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Original Research Article

Comparative Study of Sensory and Motor Blockade of Spinal Anaesthesia with Isobaric Levobupivacaine and Ropivacaine in Elective Lower Limb Orthopaedic Surgeries

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Conflict of interest: Nil

Abstract

Background: Spinal anaesthesia is widely employed for lower limb orthopaedic procedures. Levobupivacaine and ropivacaine, both stereoisomeric local anaesthetic agents, have been developed as alternatives to racemic bupivacaine with potentially improved safety profiles.

Aim: To compare the onset and duration of sensory and motor blockade produced by isobaric levobupivacaine and ropivacaine during spinal anaesthesia for elective lower limb orthopaedic surgery.

Material & Methods: This prospective comparative study included 80 patients belonging to American Society of Anesthesiologists (ASA) physical status I–II. Participants were divided into two equal groups. Group L received 0.5% isobaric levobupivacaine (n=40), whereas Group R received 0.75% isobaric ropivacaine (n=40). The onset and duration of sensory and motor blockade, haemodynamic parameters, and adverse effects were evaluated. Statistical analysis was performed using Student's *t*-test and chi-square test, with $P<0.05$ considered statistically significant.

Results: The mean onset of sensory blockade was shorter with levobupivacaine than with ropivacaine (4.8±1.1 vs. 6.2±1.4 min; $P<0.05$). Similarly, motor blockade developed earlier in Group L (6.5±1.5 vs. 7.8±1.7 min; $P<0.05$). Sensory blockade persisted for 220±25 min with levobupivacaine compared with 175±20 min with ropivacaine ($P<0.05$), while the corresponding motor blockade durations were 180±18 and 145±16 min, respectively ($P<0.05$). Haemodynamic parameters were comparable between the groups, and no major adverse events were recorded.

Conclusion: Under the conditions of this study, isobaric levobupivacaine produced a more rapid onset and longer-lasting sensory and motor blockade than isobaric ropivacaine. Ropivacaine, because of its comparatively shorter blockade duration, may be advantageous when early postoperative recovery and mobilisation are priorities.

Keywords: Spinal Anaesthesia; Levobupivacaine; Ropivacaine; Sensory Blockade; Motor Blockade; Orthopaedic Surgery; Regional Anaesthesia.

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Introduction

Spinal anaesthesia is an established regional anaesthetic technique for lower limb orthopaedic surgery because it provides dependable surgical anaesthesia while avoiding many of the systemic effects associated with general anaesthesia. Its advantages include a predictable onset, effective sensory and motor blockade, reduced requirement for systemic analgesics, and satisfactory perioperative haemodynamic control. [3-4] Recent comparative studies have demonstrated differences in the onset and duration of spinal blockade between these agents. Dikkala and Guntreddy, in a randomized double-blind study of patients undergoing elective lower limb surgery, reported comparable overall block characteristics between 0.5% levobupivacaine and 0.75% ropivacaine, with differences in sensory and motor blockade profiles and favourable haemodynamic stability with levobupivacaine.[5] Similarly, Kumar and Sengar reported comparable efficacy and safety of isobaric levobupivacaine and ropivacaine in elective lower limb orthopaedic procedures, with stable haemodynamic parameters in both groups.[6] Bupivacaine has traditionally been one of the most

frequently used local anaesthetic agents for spinal anaesthesia. However, concerns regarding cardiovascular and central nervous system toxicity associated with racemic bupivacaine have encouraged the development and clinical use of alternative local anaesthetic agents. Levobupivacaine, the pure S-enantiomer of bupivacaine, retains much of the pharmacological efficacy of bupivacaine while demonstrating a more favourable toxicity profile. [7, 8]

Ropivacaine is another stereoselective local anaesthetic that has been associated with reduced cardiotoxic potential and has subsequently gained importance in regional anaesthesia. [9,10]

The clinical characteristics of these agents are not identical. Differences in potency, onset, duration of sensory blockade, motor blockade, and recovery may influence the choice of local anaesthetic for a particular surgical procedure. Several investigations have evaluated the intrathecal use of levobupivacaine and ropivacaine and have reported differences in block characteristics and recovery profiles. [4, 11-17]

For orthopaedic procedures, an anaesthetic agent should ideally provide sufficient sensory and motor blockade for the duration of surgery while allowing appropriate postoperative recovery. A longer block may be desirable for prolonged procedures and postoperative analgesia, whereas a shorter motor block may facilitate earlier mobilisation and discharge.

Therefore, the present study was designed to compare the sensory and motor blockade characteristics of 0.5% isobaric levobupivacaine and 0.75% isobaric ropivacaine in patients undergoing elective lower limb orthopaedic surgery.

Materials and Methods

Study Design and Setting: A prospective comparative observational study was conducted among patients undergoing elective lower limb orthopaedic surgery. The study was carried out at the Department of Anaesthesiology, Shree Narayan Medical Institute & Hospital (SNMIH), Saharsa, Bihar, India.

Study Period: The study was conducted from October 2025 to April 2026.

Study Population and Sample Size: A total of 80 patients were included in the study. Participants were divided into two groups of 40 patients each:

- **Group L:** 0.5% isobaric levobupivacaine (n=40).
- **Group R:** 0.75% isobaric ropivacaine (n=40).

Eligibility Criteria: Patients aged 18–65 years, belonging to ASA physical status I–II, scheduled for elective lower limb orthopaedic surgery and willing to provide informed consent were considered eligible for participation.

Exclusion Criteria: Patients were excluded if they had coagulopathy, infection at the proposed injection site, spinal deformity, known allergy to either study drug, severe systemic illness, or pregnancy.

Assessment Parameters: The principal study outcomes were the onset and duration of sensory and motor blockade. Haemodynamic parameters and adverse events were also monitored.

Sensory blockade was evaluated by the pin-prick method, while motor blockade was assessed using the Modified Bromage Scale. Haemodynamic monitoring was performed throughout the perioperative period. Pain assessment was performed using the Visual Analogue Scale (VAS).

Data Collection: Patient information and perioperative observations were recorded using a structured case record form. Baseline demographic variables included age, sex, and body weight. The onset and duration of sensory and motor blockade were recorded in minutes.

Statistical Analysis: The collected data were entered into Microsoft Excel, coded, and statistically analysed by using SPSS Version 27.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Differences between the two groups were assessed using Student's *t*-test for continuous variables and the chi-square test for categorical variables. A two-tailed *P* value <0.05 was considered statistically significant.

Results

Table 1: Demographic Characteristics of the Study Participants

Variable	Group L (n=40)	Group R (n=40)
Age (years)	42.3±10.2	41.8±9.6
Weight (kg)	64.5±8.3	63.9±7.9
Male/Female	24/16	22/18

The demographic characteristics of the two study groups were broadly comparable. The mean age was 42.3±10.2 years in Group L and 41.8±9.6 years in Group R. Mean body weight was 64.5±8.3 kg and 63.9±7.9 kg, respectively. The sex distribution was also similar between the groups.

Table 2: Comparison of Sensory and Motor Blockade Characteristics

Parameter	Levobupivacaine (Group L)	Ropivacaine (Group R)	*P* value
Sensory onset (min)	4.8±1.1	6.2±1.4	<0.05
Motor onset (min)	6.5±1.5	7.8±1.7	<0.05
Sensory duration (min)	220±25	175±20	<0.05
Motor duration (min)	180±18	145±16	<0.05

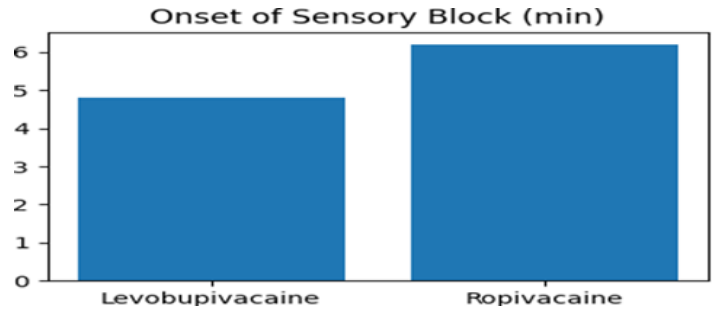

Figure 1: Onset of sensory block(min)

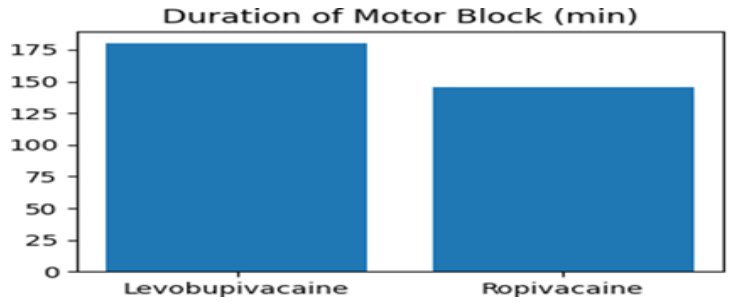

Figure 2: Duration of motor block(min)

The onset of sensory blockade occurred significantly earlier in patients receiving levobupivacaine than in those receiving ropivacaine. The mean sensory onset time was 4.8±1.1 min in Group L compared with 6.2±1.4 min in Group R (P<0.05).

Motor blockade also developed more rapidly with levobupivacaine, with a mean onset of 6.5±1.5 min, compared with 7.8±1.7 min with ropivacaine (P<0.05). The duration of both sensory and motor blockade was significantly greater in the levobupivacaine group. Sensory blockade lasted 220±25 min with levobupivacaine compared with 175±20 min with ropivacaine (P<0.05). Motor blockade persisted for 180±18 min in Group L and 145±16 min in Group R (P<0.05). Haemodynamic variables remained comparable between the two groups throughout the observation period. No major adverse events were reported in either group.

Discussion

The present investigation compared the clinical characteristics of spinal anaesthesia produced by isobaric levobupivacaine and ropivacaine in patients undergoing elective lower limb orthopaedic procedures. The principal finding was that levobupivacaine produced both earlier onset and longer duration of sensory and motor blockade than ropivacaine.

The sensory block developed at 4.8±1.1 min with levobupivacaine, whereas the corresponding onset with ropivacaine was 6.2±1.4 min. A similar pattern was observed for motor blockade, with onset times of 6.5±1.5 and 7.8±1.7 min, respectively. These observations are consistent with previous reports demonstrating clinically relevant differences in the onset and duration of neuraxial blockade produced by different local anaesthetic agents.[4, 11-17]

The longer duration observed with levobupivacaine was another important finding. Sensory blockade continued for 220±25 min with levobupivacaine compared with 175±20 min with ropivacaine. Motor blockade showed a similar difference, lasting 180±18 min and 145±16 min, respectively. Previous investigations have also reported differences in the duration of spinal blockade between levobupivacaine and ropivacaine. [13-17] The prolonged blockade associated with levobupivacaine may be clinically useful during relatively lengthy orthopaedic procedures and may also provide a longer period of postoperative analgesic benefit. Conversely, the comparatively shorter motor and sensory blockade associated with ropivacaine could permit earlier recovery of motor function and potentially facilitate early mobilisation. These characteristics may therefore be useful when selecting an intrathecal agent

according to the anticipated duration of surgery and postoperative rehabilitation requirements.

Both agents demonstrated acceptable haemodynamic profiles in the present study. No major adverse events were encountered. The favourable safety characteristics of levobupivacaine and ropivacaine have been described previously and are among the reasons for their continued use as alternatives to racemic bupivacaine.[7-10, 18]

The findings should, however, be interpreted in the context of the study design. The sample consisted of 80 ASA I–II patients undergoing elective lower limb orthopaedic procedures, and therefore the findings may not necessarily be generalisable to patients with significant systemic disease or to emergency surgery. In addition, the study compared different concentrations of the two local anaesthetic agents; consequently, the observed differences reflect the clinical regimens evaluated rather than an isolated comparison of equi-potent doses.

Conclusion

Both isobaric levobupivacaine and ropivacaine provided effective spinal anaesthesia for elective lower limb orthopaedic surgery with satisfactory haemodynamic stability. Within the treatment regimens evaluated, levobupivacaine produced a significantly earlier onset and longer duration of both sensory and motor blockade, whereas ropivacaine was associated with a shorter duration of blockade and potentially earlier postoperative recovery. Thus, levobupivacaine may be particularly useful when a prolonged block is desirable for longer orthopaedic procedures, while ropivacaine may be considered when early recovery of motor function and mobilisation are important. Selection of the intrathecal local anaesthetic should therefore be individualised according to the expected surgical duration and desired postoperative recovery profile.

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