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Comparison of Bupivacaine and Ropivacaine for Supraclavicular Brachial Plexus Block.

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Abstract

Background: Supraclavicular brachial plexus block is an established regional anaesthetic technique for surgical procedures involving the upper limb. Bupivacaine provides reliable and prolonged sensory and motor blockade but is associated with dose-dependent cardiotoxic and neurotoxic potential. Ropivacaine, a relatively newer long-acting amide local anaesthetic, has a more favourable safety profile and may provide adequate surgical anaesthesia with less intense or prolonged motor blockade. Comparative evaluation of these agents is therefore clinically relevant for selecting an appropriate local anaesthetic for supraclavicular brachial plexus block. Aim: To compare the efficacy and safety of bupivacaine and ropivacaine for ultrasound-guided supraclavicular brachial plexus block in patients undergoing elective upper-limb surgery. ***Materials and Methods***: This prospective, randomized, comparative study was conducted in the Department of Anaesthesiology at Government Medical College and Hospital, Mahbubnagar, Telangana, India, from June 2025 to May 2026. A sample of 100 adult patients scheduled for elective upper-limb surgery under supraclavicular brachial plexus block was considered appropriate and was equally allocated into two groups of 50 patients each. Group B received 0.5% bupivacaine and Group R received 0.5% ropivacaine in an equivalent volume of 30 mL under ultrasound guidance. The onset and duration of sensory and motor blockade, duration of analgesia, haemodynamic parameters, requirement for rescue analgesia, patient satisfaction, and adverse effects were assessed. Continuous variables were compared using the independent Student's t-test or Mann–Whitney U test as appropriate, while categorical variables were analysed using the chi-square test or Fisher's exact test. A P value <0.05 was considered statistically significant. ***Results***: The demographic characteristics and baseline haemodynamic parameters were comparable between the two groups. The mean onset time of sensory block was 11.2 ± 2.1 minutes in Group B compared with 10.5 ± 1.9 minutes in Group R, while motor block onset occurred at 15.4 ± 2.5 and 14.8 ± 2.3 minutes, respectively. The differences in onset times were not statistically significant. The mean duration of sensory block was significantly longer with bupivacaine than ropivacaine (724.6 ± 58.3 vs. 653.8 ± 52.7 minutes; P<0.001), while the duration of motor block was also longer in the bupivacaine group (604.2 ± 51.6 vs. 511.7 ± 46.8 minutes; P<0.001). Duration of effective postoperative analgesia was 742.8 ± 61.5 minutes with bupivacaine compared with 678.4 ± 55.9 minutes with ropivacaine (P<0.001). The mean time to first rescue analgesia was correspondingly longer with bupivacaine. However, ropivacaine was associated with earlier resolution of motor blockade and a lower incidence of clinically relevant motor impairment during the postoperative period. Haemodynamic variables remained stable in both groups, and no major local anaesthetic systemic toxicity or serious block-related complication was observed. Overall patient satisfaction was high in both groups. ***Conclusion***: Both bupivacaine and ropivacaine provided effective and clinically satisfactory supraclavicular brachial plexus blockade for upper-limb surgery. Bupivacaine produced a significantly longer duration of sensory and motor blockade and prolonged postoperative analgesia, whereas ropivacaine provided comparable onset and effective anaesthesia with earlier recovery of motor function. Ropivacaine may therefore be particularly advantageous when early postoperative motor recovery is desirable, while bupivacaine may be preferred when prolonged postoperative analgesia is the primary objective.

Keywords: Bupivacaine; Ropivacaine; Supraclavicular brachial plexus block; Regional anaesthesia; Upper-limb surgery; Sensory block; Motor block; Postoperative analgesia; Ultrasound-guided block; Local anaesthetic.

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INTRODUCTION

Supraclavicular brachial plexus block is a well-established regional anaesthetic technique for surgical procedures involving the arm, forearm, wrist and hand [1]. By depositing local anaesthetic around the brachial plexus at the level of the trunks and divisions, the technique can provide dense sensory and motor blockade with avoidance of the physiological consequences and airway manipulation associated with general anaesthesia [2,3]. The increasing use of ultrasound guidance has further improved identification of relevant anatomical structures, needle visualization and local anaesthetic deposition, thereby enhancing the predictability and safety of peripheral nerve blockade [4,5].

Selection of the local anaesthetic is an important determinant of the characteristics of brachial plexus blockade [6]. Bupivacaine is a long-acting amide local anaesthetic that has been widely used for peripheral nerve blocks because of its potent and prolonged sensory and motor effects [7]. Its principal limitation is its relatively narrow therapeutic margin, particularly with inadvertent intravascular administration or excessive systemic exposure [8]. The potential for cardiovascular and central nervous system toxicity has encouraged interest in alternative long-acting local anaesthetics with improved safety characteristics [9].

Ropivacaine is a long-acting amide local anaesthetic developed as a relatively safer alternative to bupivacaine [10]. It produces sodium-channel blockade and therefore prevents propagation of action potentials in peripheral nerves [11]. Compared with bupivacaine, ropivacaine generally produces less cardiotoxicity and a lower propensity for severe central nervous system toxicity at clinically relevant doses [12]. It also tends to produce less intense motor blockade, which may be advantageous when early postoperative limb movement and functional recovery are desirable [13].

The clinical choice between bupivacaine and ropivacaine involves balancing the duration and density of blockade against postoperative motor recovery and safety [14]. A longer sensory block may provide prolonged postoperative analgesia and reduce the need for rescue analgesics, whereas excessively prolonged motor blockade can delay functional recovery and interfere with early postoperative assessment and rehabilitation [15,16]. Conversely, earlier motor recovery with ropivacaine may be accompanied by a somewhat shorter duration of analgesia.

Several factors influence the quality of a supraclavicular block, including the concentration and volume of local anaesthetic, injection technique, use of ultrasound guidance, patient characteristics and operator experience [17,18]. Direct comparison using standardized concentrations and volumes is therefore useful for determining the relative clinical performance of the two agents [19]. Assessment should extend beyond onset of sensory and motor blockade to include duration of blockade, duration of postoperative analgesia, haemodynamic stability, rescue analgesic requirements and adverse effects [20,21].
In the setting of elective upper-limb surgery, an effective regional anaesthetic technique should provide rapid and reliable surgical anaesthesia, adequate postoperative analgesia, predictable recovery and minimal complications [22]. Bupivacaine may be advantageous when prolonged analgesia is the principal objective, whereas ropivacaine may offer a useful balance between adequate block duration and earlier motor recovery [23]. Comparative evaluation of these outcomes can assist anaesthesiologists in selecting the most appropriate local anaesthetic according to the surgical and postoperative requirements [24].

Despite extensive clinical use of both agents, differences in block characteristics may become particularly relevant in resource-constrained tertiary-care settings, where efficient postoperative recovery and reduction in opioid or other rescue analgesic requirements are important components of perioperative care. A prospective comparison under standardized conditions can provide clinically meaningful information regarding the relative efficacy and safety of the two drugs [25].
Therefore, it is of interest to compare bupivacaine and ropivacaine for supraclavicular brachial plexus block with respect to onset and duration of sensory and motor blockade, duration of postoperative analgesia, rescue analgesic requirement, haemodynamic stability, adverse effects and overall patient satisfaction.

MATERIALS AND METHODS

Study design and setting

This prospective, randomized, comparative study was conducted in the Department of Anaesthesiology at Government Medical College and Hospital, Mahbubnagar, Telangana, India. The study was carried out over a period of 12 months from June 2025 to May 2026. The study was designed to compare the clinical characteristics of 0.5% bupivacaine and 0.5% ropivacaine when used for ultrasound-guided supraclavicular brachial plexus block in patients undergoing elective upper-limb surgery.

Study population

Adult patients scheduled for elective upper-limb surgical procedures suitable for supraclavicular brachial plexus block were considered for enrolment. Patients were evaluated during the pre-anaesthetic assessment and included after fulfilling the predefined eligibility criteria and providing written informed consent.

Sample size

A total of 100 patients were included in the study and randomly allocated into two equal groups of 50 patients each. The sample size was considered appropriate to provide a meaningful comparison of the principal block characteristics, particularly the duration of sensory blockade and postoperative analgesia, between the two local anaesthetic groups.

Study groups

Participants were randomly assigned into:

- **Group B:** 50 patients receiving 30 mL of 0.5% bupivacaine for supraclavicular brachial plexus block.
- **Group R:** 50 patients receiving 30 mL of 0.5% ropivacaine for supraclavicular brachial plexus block.

The concentration and volume of local anaesthetic were standardized between groups to permit comparison of the pharmacodynamic characteristics of the two agents.

Inclusion criteria

Patients were eligible when they fulfilled the following criteria:

1. Adults aged 18–60 years.
2. American Society of Anesthesiologists (ASA) physical status I or II.
3. Patients scheduled for elective upper-limb surgery amenable to supraclavicular brachial plexus block.
4. Patients willing to participate and provide written informed consent.
5. Patients able to understand the postoperative pain assessment scale.

Exclusion criteria

Patients were excluded in the presence of:

1. Patient refusal to participate.
2. Known allergy or hypersensitivity to amide local anaesthetics.
3. Coagulopathy or ongoing anticoagulant therapy precluding peripheral nerve blockade.
4. Local infection at the proposed injection site.
5. Pre-existing neurological deficit involving the operative limb.
6. Significant hepatic, renal or cardiovascular dysfunction.
7. Pregnancy.
8. Patients receiving chronic analgesic or opioid therapy.
9. Patients requiring conversion to general anaesthesia because of inadequate or failed regional block.

Pre-anaesthetic evaluation

All patients underwent a detailed pre-anaesthetic evaluation including medical history, previous anaesthetic exposure, drug and allergy history, general physical examination and systemic examination. Baseline pulse rate, non-invasive blood pressure, respiratory rate and peripheral oxygen saturation were recorded. Routine investigations appropriate for the planned surgical procedure were reviewed.

Patients were explained regarding the block procedure, expected sensory and motor effects, postoperative analgesia and potential complications. Written informed consent for regional anaesthesia was obtained before the procedure.

Randomization and allocation

Eligible patients were randomly allocated to either Group B or Group R using a computer-generated randomization sequence. Allocation was performed before administration of the block. The anaesthetic team performing the block was aware of the allocated drug, while assessment of postoperative block characteristics and analgesic outcomes was performed using standardized criteria.

Anaesthetic technique

Standard monitoring comprising electrocardiography, non-invasive blood pressure and pulse oximetry was instituted before performing the block. An intravenous line was secured and appropriate resuscitation equipment and drugs for management of local anaesthetic systemic toxicity were kept immediately available.

The supraclavicular brachial plexus block was performed using ultrasound guidance under aseptic precautions. The patient was positioned supine with the head turned away from the side to be blocked. The ultrasound probe was placed in the supraclavicular region to identify the subclavian artery and the brachial plexus situated in relation to the artery.

After local infiltration of the skin, an appropriate block needle was advanced under continuous ultrasound visualization. Following negative aspiration, the study drug was injected incrementally around the brachial plexus, with intermittent aspiration to minimize the possibility of inadvertent intravascular injection.

Group B received 30 mL of 0.5% bupivacaine, while Group R received 30 mL of 0.5% ropivacaine.

\Assessment of sensory block

Sensory blockade was assessed at regular intervals following completion of local anaesthetic injection using standardized assessment of sensory response in the distributions of the major terminal nerves of the upper limb. Sensory block onset was defined as the time from completion of local anaesthetic injection to achievement of clinically adequate sensory blockade in the relevant nerve distributions.

Sensory block was assessed using a standardized grading system, with absence of sensation to the tested stimulus considered complete sensory blockade. The duration of sensory block was calculated from the time of achievement of complete sensory blockade until return of normal sensation in the operated limb.

Assessment of motor block

Motor blockade was assessed using standardized movements corresponding to the major nerves of the brachial plexus. Motor block onset was defined as the interval between completion of local anaesthetic injection and achievement of adequate motor blockade.

The duration of motor block was measured from achievement of complete motor blockade until clinically evident recovery of motor function.

Assessment of duration of analgesia

Postoperative pain was assessed using the visual analogue scale (VAS), with 0 representing no pain and 10 representing the worst imaginable pain. Patients were monitored at predefined postoperative intervals.

The duration of effective analgesia was defined as the interval from completion of the block until the patient first reported clinically significant postoperative pain requiring rescue analgesia.

Rescue analgesia

When the postoperative VAS score reached the predefined threshold of clinically significant pain, rescue analgesia was administered according to the institutional postoperative analgesia protocol. The time to first rescue analgesic requirement and the total analgesic requirement during the initial postoperative period were recorded.

Haemodynamic monitoring

Pulse rate and blood pressure were recorded at baseline, immediately after administration of the block, at regular intraoperative intervals and during the postoperative observation period. Any clinically significant changes in haemodynamic variables were documented and managed according to standard anaesthetic practice.

Assessment of adverse effects

Patients were monitored for complications related to the block or local anaesthetic administration, including hypotension, bradycardia, nausea, vomiting, symptoms suggestive of local anaesthetic systemic toxicity, vascular puncture, respiratory symptoms and neurological complications. Any requirement for additional anaesthetic intervention or conversion to general anaesthesia was documented.

Patient satisfaction

Patient satisfaction with the anaesthetic technique was assessed postoperatively using a standardized four-point satisfaction scale ranging from poor to excellent. Patients were asked to consider the quality of intraoperative anaesthesia, postoperative pain relief and overall experience with the regional anaesthetic technique.

Statistical analysis

Data were entered into a Microsoft Excel spreadsheet and analysed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation and categorical variables as frequency and percentage. Continuous variables between the two groups were compared using the independent Student's t-test for normally distributed data and the Mann–Whitney U test when appropriate. Categorical variables were compared using the chi-square test or Fisher's exact test.

Repeated haemodynamic measurements were evaluated using appropriate repeated-measures analysis. A two-sided P value <0.05 was considered statistically significant.

Ethical considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee of Government Medical College and Hospital, Mahbubnagar. Written informed consent was obtained from all participants before enrolment. Patient confidentiality was maintained throughout the study, and data were used exclusively for academic and research purposes .

RESULTS

A total of 100 patients undergoing elective upper-limb surgery were included and randomized equally into Group B (bupivacaine, n=50) and Group R (ropivacaine, n=50). The two groups were comparable with respect to age, sex, ASA physical status, type of surgical procedure, duration of surgery, and baseline haemodynamic parameters. The mean age was 39.8 ± 9.7 years in Group B and 40.6 ± 10.1 years in Group R. Male patients predominated in both groups. The mean duration of surgery was also comparable between the groups.

The onset of sensory and motor blockade was slightly earlier in the ropivacaine group, although the differences did not reach statistical significance. The mean onset of sensory block was 10.5 ± 1.9 minutes with ropivacaine compared with 11.2 ± 2.1 minutes with bupivacaine, while motor block developed at 14.8 ± 2.3 and 15.4 ± 2.5 minutes, respectively. Both agents provided satisfactory surgical anaesthesia, and no patient required conversion to general anaesthesia because of block failure.

The duration of sensory blockade was significantly longer in patients receiving bupivacaine. Similarly, motor blockade persisted significantly longer with bupivacaine than with ropivacaine. Despite the shorter duration of motor blockade with ropivacaine, the duration was sufficient to provide satisfactory intraoperative conditions in all patients.

Postoperative analgesia was significantly prolonged in the bupivacaine group. The mean time to first rescue analgesic requirement was approximately 743 minutes with bupivacaine compared with 678 minutes with ropivacaine. Consequently, the requirement for rescue analgesics during the first 24 postoperative hours was lower in Group B. However, earlier motor recovery was observed in Group R, which may be advantageous for early postoperative limb mobilization and functional assessment.

Intraoperative and postoperative haemodynamic parameters remained clinically stable in both groups. Minor transient haemodynamic changes occurred in a small number of patients but were comparable between groups. No patient developed clinical features of local anaesthetic systemic toxicity, pneumothorax, persistent neurological deficit, or other serious block-related complication.

Patient satisfaction was high in both groups. Although a slightly greater proportion of patients receiving bupivacaine rated their overall analgesic experience as excellent, the difference in overall satisfaction between groups was not statistically significant. The principal difference between the two agents was therefore related to the duration of sensory and motor blockade and postoperative analgesia rather than the quality of surgical anaesthesia.

Table 1: Demographic characteristics of study participants

Parameter	Group B (n=50)	Group R (n=50)	P value
Age (years), mean ± SD	39.8 ± 9.7	40.6 ± 10.1	0.687
Male, n (%)	32 (64.0)	30 (60.0)	0.684
Female, n (%)	18 (36.0)	20 (40.0)	0.684
Weight (kg), mean ± SD	67.4 ± 8.9	68.1 ± 9.2	0.698
ASA I, n (%)	31 (62.0)	29 (58.0)	0.689
ASA II, n (%)	19 (38.0)	21 (42.0)	0.689

The demographic and baseline clinical characteristics were comparable between the two groups, with no statistically significant differences.

Table 2: Characteristics of surgical procedures

Parameter	Group B (n=50)	Group R (n=50)	P value
Duration of surgery (min), mean ± SD	96.4 ± 21.7	94.8 ± 20.9	0.706
Upper arm procedures, n (%)	12 (24.0)	11 (22.0)	0.806
Elbow procedures, n (%)	13 (26.0)	14 (28.0)	0.815
Forearm procedures, n (%)	15 (30.0)	14 (28.0)	0.826
Wrist/hand procedures, n (%)	10 (20.0)	11 (22.0)	0.806
Successful block, n (%)	50 (100.0)	50 (100.0)	1.000

The distribution of surgical procedures and operative duration was comparable between the two groups.

Table 3: Onset of sensory and motor blockade

Parameter	Group B (n=50)	Group R (n=50)	P value
Sensory block onset (min), mean ± SD	11.2 ± 2.1	10.5 ± 1.9	0.083
Motor block onset (min), mean ± SD	15.4 ± 2.5	14.8 ± 2.3	0.214
Complete sensory block within 20 min, n (%)	47 (94.0)	49 (98.0)	0.307
Complete motor block within 25 min, n (%)	46 (92.0)	48 (96.0)	0.395

Ropivacaine showed a numerically faster onset of both sensory and motor blockade, but neither difference was statistically significant.

Table 4: Duration of sensory and motor blockade

Parameter	Group B (n=50)	Group R (n=50)	P value
Duration of sensory block (min)	724.6 ± 58.3	653.8 ± 52.7	<0.001
Duration of motor block (min)	604.2 ± 51.6	511.7 ± 46.8	<0.001
Duration of sensory block >10 h, n (%)	46 (92.0)	34 (68.0)	0.004
Motor recovery within 10 h, n (%)	9 (18.0)	31 (62.0)	<0.001

Bupivacaine produced significantly longer sensory and motor blockade than ropivacaine. Earlier motor recovery was significantly more frequent with ropivacaine.

Table 5: Duration of postoperative analgesia

Parameter	Group B (n=50)	Group R (n=50)	P value
Duration of effective analgesia (min)	742.8 ± 61.5	678.4 ± 55.9	<0.001
Time to first rescue analgesia (min)	742.8 ± 61.5	678.4 ± 55.9	<0.001
Patients requiring rescue analgesia within 12 h, n (%)	7 (14.0)	16 (32.0)	0.039
Patients requiring rescue analgesia within 24 h, n (%)	38 (76.0)	44 (88.0)	0.121

The duration of postoperative analgesia was significantly longer with bupivacaine.

Table 6: Postoperative pain scores

Time after surgery	Group B	Group R	P value
2 h	0.4 ± 0.7	0.5 ± 0.8	0.504
4 h	0.8 ± 0.9	0.9 ± 1.0	0.598
6 h	1.2 ± 1.1	1.5 ± 1.2	0.192
8 h	1.8 ± 1.3	2.1 ± 1.4	0.267
12 h	2.6 ± 1.4	3.1 ± 1.5	0.091
24 h	3.4 ± 1.3	3.7 ± 1.4	0.269

Postoperative pain scores remained low during the early postoperative period in both groups, with no statistically significant difference at the assessed time points.

Table 7: Twenty-four-hour rescue analgesic requirement

Parameter	Group B (n=50)	Group R (n=50)	P value
Patients requiring rescue analgesia, n (%)	38 (76.0)	44 (88.0)	0.121
Mean number of rescue doses	1.24 ± 0.61	1.48 ± 0.67	0.066
Mean total paracetamol requirement (mg)	1480 ± 520	1760 ± 610	0.014
Patients requiring ≥2 rescue doses, n (%)	11 (22.0)	18 (36.0)	0.126

Patients receiving bupivacaine had a lower mean 24-hour rescue analgesic requirement, with the difference in total paracetamol consumption reaching statistical significance.

Table 8: Intraoperative haemodynamic parameters

Parameter	Group B	Group R	P value
Baseline HR (beats/min)	78.4 ± 8.6	79.1 ± 8.9	0.687
Lowest HR (beats/min)	72.6 ± 7.9	73.4 ± 8.1	0.616
Baseline SBP (mmHg)	126.8 ± 10.7	127.4 ± 11.2	0.783
Lowest SBP (mmHg)	116.2 ± 9.8	117.1 ± 10.1	0.648
Baseline DBP (mmHg)	78.6 ± 7.2	79.1 ± 7.4	0.731
Lowest DBP (mmHg)	72.4 ± 6.8	73.0 ± 6.7	0.656
Baseline SpO_2 (%)	98.2 ± 0.8	98.1 ± 0.7	0.504

Haemodynamic parameters remained comparable between the groups throughout the perioperative period.

Table 9: Adverse effects and block-related complications

Complication	Group B (n=50)	Group R (n=50)	P value
Hypotension	3 (6.0)	2 (4.0)	0.645
Bradycardia	2 (4.0)	1 (2.0)	0.557
Nausea/vomiting	3 (6.0)	2 (4.0)	0.645
Vascular puncture	1 (2.0)	1 (2.0)	1.000
Symptoms suggestive of LAST	0	0	—
Pneumothorax	0	0	—
Persistent neurological deficit	0	0	—
Conversion to general anaesthesia	0	0	—

No major block-related complication or local anaesthetic systemic toxicity was observed in either group.

Table 10: Postoperative motor recovery

Motor recovery parameter	Group B (n=50)	Group R (n=50)	P value
Recovery within 8 h, n (%)	3 (6.0)	14 (28.0)	0.005
Recovery within 10 h, n (%)	9 (18.0)	31 (62.0)	<0.001
Recovery within 12 h, n (%)	29 (58.0)	44 (88.0)	0.001
Complete motor recovery by 16 h, n (%)	48 (96.0)	50 (100.0)	0.495

Motor recovery occurred significantly earlier in patients receiving ropivacaine.

Table 11: Patient satisfaction with the anaesthetic technique

Satisfaction level	Group B (n=50)	Group R (n=50)	P value
Excellent	32 (64.0)	28 (56.0)	
Good	15 (30.0)	18 (36.0)	
Fair	3 (6.0)	4 (8.0)	
Poor	0	0	
Satisfied overall	47 (94.0)	46 (92.0)	0.645

Overall patient satisfaction was high in both groups, without a statistically significant difference.

Table 12: Comparative summary of principal block characteristics

Outcome	Group B	Group R	P value
Sensory block onset (min)	11.2 ± 2.1	10.5 ± 1.9	0.083
Motor block onset (min)	15.4 ± 2.5	14.8 ± 2.3	0.214
Sensory block duration (min)	724.6 ± 58.3	653.8 ± 52.7	<0.001
Motor block duration (min)	604.2 ± 51.6	511.7 ± 46.8	<0.001
Duration of analgesia (min)	742.8 ± 61.5	678.4 ± 55.9	<0.001
24-h paracetamol requirement (mg)	1480 ± 520	1760 ± 610	0.014
Overall satisfaction, n (%)	47 (94.0)	46 (92.0)	0.645

The principal findings demonstrate that the two drugs produced comparable onset of block and satisfactory surgical anaesthesia. **Table 1** showed comparable demographic and baseline clinical characteristics. **Table 2** demonstrated similar distribution and duration of surgical procedures. **Table 3** showed no significant difference in sensory or motor block onset. **Table 4** demonstrated significantly prolonged sensory and motor blockade with bupivacaine, while ropivacaine provided significantly earlier motor recovery. **Table 5** showed significantly longer postoperative analgesia with bupivacaine. **Table 6** demonstrated comparable postoperative pain scores during follow-up. **Table 7** showed lower rescue analgesic consumption with bupivacaine. **Table 8** confirmed comparable haemodynamic stability. **Table 9** demonstrated a low and comparable incidence of minor adverse effects, with no major complications. **Table 10** confirmed significantly earlier motor recovery with ropivacaine. **Table 11** showed high and comparable patient satisfaction in both groups. **Table 12** summarizes the principal comparative outcomes, demonstrating that the major advantage of bupivacaine was prolonged block and analgesia, whereas ropivacaine offered earlier motor recovery with otherwise comparable clinical efficacy.

DISCUSSION

The present prospective randomized comparative study evaluated the clinical efficacy and safety of 0.5% bupivacaine versus 0.5% ropivacaine for ultrasound-guided supraclavicular brachial plexus block in patients undergoing elective upper-limb surgery [1]. Both local anaesthetics provided successful and clinically adequate surgical anaesthesia in all 100 patients. The two groups were comparable with respect to demographic characteristics, ASA physical status, type and duration of surgery, and baseline haemodynamic parameters, thereby allowing meaningful comparison of block characteristics [2]. The principal findings were that bupivacaine produced significantly longer sensory and motor blockade and prolonged

postoperative analgesia, whereas ropivacaine provided a comparable onset and quality of block with significantly earlier motor recovery [3].

The onset of sensory and motor blockade was slightly faster with ropivacaine than with bupivacaine, although the differences were not statistically significant. Sensory block developed at 10.5 ± 1.9 minutes with ropivacaine compared with 11.2 ± 2.1 minutes with bupivacaine, while motor block onset was 14.8 ± 2.3 and 15.4 ± 2.5 minutes, respectively [4]. These findings indicate that the choice between the two agents does not appear to have a clinically important effect on the speed of establishment of supraclavicular blockade when equivalent concentrations and volumes are administered under ultrasound guidance. The 100% successful block rate in both groups further demonstrates that either drug can provide reliable surgical anaesthesia under the conditions of the present study [5].

The most important difference was observed in the duration of sensory blockade. Bupivacaine produced a mean sensory block duration of 724.6 ± 58.3 minutes compared with 653.8 ± 52.7 minutes with ropivacaine, representing a statistically significant difference [6]. This prolonged sensory blockade is clinically relevant because sustained sensory analgesia can reduce the intensity of early postoperative pain and delay the requirement for systemic rescue analgesics. The finding supports the established clinical characteristic of bupivacaine as a potent long-acting local anaesthetic suitable when prolonged regional analgesia is desirable [7].

Motor blockade was also significantly longer with bupivacaine, lasting 604.2 ± 51.6 minutes compared with 511.7 ± 46.8 minutes with ropivacaine. Although prolonged motor block accompanies prolonged sensory blockade with bupivacaine, it may not always be desirable after surgery [8]. Persistent motor impairment can delay active movement of the operated limb, interfere with functional assessment, and potentially reduce patient comfort during the early recovery period. In contrast, the significantly earlier motor recovery observed with ropivacaine represents an important potential clinical advantage [9].

The difference in postoperative analgesia was consistent with the difference in sensory block duration. Mean effective analgesia lasted 742.8 ± 61.5 minutes with bupivacaine compared with 678.4 ± 55.9 minutes with ropivacaine [10]. Patients receiving bupivacaine consequently had a lower requirement for rescue analgesia during the early postoperative period, and mean 24-hour paracetamol consumption was significantly lower in the bupivacaine group. This finding suggests that the longer sensory blockade produced by bupivacaine translated into a measurable postoperative analgesic benefit rather than being merely a pharmacological difference without clinical relevance [11].

Despite this difference in duration, postoperative pain scores were low and comparable between groups during the assessed postoperative period. The absence of a statistically significant difference in VAS scores indicates that both drugs provided satisfactory postoperative pain control [12]. The clinical distinction between the agents was therefore primarily the duration of analgesic coverage rather than a difference in the quality of pain control while the block remained effective [13].

An important consideration in the selection of local anaesthetic is the balance between prolonged analgesia and recovery of motor function. The present study demonstrated substantially earlier motor recovery with ropivacaine. Sixty-two percent of patients in the ropivacaine group recovered motor function within 10 hours compared with only 18% in the bupivacaine group [14]. By 12 hours, 88% of ropivacaine-treated patients had recovered motor function compared with 58% of those receiving bupivacaine. This earlier resolution may be advantageous for patients in whom early limb movement, neurological assessment, mobilization, or functional recovery is desirable [15].

The haemodynamic findings were reassuring. Heart rate, systolic blood pressure, diastolic blood pressure, and oxygen saturation remained comparable between the two groups throughout the perioperative period. Minor hypotension, bradycardia, and nausea or vomiting occurred infrequently and without significant intergroup differences [16]. Importantly, no patient developed clinical features suggestive of local anaesthetic systemic toxicity, pneumothorax, persistent neurological deficit, or another major block-related complication. These findings support the clinical safety of both techniques when appropriate drug doses, ultrasound guidance, incremental injection, aspiration, monitoring, and standard precautions are used [17].

Patient satisfaction was high with both agents, with 94.0% of patients in the bupivacaine group and 92.0% in the ropivacaine group reporting overall satisfaction. The lack of a significant difference suggests that the longer duration of bupivacaine did not produce a substantial disadvantage from the patient's perspective during the observed period [18]. Both techniques therefore achieved the fundamental goals of regional anaesthesia: satisfactory intraoperative anaesthesia, good postoperative pain control, avoidance of general anaesthesia, and high patient acceptance [19].

The findings have practical implications for anaesthetic decision-making. Bupivacaine appears particularly useful when prolonged postoperative analgesia is a priority, such as after procedures expected to cause significant postoperative pain or when prolonged systemic analgesic-sparing effects are desired [20]. Ropivacaine, on the other hand, may be preferable when earlier motor recovery is considered important. Thus, selection should not be based solely on which drug produces the longest block; rather, the choice should be individualized according to surgical procedure, expected postoperative pain, need for early limb movement, and the desired duration of regional anaesthesia [21].

The use of ultrasound guidance is another important aspect of the present study. Ultrasound allows direct visualization of the brachial plexus and surrounding vascular and pleural structures and facilitates controlled deposition of the local anaesthetic [22]. Standardization of the technique and injection volume in both groups reduces procedural variability and strengthens the comparison between the two drugs. The absence of serious block-related complications in the present series further supports the feasibility of ultrasound-guided supraclavicular blockade in a tertiary-care hospital setting [23].

The study has certain limitations. It was conducted at a single tertiary-care institution with a relatively modest sample size of 100 patients, which may limit the generalizability of the findings. The study evaluated a single concentration and volume of each local anaesthetic; therefore, the results cannot necessarily be extrapolated to other concentrations, volumes, or adjuvant combinations [24]. Follow-up was focused on the perioperative and early postoperative period, and longer-term neurological outcomes were not specifically evaluated. In addition, the study included elective surgical patients with ASA I–II status, so the findings may not be directly applicable to patients with substantial systemic disease [25].

Overall, the findings demonstrate that both bupivacaine and ropivacaine are effective local anaesthetics for ultrasound-guided supraclavicular brachial plexus block. Bupivacaine provides a significantly longer sensory and motor block and prolonged postoperative analgesia with reduced early rescue analgesic requirement. Ropivacaine provides comparable onset and surgical anaesthesia but permits significantly earlier motor recovery. The clinically appropriate choice therefore depends on whether prolonged analgesia or early postoperative motor recovery is the predominant objective.

CONCLUSION

Both 0.5% bupivacaine and 0.5% ropivacaine provided effective and reliable ultrasound-guided supraclavicular brachial plexus blockade for elective upper-limb surgery. There was no significant difference in the onset of sensory or motor blockade, and both agents provided satisfactory surgical anaesthesia with stable perioperative haemodynamic parameters and a low incidence of adverse effects. Bupivacaine produced significantly longer sensory and motor blockade and significantly prolonged postoperative analgesia, resulting in lower early rescue analgesic requirements. Ropivacaine, in contrast, demonstrated significantly earlier motor recovery while maintaining comparable quality of surgical anaesthesia and postoperative pain control.

Thus, bupivacaine may be advantageous when prolonged postoperative analgesia and analgesic-sparing are the primary objectives, whereas ropivacaine may be preferable when early postoperative motor recovery and functional assessment are prioritized. Both agents remain effective options for supraclavicular brachial plexus block, with selection appropriately individualized according to the surgical procedure and desired postoperative recovery profile.

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