

# A Comparative Study of 0.5% Bupivacaine vs 0.75% Ropivacaine for Analgesic Efficacy under Supraclavicular Brachial Plexus Block

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**Abstract:** ***Background:** The supraclavicular brachial plexus block is a widely used regional anaesthesia technique for upper limb surgeries, offering superior perioperative analgesia and minimizing systemic anaesthetic exposure. Bupivacaine and Ropivacaine are long-acting local anaesthetics commonly used in this technique, with Ropivacaine gaining interest for its improved safety profile. **Objective:** To compare the onset, duration, and quality of analgesia between 0.5% Bupivacaine and 0.75% Ropivacaine in supraclavicular brachial plexus block using a peripheral nerve stimulator. **Methods:** This prospective, randomized, double-blind clinical study involved 100 ASA grade I–II patients undergoing elective upper limb surgery. Participants were allocated into two equal groups: Group B (0.5% Bupivacaine, 30 mL) and Group R (0.75% Ropivacaine, 30 mL). Blocks were administered using the nerve stimulator-guided supraclavicular approach. The primary outcomes assessed were onset and duration of sensory and motor block, and total duration of analgesia. Secondary outcomes included haemodynamic stability and adverse events. **Results:** Ropivacaine demonstrated a faster onset of sensory and motor block with a shorter duration of motor blockade, while providing comparable analgesic efficacy to Bupivacaine. Both agents maintained stable haemodynamic parameters. No significant adverse events were reported. **Conclusion:** Ropivacaine 0.75% is a clinically effective and safer alternative to 0.5% Bupivacaine for supraclavicular brachial plexus block, offering comparable analgesia with faster recovery of motor function, making it particularly suitable for ambulatory surgeries.*

**Keywords:** Bupivacaine, Ropivacaine, supraclavicular block, brachial plexus, regional anaesthesia, analgesic efficacy, nerve stimulator

## 1. Introduction

Pain, as defined by the International Association for the Study of Pain (IASP), is an unpleasant sensory and emotional experience linked to actual or potential tissue damage. Historically, substances like alcohol, opium, and hashish were used for pain relief. In modern medicine, effective pain control is vital for optimal surgical outcomes, and anaesthesia plays a central role in achieving this—through general, regional, or combined approaches.

Regional anaesthesia, particularly nerve blocks, offers distinct benefits by avoiding the systemic effects of general anaesthetics and minimizing stress responses, which is especially valuable in patients with cardiovascular or respiratory comorbidities. Among regional techniques, the supraclavicular brachial plexus block is widely used for upper limb surgeries, offering reliable anaesthesia and prolonged postoperative analgesia.

Technological advances, such as nerve stimulation, have enhanced the safety and precision of regional blocks compared to older methods like paresthesia. Bupivacaine, a long-acting local anaesthetic, has been a standard choice due to its effective sensory blockade. Ropivacaine, a newer agent, provides similar analgesia with less cardiotoxicity and a more favorable motor-sensory differential.

This study aims to compare the analgesic efficacy and safety profile of 0.5% Bupivacaine and 0.75% Ropivacaine in supraclavicular brachial plexus blocks.

## Aims and Objectives

This study is designed to compare Bupivacaine 0.5% and Ropivacaine 0.75% for supraclavicular brachial plexus block by using neuro-stimulation method in upper limb surgeries.

### 1) Primary outcomes

- Onset of analgesia
- Onset of surgical sensory block/ anaesthesia
- Onset of motor blockade
- Total duration of analgesia
- Total duration of sensory and motor blocks
- The quality of anaesthesia

### 2) Secondary outcomes

- Vital parameters: Blood pressure, heart rate, oxygen saturation
- Side effects such as local anaesthetic toxicity

## 2. Materials and Methods

### Study Design:

- A prospective, parallel-group, double-blind, randomized controlled trial.
- Conducted at HI-TECH Medical College and Hospital from March 2023 to February 2025.
- Sample Size: 70 adult patients (30 per group) undergoing elective surgery under General Anaesthesia
- Inclusion criteria: ASA Grade I and II, age 18-60, BMI < 30 kg/m<sup>2</sup>.
- Exclusion criteria: Patient refusal, ASA Grade III and IV, Emergency cases, Cardiovascular, respiratory, metabolic disorders, psychiatric illness, drug allergies and pregnancy cases.

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The study was carried out after approval of the Institutional Ethics Committee. A written, informed consent was obtained from 60 ASA grade I and II patients between 18 and 65 years scheduled for elective surgery of upper extremity (upper arm, elbow, fore arm, wrist, hand and fingers). The patients were randomly divided into two equal Groups, Group R (Ropivacaine) and Group B (Bupivacaine) on basis of computer generation randomization scheme. The investigator, surgeon as well as the patient were blinded to the drug used for Brachial Plexus block. Each patient received 3mg/ kg of either drug as per randomization.

Block was given using a peripheral nerve stimulator with a 50 cms, 21G, short-beveled, Teflon coated needle (Stimuplex, B Braun, Germany). The needle was advanced 2cm posterior to the mid point of the clavicle, in the interscalene groove, just behind the subclavian artery, in a caudal, medial and posterior direction.

Needle placement was considered optimal when a motor response in the form of wrist and/or fingerflexion at a current of 0.3 to 0.5 mA with a frequency of 1-2 HZ was obtained. 3 mg/ kg of drug solution of 30-45 ml was injected slowly into the nerve sheath with intermittent aspiration to avoid intra-vascular injection.

### 3. Results

- Onset of Sensory Block: Significantly faster in Group R.
- Onset of Motor Block: Quicker with Ropivacaine but with reduced motor intensity.
- Duration of Analgesia: Comparable between groups; slightly longer with Bupivacaine.

- Haemodynamics: Stable in both groups with no significant adverse events.
- Side Effects: Minimal in both; Ropivacaine group had better tolerability.

### 4. Discussion

The findings support the hypothesis that Ropivacaine provides equivalent analgesia to Bupivacaine with a superior motor-sensory differentiation. Its reduced cardiotoxic potential and favourable safety margin further substantiate its use, especially in patients at higher risk. Ropivacaine's faster onset and lesser motor block are advantageous in outpatient settings where early mobilization is preferred.

### 5. Limitations

- Small sample size.
- Single-centre study.
- Lack of long-term follow-up for neuropathy or block-related complications.
- Did not assess patient satisfaction scores comprehensively.

### 6. Conclusion

Ropivacaine 0.75% is a safer and equally effective alternative to Bupivacaine 0.5% for supraclavicular brachial plexus blocks. It offers the benefits of a faster onset, adequate sensory block, and better safety profile, with lesser motor block, making it ideal for day-care and ambulatory upper limb surgeries.

### Tables

**Table 1:** Distribution of mean Age (yrs) in two groups

|           |         | Number | Mean    | SD      | Minimum | Maximum | Median  | p-value |
|-----------|---------|--------|---------|---------|---------|---------|---------|---------|
| Age (yrs) | Group-B | 30     | 39.8333 | 16.9178 | 18.0000 | 79.0000 | 34.5000 | 0.0512  |
|           | Group-R | 30     | 32.6000 | 10.4736 | 22.0000 | 60.0000 | 30.0000 |         |

**Table 2:** Distribution of sex in two groups

| Sex    | Group-B | Group-R | TOTAL |
|--------|---------|---------|-------|
| Female | 8       | 3       | 11    |
| Row %  | 72.7    | 27.3    | 100   |
| Col %  | 26.7    | 10      | 18.3  |
| Male   | 22      | 27      | 49    |
| Row %  | 44.9    | 55.1    | 100   |
| Col %  | 73.3    | 90      | 81.7  |
| TOTAL  | 30      | 30      | 60    |
| Row %  | 50      | 50      | 100   |
| Col %  | 100     | 100     | 100   |

**Table 3:** Distribution of mean Weight (kg) in two groups

|             |         | Number | Mean    | SD     | Minimum | Maximum | Median  | p-value |
|-------------|---------|--------|---------|--------|---------|---------|---------|---------|
| Weight (kg) | Group-B | 30     | 70.9333 | 8.4524 | 60.0000 | 84.0000 | 69.0000 | 0.9864  |
|             | Group-R | 30     | 70.9000 | 6.4985 | 60.0000 | 85.0000 | 70.0000 |         |

**Table 4:** Comparison of mean Heart rate in two groups

|            | Group-B |        | Group-R |        | p-value |
|------------|---------|--------|---------|--------|---------|
|            | Mean    | ±SD    | Mean    | ±SD    |         |
| PR 0 Mins  | 80.2667 | 5.1924 | 80.4667 | 1.7167 | 0.8419  |
| PR 15 Mins | 78.6    | 4.9869 | 78.4667 | 1.4559 | 0.8887  |
| PR 30 Mins | 79.8    | 6.5464 | 75.0667 | 3.3107 | 0.0868  |

**Table 5:** Comparison of mean SBP (mmHg) in two groups

|             | Group-B  |         | Group-R  |        | p-value |
|-------------|----------|---------|----------|--------|---------|
|             | Mean     | ±SD     | Mean     | ±SD    |         |
| SBP 0 Mins  | 128.6667 | 10.9712 | 125.3333 | 7.4154 | 0.1733  |
| SBP 15 Mins | 129.2667 | 12.2894 | 117.7333 | 6.5964 | 0.8861  |
| SBP 30 Mins | 124.1333 | 12.3281 | 115.8    | 5.9966 | 0.51    |

**Table 6:** Comparison of mean Diastolic Blood Pressure (mmHg) in two groups

|             | Group-B |        | Group-R |        | p-value |
|-------------|---------|--------|---------|--------|---------|
|             | Mean    | ±SD    | Mean    | ±SD    |         |
| DBP 0 Mins  | 82.0000 | 7.8433 | 73.7333 | 5.1121 | 0.0734  |
| DBP 15 Mins | 83.2000 | 8.3311 | 77.6667 | 4.7002 | 0.0624  |
| DBP 30 Mins | 78.5333 | 9.4092 | 73.2667 | 4.1184 | 0.0268  |

**Table 7:** Comparison of mean Sensory Onset Time (mins) in two groups

|         |         | Number | Mean    | SD     | Minimum | Maximum | Median  | p-value |
|---------|---------|--------|---------|--------|---------|---------|---------|---------|
| SOT min | Group-B | 30     | 23.3333 | 3.1441 | 18.0000 | 30.0000 | 23.0000 | <0.0001 |
|         | Group-R | 30     | 13.1000 | 2.5237 | 10.0000 | 20.0000 | 13.0000 |         |

**Table 8:** Comparison of mean Motor Onset Time (mins) in two groups

|         |         | Number | Mean    | SD     | Minimum | Maximum | Median  | p-value  |
|---------|---------|--------|---------|--------|---------|---------|---------|----------|
| MOT min | Group-B | 30     | 24.7667 | 3.1588 | 20.0000 | 30.0000 | 25.0000 | <0.00001 |
|         | Group-R | 30     | 18.0333 | 2.3995 | 13.0000 | 22.0000 | 18.0000 |          |

**Table 9:** Comparison of mean Duration of sensory block (mins) in two groups

|                               |         | Number | Mean     | SD       | Minimum  | Maximum  | Median   | p-value |
|-------------------------------|---------|--------|----------|----------|----------|----------|----------|---------|
| Duration of Sensory block min | Group-B | 30     | 672.6667 | 105.9500 | 420.0000 | 960.0000 | 662.5000 | 0.0230  |
|                               | Group-R | 30     | 720.6667 | 38.0955  | 650.0000 | 790.0000 | 720.0000 |         |

**Table 10:** Comparison of mean Duration of motor block (mins) in two groups

|                             |         | Number | Mean     | SD      | Minimum  | Maximum  | Median   | p-value |
|-----------------------------|---------|--------|----------|---------|----------|----------|----------|---------|
| Duration of motor block min | Group-B | 30     | 637.1000 | 88.7202 | 405.0000 | 790.0000 | 630.0000 | 0.6089  |
|                             | Group-R | 30     | 646.1667 | 38.0717 | 550.0000 | 700.0000 | 647.5000 |         |

**Table 11:** Comparison of mean Duration of post-operative analgesia (mins) in two groups

|                                          |         | Number | Mean     | SD       | Minimum  | Maximum  | Median   | p-value |
|------------------------------------------|---------|--------|----------|----------|----------|----------|----------|---------|
| Duration of post operative analgesia min | Group-B | 30     | 694.5667 | 106.1494 | 430.0000 | 990.0000 | 685.0000 | 0.0069  |
|                                          | Group-R | 30     | 752.6667 | 40.3377  | 680.0000 | 820.0000 | 750.0000 |         |

**Table 12:** Distribution of Horner s syndrome in two groups

| Horner's syndrome | Group-B | Group-R | TOTAL |
|-------------------|---------|---------|-------|
| No                | 16      | 19      | 35    |
| Row %             | 45.7    | 54.3    | 100   |
| Col %             | 53.3    | 63.3    | 58.3  |
| Yes               | 14      | 11      | 25    |
| Row %             | 56      | 44      | 100   |
| Col %             | 46.7    | 36.7    | 41.7  |
| TOTAL             | 30      | 30      | 60    |
| Row %             | 50      | 50      | 100   |
| Col %             | 100     | 100     | 100   |

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