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*Original Research Article*

# Comparative study between 20ml of 0.5% ropivacaine and 20ml of 0.5% levobupivacaine in ultrasound guided supraclavicular brachial plexus block for upper limb surgeries

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## Abstract

**Aim:** This study is aimed to compare the effects between 20ml of 0.5% Ropivacaine and 20ml of 0.5% Levobupivacaine in ultrasound guided supraclavicular brachial plexus block for Upper limb surgeries.
**Methodology:** It was a prospective double blinded randomized controlled study in sixty adult patients undergoing upper limb surgeries admitted in Rajah Muthiah Medical college and hospital from November 2020 to November 2022.
**Result:** Significant earlier onset of sensory blockade (p=0.001) and motor blockade (p=0.001), prolonged duration of sensory and motor blockade (p=0.001) was observed in group of patients receiving 0.5% levobupivacaine compared to 0.5% ropivacaine. Intraoperatively throughout the study heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were comparable in both the groups and found no statistically significant difference ($p$>0.05). The heart rate, systolic and diastolic blood pressure for both the groups were also compared postoperatively and observed no significant statistical difference ($p$>0.05). No adverse effects were observed in both the groups.
**Conclusion:** 0.5% levobupivacaine used in ultrasound guided supraclavicular brachial plexus block for upper limb surgeries provides rapid onset of sensory and motor blockade and prolonged duration of analgesia compared to 0.5% ropivacaine.

**Keywords:** Ultrasound guided supraclavicular block, ropivacaine, levobupivacaine, upper limb surgeries, brachial plexus block, post-operative pain

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## Introduction

Peripheral nerve blocks are widely popular now due to the advantages that regional anaesthesia has over general anaesthesia. Peripheral nerve blocks are widely accepted as the standard method of anaesthesia or analgesia for ambulatory limb surgeries. Regional anaesthesia have been found to be very useful in high risk patients, especially patients in the elderly age group undergoing surgeries involving upper or lower extremities. Patients with comorbidities such as cardiovascular diseases, chronic lung disease, metabolic diseases, neuropathies and/or immunosuppressive states, when undergoing general anaesthesia, face challenges like changes in haemodynamic stress response and potential for drug interaction due to polypharmacy. These patients would benefit from regional anaesthesia, especially for ambulatory limb surgeries. Regional anaesthesia can be a good alternative to general anaesthesia with the advent of accessories such as peripheral nerve stimulator and ultrasound. All the disadvantages of a block by a landmark guided technique have been overcome with nerve stimulation and ultrasound guidance. The added advantages of visualization of the nerve plexus have helped in administration of the drug with more precision, obtaining better quality of the nerve block, shortening the latency and minimizing the amount of drug needed for the block. It has also resulted in decreased complications such as vessel puncture and injury to pleura. Nerve stimulation was earlier considered as the gold standard for neuronal blockade, with its ability to predict the spread of drug to the proximity of the nerve. However, the neuronal sparing which was seen with this technique was probably due to non-uniform distribution of sensory and motor fascicles in a compound nerve. This meant that the technique was relatively insensitive but very specific. Ultrasound overcame this shortcoming by providing direct visualization of the nerve. Combining nerve stimulator and ultrasound proved to be more accurate and reliable. Ultrasound guided nerve blocks provided visual guidance to needle position and, hence, more successful and safer blocks. Newer local anaesthetics with minimal cardiovascular effects and longer duration of action have been developed. This study aims to compare the onset of motor and sensory blockade duration and post-operative pain relief between Ropivacaine and Levobupivacaine.

## Methodology

It was a prospective double blinded randomized study in sixty adult patients undergoing upper limb surgeries admitted in Rajah Muthiah medical college and Hospital from November 2020 to November 2022

### Inclusion criteria

1. Patients aged 18-60 years scheduled for upper limb surgeries.
2. ASA I-II Patients.

### Exclusion criteria

1. Patients who refused to be part of the study.
2. Patients with significant coagulopathies.
3. Patients with psychiatric history.
4. Patients allergic to amide local anesthetic.
5. Pregnant patients.
6. ASA III-V.

After obtaining approval from the institutional Human ethics committee and informed

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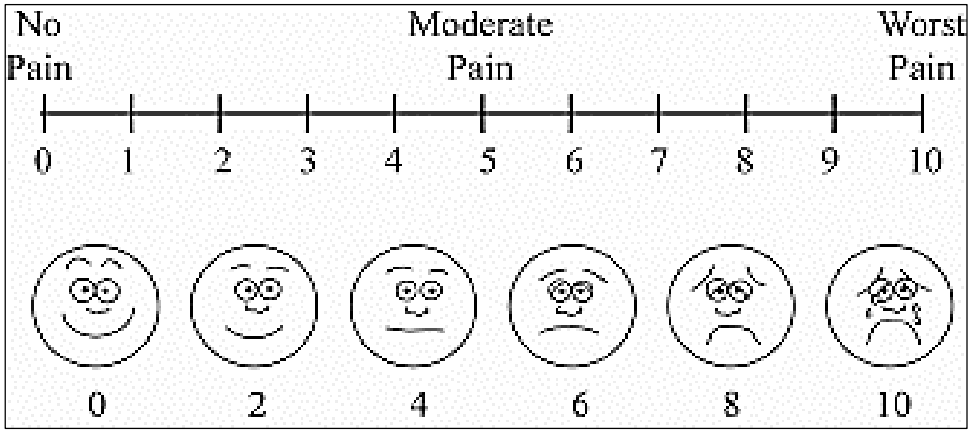
consent, 60 patients for upper limb surgeries were included in the study. Patients were randomized into two Groups. Ultrasound guided Supraclavicular Brachial plexus block was performed. Drug was prepared by anesthesiologist who was not be involved in the study and handed over to study performing anesthesiologist. One group received 20 ml of 0.5% Ropivacaine and other group received 20 ml of 0.5% Levobupivacaine. Baseline hemodynamic parameters was recorded before the procedure. End of injection of local anesthetic was taken as time 0, thereafter patients were monitored at 5, 10, 15, 20, 25, 30 minutes and so on. Post operatively VAS scores were monitored for 24hrs at 2 hourly interval and rescue analgesic injection Tramadol 100mg IV was administered when VAS score more than or equal to 4. That time denotes end of study. Randomization was decoded at the end of study and subjected to statistical analysis.

**Pain score (visual analogue scale)**




**Sensory block grading by Pin Prick Method**

**Grade 0:** Sharp pin felt.
**Grade 1:** Analgesia, dull sensation felt.
**Grade 2:** Anaesthesia, no sensation felt.

**Motor block graded according to Modified Lovett's Scoring as**

**Grade 6:** Normal.
**Grade 5:** Slightly reduced muscular force.
**Grade 4:** Pronounced reduction.
**Grade 3:** Slightly impaired mobility.
**Grade 2:** Pronounced mobility impairment.
**Grade 1:** Almost complete paralysis.
**Grade 0:** Complete paralysis.

**Data collection:** Information on age, gender, height, weight, comorbidities were extracted from proforma collected by anesthestist who is not involved in the study.

**Statistical analysis**

The data collected were entered into Microsoft excel 360 in order to create a master chart. The master chart was then loaded into statistical package for social sciences (SPSS) version 26 for further statistical analysis. Both quantitative and qualitative variables were present in the master chart. Both descriptive and inferential statistics were used for analysis.

For describing the qualitative variables, frequency and percentages were used. For describing the quantitative data, mean and standard deviation were used. In order to find out difference in distribution of qualitative variable between the experimental arms, chi-square test was applied. To find out the difference in mean between two groups, independent samples T test was applied. To find out the difference in change of mean between the groups for a repeatedly measured variables, Repeated measures analysis of variance (RM-ANOVA) was used. A P value of less than 0.05 was considered to be statistically significant.

## Results

**Table 1:** Demographiic variables

| Variables | Ropivacaine | Levobupivacaine | P Value |
|---|---|---|---|
| Age | 40.63 ±9.27 | 39.46±9.11 | 0.62 |
| Weight | 66.7 ± 7.99 | 65.46 ± 6.58 | 0.792 |

The mean age among the Ropivacaine group and levobupivacaine group was found to be 40.63 ±9.27 years and 39.46±9.11 years, respectively. The mean age of both the groups were found to be statistically similar with P value of more than 0.05. The mean weight among the participants in the levobupivacaine group was 66.7 ± 7.99 Kgs and that of the ropivacaine group was 65.46 ± 6.58 Kgs. The mean weight of both the groups were found to be similar with P value of more than 0.05

**Table 2:** Distribution of sex between the groups

| Variables | | Levobupivacaine | | Ropivacaine | | $X^2$ | P value* |
|---|---|---|---|---|---|---|---|
| | | N | % | N | % | | |
| Sex | Male | 21 | 70 | 23 | 77 | 0.087 | 0.634 |
| | Female | 9 | 30 | 7 | 23 | | |

Among the participants in the levobupivacaine group, 70% were males and among those in the ropivacaine group, 77% were males. The distribution of sex was found to be similar between the groups with P value of more than 0.05.

**Table 3:** Distribution of ASA between Ropivacaine and Levobupivacaine group

| Variables | | Ropivacaine | | Levobupivacaine | | t | P value |
|---|---|---|---|---|---|---|---|
| | | N | % | N | % | | |
| ASA | I | 22 | 73 | 21 | 70 | 0.673 | 0.551 |
| | II | 8 | 27 | 9 | 30 | | |

In the Ropivacaine group, 73% were in ASA I and 27% ASA II. In the Levobupivacaine group, 70% were in ASA I and 30% had ASA II. Both the groups were similar with respect to the distribution of ASA (P value > 0.05).

**Table 4:** Mean systolic blood pressure (mmHg) between Ropivacaine and levobupivacaine groups

| Timeline | Ropivacaine (mmHg) | | Levobupivacaine (mmHg) | | P value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Baseline | 113.07 | 7.13 | 111.87 | 5.01 | 0.998 |
| 5 minutes | 113.80 | 5.28 | 114.07 | 5.54 | |
| 10 minutes | 110.93 | 4.24 | 112.07 | 4.74 | |
| 15 minutes | 112.38 | 4.34 | 110.47 | 4.02 | |
| 20 minutes | 110.80 | 4.15 | 110.60 | 3.82 | |
| 30 minutes | 109.21 | 3.45 | 111.53 | 4.25 | |

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| | | | | | |
|---|---|---|---|---|---|
| 60 minutes | 111.13 | 4.38 | 110.47 | 3.51 | |
| 90 minutes | 110.07 | 3.38 | 110.13 | 3.36 | |
| 2 hours | 110.27 | 4.38 | 110.20 | 4.40 | |
| 4 hours | 109.20 | 3.62 | 109.13 | 3.58 | |
| 8 hours | 109.20 | 3.81 | 109.20 | 3.58 | |
| 16 hours | 108.93 | 3.39 | 108.93 | 3.39 | |
| 24 hours | 111.87 | 3.52 | 111.93 | 3.46 | |

Over the timeline the mean systolic blood pressure of both the groups were found to be similar with P value of more than 0.05.

**Table 5:** Mean diastolic blood pressure (mmHg) over the timeline between the groups

| **Timeline** | **Ropivacaine (mmHg)** | | **Levobupivacaine (mmHg)** | | **P value** |
|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | |
| Baseline | 66.73 | 4.25 | 69.40 | 3.93 | |
| 5 minutes | 69.60 | 7.54 | 70.53 | 6.74 | |
| 10 minutes | 68.40 | 7.54 | 68.40 | 7.54 | |
| 15 minutes | 68.67 | 6.06 | 68.80 | 5.13 | |
| 20 minutes | 68.20 | 7.84 | 68.53 | 7.40 | |
| 30 minutes | 65.87 | 5.30 | 66.20 | 5.07 | |
| 60 minutes | 64.93 | 5.84 | 65.07 | 5.62 | 0.970 |
| 90 minutes | 64.80 | 5.21 | 64.53 | 5.01 | |
| 2 hours | 65.80 | 5.54 | 65.87 | 5.09 | |
| 4 hours | 64.13 | 4.63 | 64.13 | 4.63 | |
| 8 hours | 67.60 | 6.24 | 68.67 | 4.89 | |
| 16 hours | 66.93 | 4.89 | 66.87 | 4.74 | |
| 24 hours | 65.40 | 4.98 | 65.87 | 4.60 | |

Over the timeline the mean diastolic blood pressure of both the groups were found to be similar with P value of more than 0.05.

**Table 6:** Mean pulse rate (per minute) over the timeline between the groups

| **Timeline** | **Ropivacaine (per minute)** | | **Levobupivacaine (per minute)** | | **P value** |
|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | |
| Baseline | 100.80 | 8.04 | 103.07 | 6.98 | |
| 5 minutes | 101.07 | 9.04 | 101.53 | 8.56 | |
| 10 minutes | 99.87 | 8.28 | 100.60 | 7.98 | |
| 15 minutes | 99.00 | 7.51 | 100.53 | 6.53 | |
| 20 minutes | 96.80 | 9.75 | 98.87 | 8.70 | |
| 30 minutes | 97.27 | 8.63 | 97.60 | 8.55 | |
| 60 minutes | 96.80 | 8.07 | 97.67 | 7.64 | 0.928 |
| 90 minutes | 97.27 | 8.37 | 99.07 | 7.91 | |
| 2 hours | 99.20 | 7.17 | 99.27 | 7.17 | |
| 4 hours | 98.87 | 7.62 | 99.87 | 7.18 | |
| 8 hours | 100.93 | 9.94 | 101.60 | 9.01 | |
| 16 hours | 101.73 | 7.99 | 101.33 | 6.85 | |
| 24 hours | 101.93 | 5.97 | 101.87 | 5.43 | |

Over the timeline the mean pulse rate of both the groups were found to be similar with P value of more than 0.05.

**Table 7:** Mean $SpO_2$ over the timeline between the groups

| Timeline | Ropivacaine | | Levobupivacaine | | P value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Baseline | 98.9 | 0.88 | 99.03 | 0.92 | 0.294 |
| 5 minutes | 98.80 | 0.66 | 98.93 | 0.69 | |
| 10 minutes | 98.87 | 0.81 | 99 | 0.83 | |
| 15 minutes | 98.97 | 0.71 | 99.13 | 0.73 | |
| 20 minutes | 98.93 | 0.69 | 98.93 | 0.69 | |
| 30 minutes | 99.17 | 0.69 | 99.13 | 0.68 | |
| 60 minutes | 98.93 | 0.78 | 98.97 | 0.81 | |
| 90 minutes | 98.93 | 0.78 | 98.97 | 0.81 | |
| 2 hours | 98.70 | 0.59 | 98.70 | 0.59 | |
| 4 hours | 98.97 | 0.55 | 98.97 | 0.55 | |
| 8 hours | 98.80 | 0.81 | 98.97 | 0.55 | |
| 16 hours | 98.97 | 0.71 | 99.10 | 0.66 | |
| 24 hours | 99.13 | 0.68 | 99.17 | 0.69 | |

Over the timeline the mean $SpO_2$ of both the groups were found to be similar with P value of more than 0.05.

**Table 8:** Comparison of mean Sensory bock onset time between the Ropivacaine and levobupivacaine groups

| Groups | Onset of Sensory block (in minutes) | | P value* |
|---|---|---|---|
| | Mean | SD | |
| Levobupivacaine | 17.7 | 2.311 | <0.001 |
| Ropivacaine | 20.8 | 2.15 | |

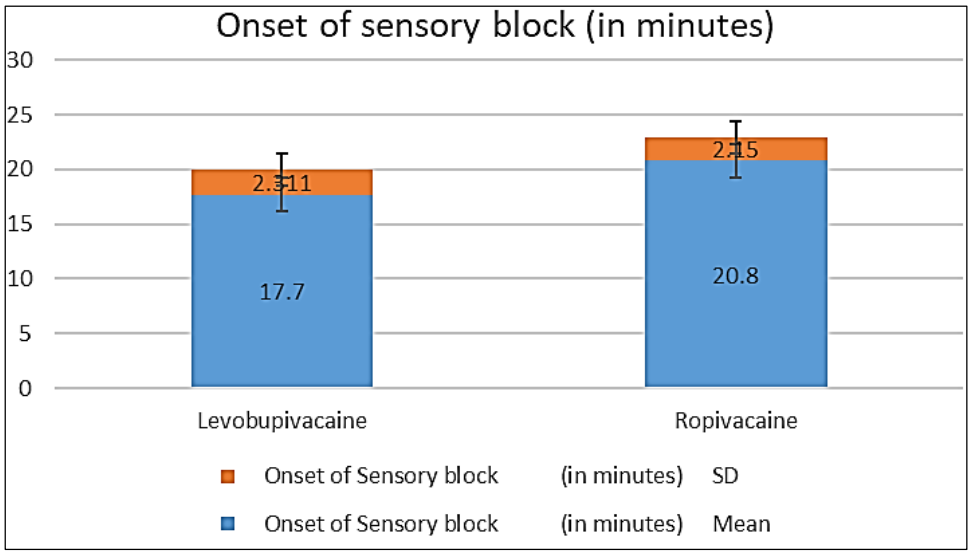


**Fig 1:** Bar chart showing change in mean onset of Sensory block between the groups

The mean onset of Sensory block among the Ropivacaine group and levobupivacaine group was found to be 20.8±2.15 minutes and 17.7±2.311 minutes, respectively. The mean onset of Sensory block between the groups were found to be statistically significant with P value of less than 0.05.

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**Table 9:** Comparison of mean Motor block onset time between the Ropivacaine and levobupivacaine groups

| Groups | Onset of Motor block (in minutes) | | P value* |
|---|---|---|---|
| | Mean | SD | |
| Levobupivacaine | 20.6 | 1.6 | 0.001 |
| Ropivacaine | 22.2 | 2.7 | |

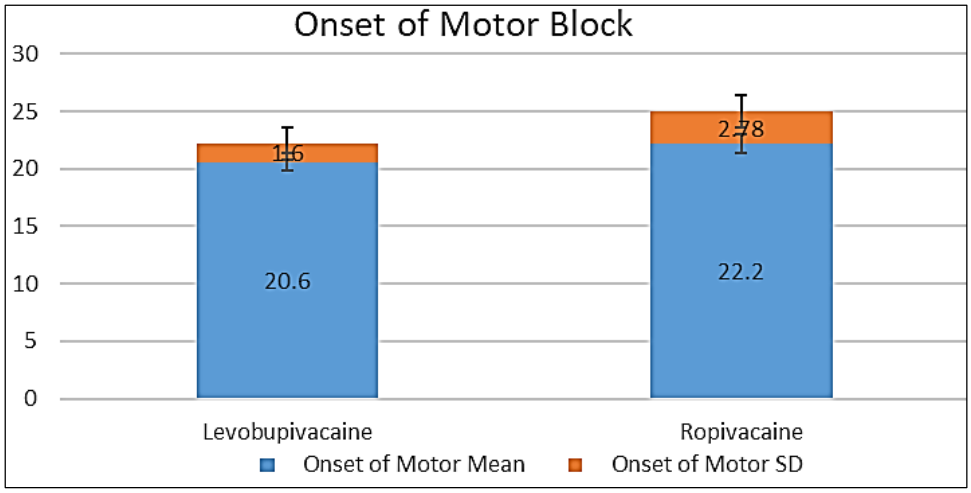


**Fig 2:** Bar chart showing change in mean onset of Motor block between the groups

The mean onset of Motor block among the Ropivacaine group and levobupivacaine group was found to be22.2± 2.7 minutes and 20.6± 1.6 minutes, respectively. The mean onset of Motor block between the groups were found to be statistically significant with P value of less than 0.05.

**Table 10:** Comparison of mean duration of sensory block between the Ropivacaine and levobupivacaine groups

| Groups | Duration of sensory block (in minutes) | | P value* |
|---|---|---|---|
| | Mean | SD | |
| Levobupivacaine | 357.7 | 32.9 | 0.001 |
| Ropivacaine | 302 | 42.3 | |

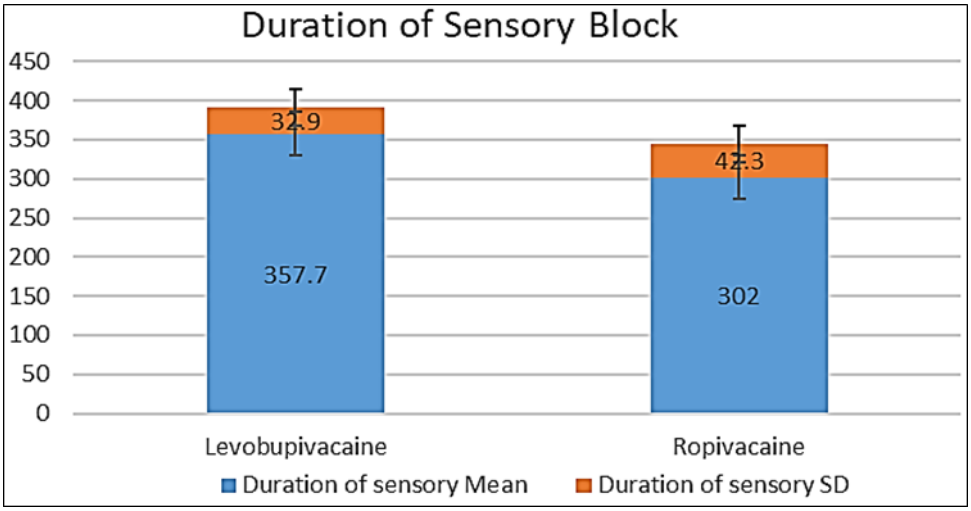


**Fig 3:** Bar chart showing change in duration of sensory block between the groups

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The mean duration of sensory block among the Ropivacaine group and levobupivacaine group was found to be 302±42.3 minutes and 357±32.9 minutes, respectively. The mean duration of sensory block between the groups were found to be statistically significant with P value of less than 0.05.

**Table 11:** Comparison of mean duration of motor block between the Ropivacaine and levobupivacaine groups

| Groups | Duration of motor block (in minutes) | | P value* |
|---|---|---|---|
| | Mean | SD | |
| Levobupivacaine | 369 | 41.05 | 0.001 |
| Ropivacaine | 336 | 37.3 | |

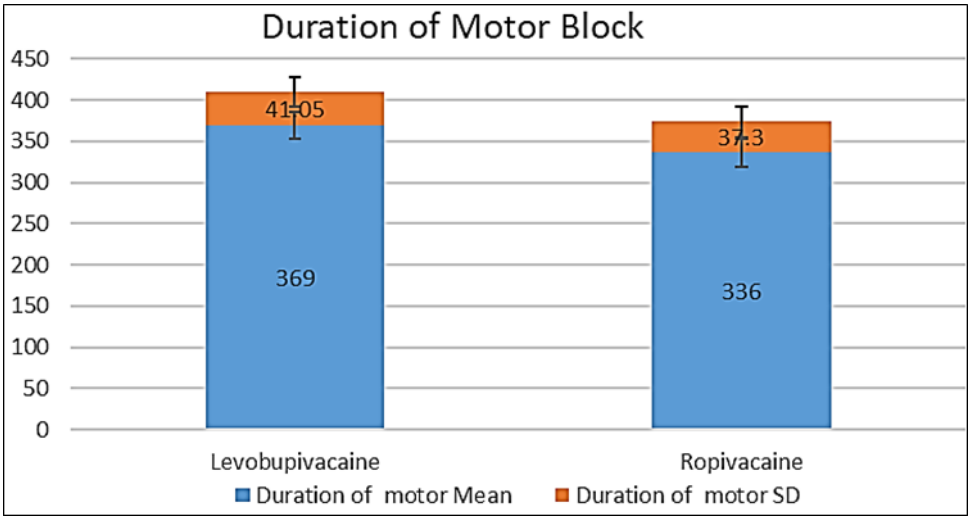


**Fig 4:** Bar chart showing change in duration of motor block between the groups

The mean duration of motor block among the Ropivacaine group and levobupivacaine group was found to be 336±37.3 minutes and 369±41.05 minutes, respectively. The mean duration of motor between the groups were found to be statistically significant with P value of less than 0.05.

**Table 12:** Comparison of mean duration of Analgesia between the Ropivacaine and levobupivacaine groups

| Groups | Duration of analgesia (in minutes) | | P value* |
|---|---|---|---|
| | Mean | SD | |
| Levobupivacaine | 372 | 42.9 | 0.001 |
| Ropivacaine | 341 | 36.5 | |

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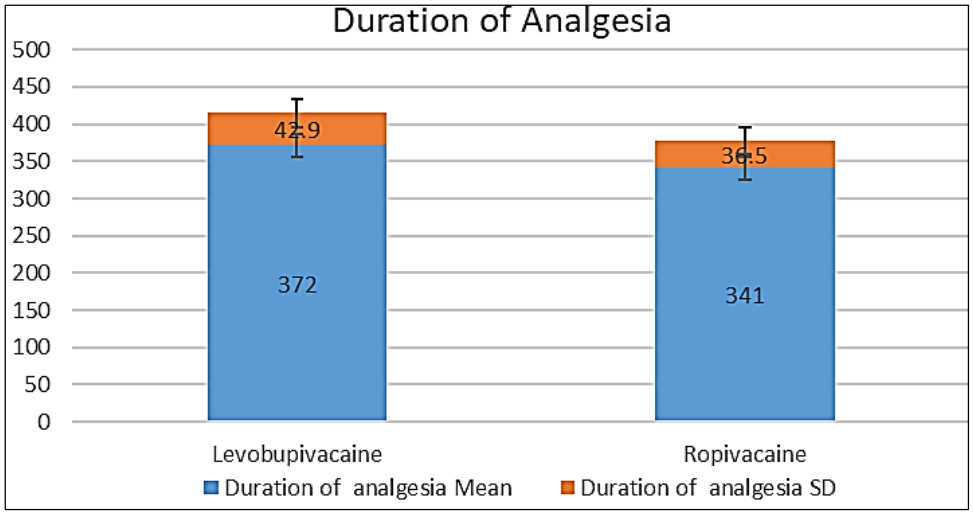


**Fig 5:** Bar chart showing change in duration of analgesia between the groups

The mean duration of analgesia among the Ropivacaine group and levobupivacaine group was found to be 341±36.5 minutes and 372±42.9 minutes, respectively. The mean duration of analgesia between the groups were found to be statistically significant with P value of less than 0.05

## Discussion

Brachial plexus block forms the multipurpose and dependable local anesthetic technique and an appropriate substitute to general anesthesia for upper limb surgery. The supraclavicular approach provides the most complete and reliable anesthesia as it provides anesthesia of the entire upper extremity in the most consistent, time efficient manner for elbow, forearm, and hand surgery [1]. Since the introduction of long-acting local anesthetics (LAs) with better safety clinical profiles, usage of peripheral nerve blocks has been increased. Despite its long-acting analgesic properties, concerns about racemic bupivacaine have been raised over its potential cardiotoxicity and central nervous system (CNS) toxicity after inadvertent intravenous administration which may be fatal sometimes [2, 3]. To reduce risk of specific toxic characteristics, nonracemic LAs such as ropivacaine or levobupivacaine emerged at the right moment, both of which are the pure left-isomers of bupivacaine and quite similar in physicochemical properties. Both these 2 long-acting LA amides are associated with lower cardiac and CNS toxicity than racemic bupivacaine, having been developed to offer a safer alternative to bupivacaine [4]. In our study it appears that the demographic data such as age, sex, patient weight and ASA grade are equally distributed between the two groups of 30 patients each and are, hence, comparable. For pharmacological properties, ropivacaine is about 10 times less lipophilic than levobupivacaine and is therefore resistant to rapidly penetrating the myelinated nerve fibers and easily induces local vasoconstriction in tissues surrounding the injection site [5, 6]. Consequently, it might have hindered diffusion of ropivacaine solution within the soft tissues and fat, leaving a high level of concentration near the nerves to block. Illustrated by some literatures, adipose tissue can influence regional anesthesia, especially the perineural and epineural fat, leading to a delayed onset time of motor and sensory block and a diminished degree of anesthesia intensity [7]. The statistically significant mean onset of sensory and motor blockade was observed earlier in group of patients who received levobupivacaine compared to patients received ropivacaine. Similar results were observed by Mageswaranand Choy [8] On the contrary, Nodulas *et al*. found that both 0.5% Levobupivacaine and 0.5% ropivacaine had similar onset of action [9]. In our study, the duration of sensory and motor blockade was prolonged in Group L as compared to Group

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R. This difference in duration of motor blockade was found to be statistically significant (p=0.001). This observation is similar to the results of Casati *et al*. [10]. Similarly, in the study conducted by Deshpande *et al*., they found the onset of sensory and motor block early with levobupivacaine 0.5% with a statistically high significance. The duration of sensory, motor block and postoperative analgesia was prolonged with levobupivacaine when compared to 0.5% ropivacaine in supraclavicular brachial plexus block [11]. The time between the supraclavicular block administration and onset of pain (VAS >4) requiring the administration of a rescue analgesic, was measured as the duration of analgesia. Injection diclofenac 75 mg (i.v.) was given if the VAS was >4. The time for first rescue analgesia was 372±42.9 minutes in group L which was more as compared to Group R (341±36.5 minutes) and the difference was statistically significant (p=0.001). In our study, intra operative and postoperative haemodynamic parameters were also monitored. The pulse rate, systolic blood pressure, diastolic blood pressure and oxygen saturation were comparable in both the groups intra operatively and post operatively and they were found to be statistically insignificant ($p$>0.05). Similarly, in the study conducted by Deshpande *et al*. showed that there was no significant difference between both the groups in terms of heart rate and blood pressure, ECG and SPO2 throughout the surgery and postoperatively. The same findings were also observed by Fusun *et al*. [12] In our study the patients were monitored postoperatively for any complications like hypotension, bradycardia, postoperative pain, paraesthesia, myonecrosis, headache, allergic reactions if any. No complications had been reported at the dosages used in present study and our results are also in accordance with the findings reported in previous studies. Thus, in general, levobupivacaine showed a better quality of analgesia with a shorter onset and prolong recovery time for both sensory and motor blockade in comparison to ropivacaine.

## Conclusion

On the basis of our study, we can draw the conclusion that at equal volumes Levobupivacaine 0.5% has an advantage over Ropivacaine 0.5% for supraclavicular Brachial Plexus block in terms of

- Early onset of Sensory blockade.
- Early onset of Motor blockade.
- Prolonged Duration of Sensory blockade.
- Prolonged Duration of Motor blockade.
- Prolonged Duration of Analgesia.

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