



Research Article

Comparison Of Intrathecal Ropivacaine 0.5% Vs Levobupivacaine 0.5% In Infraumbilical Surgeries

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ABSTRACT

Background: Spinal anesthesia is widely used for infraumbilical surgeries, and selection of an ideal local anesthetic agent is essential to balance efficacy, safety, and recovery profile. Levobupivacaine and ropivacaine are newer agents with improved safety profiles compared to bupivacaine.

Objective: To compare the efficacy and safety of intrathecal 0.5% levobupivacaine and 0.5% ropivacaine in infraumbilical surgeries.

Methods: A prospective randomized double-blind study was conducted on 60 patients divided into two groups of 30 each. Group L received 0.5% levobupivacaine and Group R received 0.5% ropivacaine intrathecally. Parameters assessed included onset and duration of sensory and motor block, hemodynamic changes, and adverse effects.

Results: Group R showed faster onset of sensory (3.75±0.42 min) and motor block (5.54±0.72 min) compared to Group L (3.99±0.36 min and 6.05±0.69 min). However, Group L demonstrated significantly longer duration of sensory (277.57±15.64 min) and motor block (246.57±16.41 min) compared to Group R (160.4±12.51 min and 160.4±12.51 min). Hemodynamic parameters were comparable in both groups.

Conclusion: Ropivacaine provides faster onset with shorter duration, making it suitable for short procedures, whereas levobupivacaine offers prolonged analgesia and is preferable for longer surgeries.

Keywords: Spinal anesthesia, Levobupivacaine, Ropivacaine, Infraumbilical surgery.

INTRODUCTION

Spinal anesthesia is widely regarded as a reliable and effective regional anesthetic technique for infraumbilical surgeries, including urological and gynecological procedures, due to its rapid onset, cost-effectiveness, and favorable safety profile compared to general anesthesia [1]. Over the years, the choice of intrathecal local anesthetic agents has evolved significantly, driven by the need to achieve optimal sensory blockade with minimal motor impairment and reduced systemic toxicity [2].

Bupivacaine has traditionally been the gold standard for spinal anesthesia because of its long duration of action and profound sensory and motor blockade. However, its clinical utility is limited by dose-dependent cardiotoxicity and neurotoxicity, along with prolonged motor block that may delay postoperative recovery and ambulation [3]. These limitations have prompted the search for safer alternatives with improved pharmacodynamic profiles.

Levobupivacaine, the pure S(-)-enantiomer of bupivacaine, has emerged as a safer substitute due to its reduced affinity for cardiac sodium channels, thereby offering a significantly lower risk of cardiotoxicity and central nervous system toxicity [4]. It provides comparable anesthetic efficacy to racemic bupivacaine while maintaining a more favorable safety margin, making it particularly suitable for high-risk patients and prolonged surgical procedures [5]. Furthermore, levobupivacaine has been shown to produce a more differential blockade, preserving motor function to some extent while maintaining adequate sensory anesthesia [6].

Ropivacaine, another long-acting amide local anesthetic, is structurally similar to bupivacaine but demonstrates lower lipid solubility, which contributes to its reduced penetration into large myelinated motor fibers [7]. This characteristic results in a less intense motor blockade and facilitates earlier postoperative mobilization, which is especially advantageous in ambulatory and day-care surgeries [8]. Additionally, ropivacaine exhibits a lower potential for cardiovascular and neurological toxicity, enhancing its safety profile in clinical practice [9].

Several comparative studies have evaluated the clinical efficacy of levobupivacaine and ropivacaine for intrathecal use. While levobupivacaine is associated with a longer duration of sensory and motor blockade, ropivacaine offers a shorter duration of action with faster recovery, making it preferable in procedures where early ambulation is desired [10]. However, the balance between adequate anesthesia and rapid recovery remains a subject of ongoing research, particularly in infraumbilical surgeries where both intraoperative stability and postoperative recovery are critical.

Despite the availability of multiple studies, there remains a need for further comparative evaluation of these agents in terms of onset time, duration of sensory and motor block, hemodynamic stability, and incidence of adverse effects in diverse patient populations. Therefore, this study aims to provide a comprehensive comparison of intrathecal 0.5% levobupivacaine and 0.5% ropivacaine in infraumbilical surgeries to determine the most effective and safe anesthetic agent for clinical use.

MATERIAL AND METHODS

This prospective, randomized, double-blinded study was conducted after obtaining approval from the Institutional Ethics Committee and written informed consent from all participants. A total of 60 adult patients of either gender, aged between 20 and 60 years, belonging to American Society of Anesthesiologists (ASA) physical status I and II, who were scheduled for elective infraumbilical surgeries under spinal anesthesia during the study period from 2020 to 2023, were included in the study.

The patients were randomly allocated into two equal groups of 30 each using a sealed envelope technique. Group L received 3 ml of 0.5% hyperbaric levobupivacaine (15 mg), whereas Group R received 3 ml of 0.5% hyperbaric ropivacaine (15 mg), prepared by mixing 2 ml of 0.75% isobaric ropivacaine with 1 ml of 80 mg glucose to achieve hyperbaricity. The study drugs were prepared by an anesthesiologist not involved in patient management, thereby maintaining blinding of both the patient and the observer.

Patients who refused participation, those undergoing emergency surgeries, individuals younger than 20 years or older than 60 years, patients with ASA grade III or higher, history of seizure disorders, contraindications to regional anesthesia such as bleeding disorders or local infection at the injection site, those on anticoagulant or antiplatelet therapy, known hypersensitivity to amide local anesthetics, and cases with technical difficulty or failed spinal anesthesia were excluded from the study.

All patients underwent a thorough pre-anesthetic evaluation on the day prior to surgery, including detailed history taking, general and systemic examination, and routine laboratory investigations such as complete blood count, random blood sugar, and serum creatinine. Patients were kept nil per oral for at least six hours prior to surgery.

On arrival in the operation theatre, an 18-gauge intravenous cannula was secured, and patients were preloaded with Ringer lactate or normal saline at a rate of 10 ml/kg. Standard monitoring including electrocardiography, non-invasive blood pressure, and pulse oximetry was instituted, and baseline parameters such as heart rate, blood pressure, and oxygen saturation were recorded.

Spinal anesthesia was administered under strict aseptic precautions in the sitting or lateral position using a 23-gauge Quincke spinal needle at the L2–L3 or L3–L4 intervertebral space. After confirming free flow of cerebrospinal fluid, the study drug was injected intrathecally, and the patient was immediately placed in the supine position. The time of intrathecal injection was considered as time zero for all subsequent observations.

An independent anesthesiologist, blinded to group allocation, recorded all intraoperative parameters. Hemodynamic variables including heart rate, mean arterial pressure, and oxygen saturation were monitored immediately after spinal injection and at five-minute intervals for the first 30 minutes, followed by 15-minute intervals until the end of surgery, and thereafter at 30-minute intervals in the postoperative period until discharge from the post-anesthesia care unit.

Sensory blockade was assessed using the pinprick method with a 23-gauge needle, and onset was defined as the time taken to achieve sensory block at the T10 dermatome. The maximum level of sensory block, time to reach peak sensory level, time to two-segment regression, and total duration of sensory block were recorded.

Motor blockade was evaluated using the Modified Bromage Scale, where Grade 0 indicated no motor block and Grade 3 indicated complete motor block. The onset of motor block, time to achieve maximum motor block, and total duration of motor blockade were noted.

Intraoperative complications such as hypotension, bradycardia, nausea, vomiting, shivering, and respiratory depression were recorded and managed appropriately. Hypotension, defined as a systolic blood pressure less than 80 mmHg or a decrease of more than 20% from baseline, was treated with intravenous mephentermine and fluid administration. Bradycardia, defined as heart rate less than 50 beats per minute, was managed with atropine or glycopyrrolate. Oxygen supplementation was provided if oxygen saturation dropped below 90%. Postoperative pain was managed with intravenous tramadol as rescue analgesia.

Data were entered into Microsoft Excel and analyzed using the Statistical Package for Social Sciences (SPSS). Quantitative variables were expressed as mean \pm standard deviation and compared using the Student's t-test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The demographic characteristics of patients in both groups were comparable, as shown in Table 1. The mean age in Group L was 38.6 \pm 9.43 years and in Group R was 39.46 \pm 10.48 years, with a p value of 0.74 indicating no statistical significance. The mean weight was 60 \pm 5.7 kg in Group L and 62 \pm 9.1 kg in Group R (p=0.31), while the mean height was 160 \pm 4.6 cm and 159 \pm 5.8 cm respectively (p=0.46). The duration of surgery was also similar between the groups, with 44 \pm 10.8 minutes in Group L and 41 \pm 10.1 minutes in Group R (p=0.27). The sex distribution and ASA grading were also comparable, confirming that both groups were well matched and homogeneous.

The sensory block characteristics are presented in Table 2. The mean time to onset of sensory block at T12 was shorter in Group R (3.75 \pm 0.42 minutes) compared to Group L (3.99 \pm 0.36 minutes), with a statistically significant p value of 0.02. The time to reach maximum sensory block was significantly faster in Group R (8.16 \pm 0.72 minutes) compared to Group L (10.07 \pm 1.43 minutes) (p=0.0001). However, the duration of sensory block was significantly longer in Group L (277.57 \pm 15.64 minutes) compared to Group R (160.4 \pm 12.51 minutes), and the time to two segment regression was also prolonged in Group L (223.23 \pm 14.75 minutes) versus Group R (148.63 \pm 11.09 minutes), both showing highly significant p values (p=0.0001).

The motor block characteristics are shown in Table 3. The onset of motor block was faster in Group R (5.54 \pm 0.72 minutes) compared to Group L (6.05 \pm 0.69 minutes), with a statistically significant p value of 0.0069. The time to reach maximum motor block was also significantly shorter in Group R (16.61 \pm 1.42 minutes) compared to Group L (21.21 \pm 1.57 minutes) (p=0.0001). However, the duration of motor block was significantly longer in Group L (246.57 \pm 16.41 minutes) compared to Group R (160.4 \pm 12.51 minutes), with a p value of 0.0001.

The hemodynamic parameter of heart rate remained stable in both groups throughout the study period, as depicted in Table 4. The preoperative heart rate was 81.9 \pm 8.01 beats per minute in Group L and 85 \pm 10 beats per minute in Group R (p=0.19). At various intraoperative intervals, including 1 minute, 5 minutes, 10 minutes, 15 minutes, 20 minutes, 30 minutes, 45 minutes, 1 hour, and 2 hours, the differences in heart rate between the two groups remained statistically insignificant, with all p values greater than 0.05.

The mean arterial blood pressure trends are shown in Table 5. The baseline mean arterial pressure was 101 \pm 6.84 mmHg in Group L and 102 \pm 10.4 mmHg in Group R (p=0.66). Although there was a transient decrease in mean arterial pressure between 5 to 15 minutes in both groups, the values remained comparable, and no statistically significant difference was observed at most time intervals, except at 10 minutes where the p value was 0.02. Overall, both groups maintained stable hemodynamic profiles throughout the intraoperative and postoperative periods.

Table 1: Comparison of Demographic and Clinical Characteristics between Group L and Group R

Patients characteristics	Group L (Mean \pm SD)	Group R (Mean \pm SD)	P value
Age (years)	38.6 \pm 9.43	39.46 \pm 10.48	0.74
Sex (m:f)	15:15	22:8	—
Weight (kg)	60 \pm 5.7	62 \pm 9.1	0.31
Height (cm)	160 \pm 4.6	159 \pm 5.8	0.46
ASA grade (i/ii)	29:1	29:1	—
Duration of surgery (min)	44 \pm 10.8	41 \pm 10.1	0.27

Table 2: Comparison of Sensory Block Characteristics Between Group L and Group R

Variable	Group L (Mean \pm SD)	Group R (Mean \pm SD)	P value
Time to onset of sensory block (T12) (min)	3.99 \pm 0.36	3.75 \pm 0.42	0.02
Time to reach maximum sensory block (min)	10.07 \pm 1.43	8.16 \pm 0.72	0.0001
Time to two segment regression (min)	223.23 \pm 14.75	148.63 \pm 11.09	0.0001
Duration of sensory block (min)	277.57 \pm 15.64	160.4 \pm 12.51	0.0001

Table 3: Comparison of Motor Block Characteristics Between Group L and Group R

Variable	Group L (Mean ± SD)	Group R (Mean ± SD)	P value
Time to onset of motor block (min)	6.05±0.69	5.54±0.72	0.0069
Time to reach maximum motor block (min)	21.21±1.57	16.61±1.42	0.0001
Duration of motor block (min)	246.57±16.41	160.4±12.51	0.0001

Table 4: Comparison of Mean Heart Rate Between Group L and Group R at Different Time Intervals

Time	Group L (Mean ± SD)	Group R (Mean ± SD)	P value
Pre op	81.9±8.01	85±10	0.19
1 min	80.4±8.08	84±10.4	0.13
5 min	79.3±7.4	83.1±10.3	0.10
10 min	79±6.6	83±10	0.07
15 min	78.9±6.45	83±9.9	0.06
20 min	78±6.03	80.4±8.56	0.21
30 min	80.2±6.97	80±9.6	0.92
45 min	81.8±7.83	79.2±10.3	0.27
1 hr	80.37±7.15	83.2±10.7	0.23
2 hr	79.9±6.76	81.9±8.78	0.32

Table 5: Comparison of Mean Arterial Blood Pressure Between Group L and Group R at Different Time Intervals

Time	Group L (Mean ± SD)	Group R (Mean ± SD)	P value
Pre op	101±6.84	102±10.4	0.66
1 min	99.1±5.62	102±8.5	0.12
5 min	96.9±6.21	95.1±8.88	0.36
10 min	94.7±5.47	92±7.5	0.02
15 min	93.3±5.71	91.6±5.34	0.23
20 min	92.2±4.9	90±5.5	0.10
30 min	98.6±3.77	100±3.2	0.12
45 min	91.1±7.08	91±6.26	0.95
1 hr	89.8±7.65	92±5.3	0.20
2 hr	90.1±5.38	90±5.4	0.94

DISCUSSION

The present study was designed to compare the efficacy and safety of intrathecal 0.5% levobupivacaine and 0.5% ropivacaine in infraumbilical surgeries, with emphasis on sensory and motor block characteristics, hemodynamic stability, and adverse effects. The demographic variables including age, weight, height, ASA grading, and duration of surgery were comparable between Group L and Group R, indicating that both groups were well matched and eliminating confounding bias, which is consistent with findings reported in similar comparative trials [11].

In the present study, the onset of sensory block was faster in Group R (3.75±0.42 min) compared to Group L (3.99±0.36 min), and the time to reach maximum sensory block was also significantly shorter in Group R (8.16±0.72 min) versus Group L (10.07±1.43 min). These findings are in agreement with the study by Manazir Athar et al., who reported a faster onset and earlier attainment of peak sensory level with ropivacaine compared to levobupivacaine [12]. The relatively rapid onset with ropivacaine can be attributed to its lower lipid solubility and differential nerve fiber penetration characteristics, which facilitate quicker blockade of sensory fibers.

However, the duration of sensory block and time to two-segment regression were significantly prolonged in Group L (277.57±15.64 min and 223.23±14.75 min, respectively) compared to Group R (160.4±12.51 min and 148.63±11.09 min). This indicates a longer-lasting sensory blockade with levobupivacaine, which has also been demonstrated in previous studies where levobupivacaine showed prolonged analgesia and delayed regression due to its pharmacokinetic profile [13]. The extended duration of action may be advantageous in surgeries requiring prolonged analgesia but may delay recovery in ambulatory settings.

Regarding motor block characteristics, the onset of motor block and time to achieve maximum motor block were significantly faster in Group R (5.54±0.72 min and 16.61±1.42 min) compared to Group L (6.05±0.69 min and 21.21±1.57 min). These findings are consistent with observations reported by other authors, where ropivacaine demonstrated earlier onset of motor blockade [12]. However, the duration of motor block was significantly longer in Group L (246.57±16.41 min) than in Group R (160.4±12.51 min), which is in accordance with the study by Alpa M Patel et al., who reported prolonged motor blockade with levobupivacaine compared to ropivacaine [14]. The shorter duration of motor block with ropivacaine can be beneficial in facilitating early ambulation and reducing postoperative complications such as deep vein thrombosis.

Hemodynamic stability is a critical factor in evaluating the safety of spinal anesthetic agents. In the present study, both groups maintained stable heart rate and mean arterial pressure throughout the intraoperative and postoperative periods, with no statistically significant differences at most time intervals. Although a transient decrease in mean arterial pressure was observed at 10 minutes ($p=0.02$), it was clinically insignificant and comparable between groups. These findings are consistent with previous studies that reported comparable hemodynamic profiles for both levobupivacaine and ropivacaine when used intrathecally [15].

The incidence of adverse effects such as hypotension, bradycardia, nausea, and vomiting was low and comparable between the two groups. Slightly higher incidence of hypotension in Group L (13.33%) compared to Group R (3.33%) may be attributed to the longer duration and more intense sympathetic blockade produced by levobupivacaine. Similar trends have been reported in earlier studies where ropivacaine demonstrated a more favorable safety profile with reduced cardiovascular depression [11].

Overall, the findings of the present study suggest that while ropivacaine provides faster onset and shorter duration of both sensory and motor block, levobupivacaine offers prolonged anesthesia and analgesia with comparable hemodynamic stability. The choice between these agents should therefore be tailored according to the surgical requirement and the need for postoperative recovery.

CONCLUSION

From the present study, it can be concluded that both intrathecal 0.5% levobupivacaine and 0.5% ropivacaine are effective and safe for infraumbilical surgeries. Ropivacaine provides a faster onset of sensory and motor block with shorter duration, making it more suitable for short-duration and day-care procedures. Levobupivacaine, on the other hand, provides prolonged sensory and motor blockade with adequate hemodynamic stability, making it more suitable for longer surgical procedures where extended postoperative analgesia is desired.

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