable or superior to bupivacaine [24,25]. Taken together, these data and our results suggest that levobupivacaine, at doses equipotent to bupivacaine, can extend the duration of postoperative pain relief without increasing motor blockade.

Haemodynamic stability is a critical safety consideration, especially when high thoracolumbar sympathetic blockade is anticipated. In the present study, patients in the bupivacaine group exhibited significantly lower mean arterial pressure and heart rate at several early time points, and more of them required atropine for bradycardia, whereas levobupivacaine maintained values closer to baseline. These findings are concordant with clinical studies in high-risk vascular surgery patients, where epidural levobupivacaine produced adequate anaesthesia with minimal hypotension and bradycardia, and with fewer rescue vasopressor requirements than bupivacaine [16]. Other series comparing levobupivacaine and bupivacaine in abdominal, orthopaedic and obstetric surgery have similarly noted a trend towards better haemodynamic stability and fewer cardiovascular adverse events with levobupivacaine, even when both drugs are combined with intrathecal or epidural opioids [19,21–23,26,27]. These observations are consistent with experimental work demonstrating lower cardiotoxicity and a wider safety margin for levobupivacaine compared with the racemate.

The motor-sparing profile we observed with levobupivacaine has important clinical implications. In our study, two patients in the levobupivacaine group never developed complete motor block, whereas all patients in the bupivacaine group did. Similar findings have been reported in Indian orthopaedic and vascular surgery series, where levobupivacaine allowed early limb movement and mobilisation without compromising surgical anaesthesia [16,20,23]. For infraumbilical procedures where early postoperative ambulation and physiotherapy are desired, levobupivacaine may therefore be preferable to racemic bupivacaine, particularly when combined with an opioid to optimise analgesia.

This study has some limitations. The sample size, although statistically powered to detect the prespecified difference in sensory block duration, remains relatively small and from a single centre, which may limit generalisability. Only ASA I–II patients were included; the haemodynamic advantages of levobupivacaine might be even more relevant in elderly or high-risk populations, but this cannot be confirmed from our data. We did not measure plasma concentrations of local anaesthetic, so conclusions regarding systemic toxicity are based solely on clinical observation. Finally, only one

concentration and volume of each drug, and a single opioid adjuvant (fentanyl), were studied; different dosing regimens or adjuvants might yield somewhat different relative profiles.

Despite these limitations, our results, together with existing Indian and international evidence [16–23,26,27] support the use of isobaric 0.5% levobupivacaine with fentanyl as an attractive alternative to racemic 0.5% bupivacaine with fentanyl for lumbar epidural anaesthesia in infraumbilical surgery. Levobupivacaine provided comparable onset, longer sensory block, shorter and less intense motor block, more stable haemodynamics and delayed requirement for rescue analgesia, thereby offering a favourable balance between efficacy and safety.

CONCLUSION

In this randomized double-blind study, epidural administration of isobaric 0.5% levobupivacaine combined with 50 µg fentanyl provided several clear clinical advantages over an equivalent dose of racemic 0.5% bupivacaine with fentanyl for elective infraumbilical surgery. Although the onset of sensory block was comparable between the two agents, levobupivacaine produced a significantly longer duration of sensory analgesia and delayed the requirement for rescue analgesia. In contrast, racemic bupivacaine produced a faster onset and longer duration of motor block, while levobupivacaine demonstrated a motor-sparing profile, with shorter duration of motor blockade and preservation of limb movement in a subset of patients.

Hemodynamic stability was superior in the levobupivacaine group. Mean arterial pressure and heart rate remained closer to baseline, and fewer patients required atropine for bradycardia, suggesting a safer cardiovascular profile in the early post-block period. These findings are consistent with the known stereospecific pharmacological advantages of levobupivacaine and support its favourable safety margin.

Taken together, levobupivacaine with fentanyl provides effective epidural anaesthesia with prolonged sensory analgesia, reduced motor blockade and better hemodynamic stability, making it a suitable and often preferable alternative to racemic bupivacaine for infraumbilical surgical procedures. Future studies with larger sample sizes, inclusion of high-risk patients and evaluation of long-term outcomes may further validate and extend these observations.

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