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A comparative study of levobupivacaine and ropivacaine as supraclavicular brachial plexus block in patients undergoing upper limb surgery

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Abstract

Introduction: Peripheral nerve blocks are the preferred choice of anaesthesia for surgeries involving the extremities of the human body, with fewer complications. Earlier, the most common drug to be used for the brachial plexus block was bupivacaine, but of late, levobupivacaine and Ropivacaine are used as substitutes to counter the toxicity by Bupivacaine.
Materials and methods: 100 patients aged between 18-60 years with ASA I and ASA II undergoing bony surgeries were randomly divided into Group L and Group R. Group L was given 30 ml of 0.5% Levobupivacaine and Group R was given 30 ml of 0.5% Ropivacaine.
Results: The onset of the sensory blockade was significantly lesser in Group L (4.51 ± 0.45 minutes) rather than Group R (5.95 ± 1.33 minutes) while there was no significant difference in the onset of the motor blockade (8.13 ± 2.46 minutes in Group L and 8.42 ± 2.51 minutes in Group R). The duration of the sensory blockage was significantly more in Group L (11.13 ± 2.11 hours) than Group R (9.04 ± 1.42 hours) while there was no difference in the duration of the motor blockade. The duration of analgesia was 11.43 ± 2.17 in Group L and 8.23 ± 1.72 hours in Group R, which was statistically significant.
Conclusion: Since the onset is shorter and duration of anesthesia and analgesic is more effective in Levobupivacaine, it can be used as a preferred drug.

Keywords: Levobupivacaine, bupivacaine, Ropivacaine, upper limb surgery, Supraclavicular brachial plexus block

Introduction

Peripheral nerve blocks are the preferred choice of anaesthesia for surgeries involving the extremities of the human body, with fewer complications. They are also used as drugs for pain relief, both chronic and post-operative pain. Compared to the regional nerve blocks, patients have preferred the use of regional anaesthesia for surgery [1, 2]. Brachial plexus block may be used as a sole anesthetic agent or as an adjuvant to the general anaesthesia. A brachial plexus block for an upper limb surgery is commonly used as it helps to reduce pain and

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nausea, thereby resulting in a lesser hospital days [3].
Many different types of approaches for a brachial plexus block are used such as Supraclavicular approach, Infraclavicular approach interscalene approach and Axillary approach. For an upper limb surgery, without shoulder involvement, Supraclavicular approach is a preferred technique as it has a rapid onset, safe and highly effective with good motor blockade with post-operative analgesia. It is usually referred as the 'spinal anaesthesia of the upper extremity' as it provides complete anaesthesia to the midarm and below region and a high success rate [4, 5]. The patient is usually awake during this technique. The recovery is early with resumption of oral feeds. Since there is no airway manipulation and the use of the drugs is also minimal, the post-operative nausea and vomiting is also minimal [6].
Earlier, the most common drug to be used for the brachial plexus block was bupivacaine for its longer duration of anaesthesia and a successful sensory as well as motor blockade, but it has side effects like cardiac toxicity, which was due to dextro-bupivacaine enantiomer [7, 8].
The first replacement identified for bupivacaine was ropivacaine, which was a long acting amide with lesser side effects compared to bupivacaine [9, 10]. Even when large amount of anaesthesia is required, this drug is quite advantageous for neural blockade with enhanced speed of onset and a longer duration [9-11].
Latest anaesthetic agent to be introduced is Levobupivacaine, which is an S-enantiomer of Bupivacaine. It has a similar anaesthetic property as Bupivacaine, but the cardiac and neurological toxicity is minimal [12-14].
This study was done to compare the effectively of levobupivacaine and ropivacaine as a supraclavicular brachial plexus block with regards to the onset, duration and quality of the sensory and the motor blockade in upper limb surgeries.

Materials and Methods

100 patients aged between 18-60 years with ASA I and ASA II undergoing bony surgeries in the upper limb was included in this study conducted by the Department of Anaesthesiology at Medi Citi Inistitute of Medical Sciences, Ghanpur-501401, and Telangana. The duration of this study was November 2020 to July 2021. After attaining the clearance of this study by the Institutional Ethical Committee, the nature of the study was explained to the patients and informed consent was taken. All the patients were undergoing different bone surgeries of the upper limb by the orthopedic department under supraclavicular brachial plexus block. All the patients were randomly allocated into one of the two groups (Group L and Group R) by the computer randomized numbers. Group L was given 30 ml of 0.5% Levobupivacaine and Group R was given 30 ml of 0.5% Ropivacaine. Patients with preexisting neuropathy, having infections at the side of blockade, pregnant women and those who refused to give informed consent were excluded from the study. Patients with cardiovascular, neurological, psychiatric conditions, pulmonary or renal conditions, patients with a chronic analgesic history and those undergoing anticoagulation therapy were also excluded from the study.
A day before the surgery, complete clinical examination was done and basic investigations such as complete blood picture, hemoglobin, random blood sugar, serum creatinine, blood urea, Bleeding time and Clotting time and Electrocardiogram (ECG) was done for all the patients. The patients were asked to fast overnight or at least for 8 hours prior to surgery. 10cm Visual Analog Scale, ranging from 0 for no pain, to 10 for worst pain was explained to all of them.
On the day of surgery, IV access was established by using 18G cannula on the non-operating hand. The baseline vitals like pulse rate, respiratory rate, blood pressure and oxygen saturation were taken and noted. All the patients were made to lie down supine with the head turned slightly away from the arm being given the block. 0.2 mg Inj. Glycopyrrolate, Ondansetron 4mg and Ranitidine 50 mg were all given IV. 10ml/kg Ringer lactate was started

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intravenously for 15 minutes. The supraclavicular brachial plexus block was given using perivascular subclavian approach. Since this was a double blinded study, neither the anaesthetist delivering the drug nor the patient knew the block being given. The injection was prepared by another anaesthesiologist.
The sensory blockade was assessed using the pin prick method every minute till the complete anaesthetic effect was received. The sensory block was graded as [15] (Table: 1)

Table 1: Grades of Sensory Block

Grade of Block	Symptoms
Grade 0	Normal sensation/Sharp pain felt
Grade 1	Dull pain or Blunted sensation
Grade 2	No pain feeling even after pin prick

The sensory block was assessed along the Radial Nerve, Medial Nerve, Ulnar Nerve and Musculocutaneous Nerve. Time to peak sensory block was Grade 2 in all the nerves. Duration of the sensory block was the reversal of sensation from Grade 2 to Grade 1.
The motor Block was assessed with the Modified Bromage Scale [16] (table: 2)

Table 2: Modified Bromage Scale

Scale	Symptoms
Grade 0	Full Flexion and Extension of elbow, wrists and fingers
Grade 1	Weakness in Grip
Grade 2	Unable to move fingers

The onset of motor block was considered between the time of injection and Grade 1 and peak motor block was the time on attainment of Grade 2. Duration of the motor block was the time from Grade 2 to the reversal to Grade 1.
The surgery was started after the complete sensory and motor block was attained. Every 5 minutes during the surgery till 15 minutes, the vital signs were noted and every 15 minutes thereafter.
Postoperatively the patients were examined at 30 minutes and at 60 minutes and every hourly thereafter till rescue analgesia was needed. The pain was analysed with the VAS score. When the VAS score was more than 4, rescue analgesic was given with Inj. Diclofenac Sodium 1.5mg/kg IM.
Onset of any complications like nausea or vomiting, excessive sedation, respiratory depression, hypotension, bradycardia, allergic reaction, hematoma, pneumothorax were monitored.
Statistical analysis was done using SOSS software and the data were tabulated. Comparisons were done using paired t test and p value < 0.05 were taken as significant.

Results

The total patients in each group were 50. The mean age of the patients in Group L was 41.82 ± 10.53 years and 40.66 ± 12.84 years in Group R. The number of males in Group L was 23 and in Group R were 26. Both the Groups had more number of patients with ASA I rather than ASA II, and the mean duration of surgery was 96.32 ± 18.45 minutes in Group l and 99.46 ± 16.39 minutes in Group R. There was no significant difference in any of the parameters between both the groups (Table: 3).

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Table 3: Demographic and Baseline parameters of the patients

Variable	Group L	Group R	P value
Total Number of patients	50	50	>0.05 (NS)
Mean age ± SD	41.82 ± 10.53	40.66 ± 12.84	>0.05 (NS)
Male: Females	23:27	26:24	>0.05 (NS)
Mean BMI (kg/m2)	23.85 ± 4.57	24.05 ± 5.26	>0.05 (NS)
ASA (1:2)	42:8	38:12	>0.05 (NS)
Mean Duration of surgery (in Minutes)	96.32 ± 18.45	99.46 ± 16.39	>0.05 (NS)
Base line HR (Beats/min	85.31 ± 6.38	86.27 ± 4.62	>0.05 (NS)
Base Systolic BP mmHg	124.72 ± 8.62	123.88 ± 5.85	>0.05 (NS)
Baseline Diastolic BP mmHg	71.35 ± 3.72	73.25 ± 6.37	>0.05 (NS)
Baseline SpO2	99 ± 0.4	98.9 ± 0.5	>0.05 (NS)

The onset of the sensory blockade was significantly lesser in Group L (4.51 ± 0.45 minutes) rather than Group R (5.95 ± 1.33 minutes) while there was no significant difference in the onset of the motor blockade (8.13 ± 2.46 minutes in Group L and 8.42 ± 2.51 minutes in Group R). The duration of the sensory blockage was significantly more in Group L (11.13 ± 2.11 hours) than Group R (9.04 ± 1.42 hours) while there was no difference in the duration of the motor blockade. The duration of analgesia was 11.43 ± 2.17 in Group L and 8.23 ± 1.72 hours in Group R, which was statistically significant. (Table: 4)

Table 4: Sensory and motor blockade details

Blockade characteristics	Group L	Group R	P value
Sensory Blockage onset (minutes)	4.51 ± 0.45	5.95 ± 1.33	<0.05
Motor Blockage onset (minutes)	8.13 ± 2.46	8.42 ± 2.51	>0.05
Duration of sensory blockade (Hours)	11.13 ± 2.11	9.04 ± 1.42	<0.05
Duration of Motor Blockade (Hours)	9.34 ± 0.57	8.92 ± 0.46	>0.05
Duration of analgesia (Hours)	11.43 ± 2.17	8.23 ± 1.72	<0.05

There was no significant difference in the heart rate of the two groups (Fig: 1)

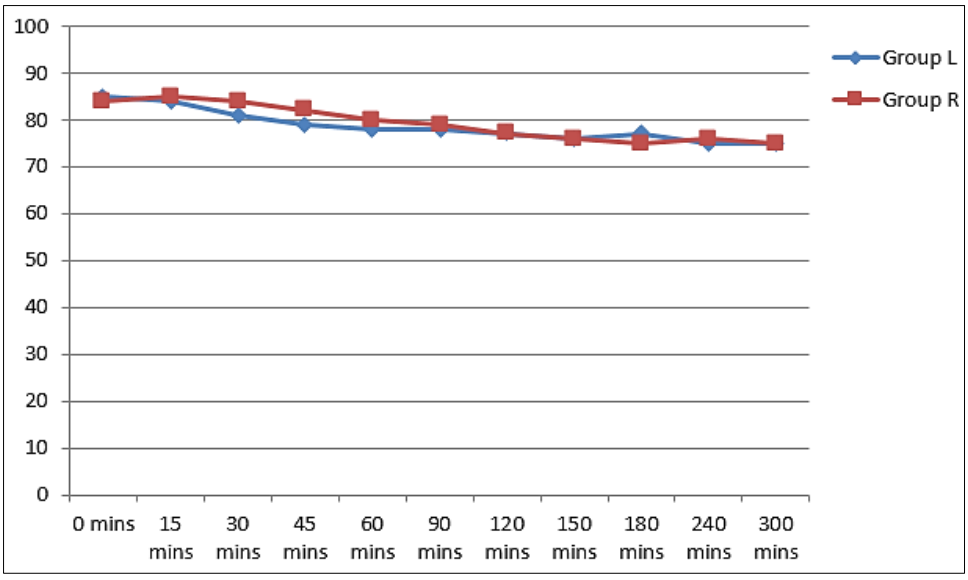

Fig 1: Mean heart rate among the two groups

The systolic and the diastolic blood pressure were comparable and constant throughout the surgery (Fig: 2)

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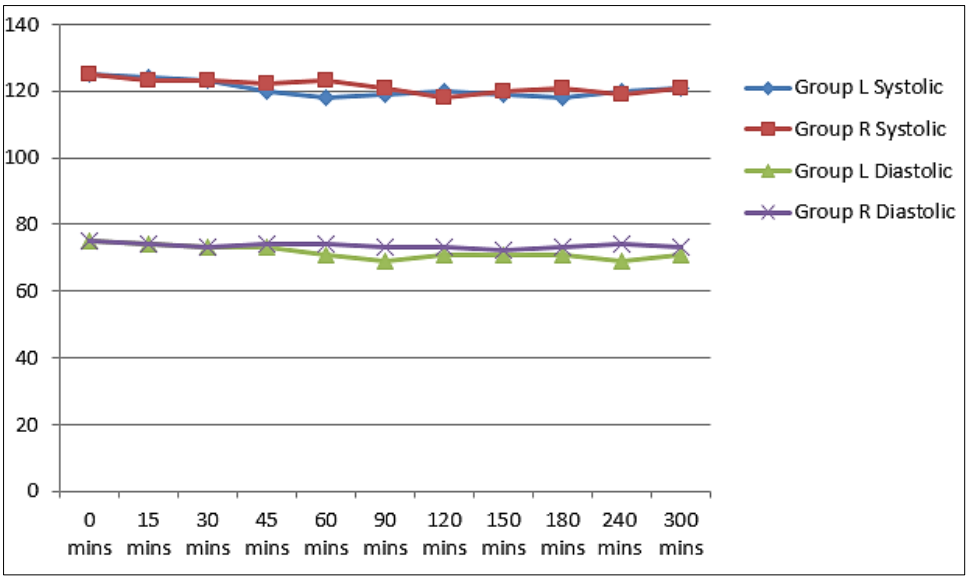

Fig 2: Systolic and diastolic blood pressure among the two groups

The VAS score was 0 among the patients of Group L for up to 5 hours in the Group R it was 0 for 2 hours. After 4 hours, the VAS was more than 4 in group R and around 11 hours for patients in Group L. Rescue analgesia was given after 12 hours in these patients and in the patients of Group L, it was given after 6 hours.

Discussion

The regional nerve blockade not only provides regional anaesthesia, but also postoperative analgesia after a limb surgery. Most of the drugs causing brachial plexus block have a better sympathetic block and postoperative analgesia with very few side effects compared to the general anaesthesia [17]. Bupivacaine, although a very effective drug for sensory blockade, is prone to cause fatal cardiac arrhythmias when used in a larger volume. Levobupivacaine and Ropivacaine, are nontoxic with very few side effects [18].

In the present study, there was no significant difference in the demographic details of the patients as well as the baseline vital signs. Similar was the case in another study by Rathore *et al*. [11] a study by Chauhan *et al*. also performed a similar study and also reported no significant difference between the demographic details of the patients. Even the baseline readings were comparable to our study [19].

The onset of the sensory blockade was significantly lesser in Group L rather than Group R, where it took a longer time. The duration of the anaesthesia was lesser longer the patients with Levobupivacaine rather than Ropivacaine. However, there was no difference in the motor blockade between the two groups. Another study by Chauhan observed a prolonged duration of analgesia in patients given levobupivacaine rather than those given ropivacaine, further strengthening our study [20]. In yet another study by Cline *et al*, the duration of levobupivacaine effect was longer than ropivacaine. The return of motor activity was also faster in the levobupivacaine rather than ropivacaine. Mankad *et al*. found no significant difference in the sensory blockade between the two groups, but in case of Motor Blockade, Ropivacaine had a faster onset compared to levobupivacaine [21]. But the peak time of sensory and motor blockade was significantly faster in ropivacaine group when compared to levobupivacaine group in this study [21]. Noulas *et al*. reported that Levobupivacaine and Ropivacaine both had similar mode and duration of action [19]. A study by Cho *et al*. also found a longer duration of the motor block in the patients with Levobupivacaine compared to the patients with Ropivaciane [22]. The slow onset of the Ropivacaine was attributed to the

lesser lipophilicity of the drug to levobupivacaine thereby slower penetration of the myelinated nerve fibers and the easy induction of vasoconstriction in the tissues around the injection site [23].

A study by Rathore *et al*. also found the sensory block to take a longer time among the patients administered Levobupivacaine compared to those administered Ropivacaine. The Duration of the sensory block was longer among the levobupivacaine group, corroborating our study [11]. In a study by Kaur *et al.*, the onset of the sensory blockage was 5 minutes in the Ropivacaine Group, the same was 20 minutes, while the onset of the motor blockage was lesser on the Ropivacaine group compared to the Bupivacaine Group [24]. A study by Chauhan reported a shorter onset time in the patients administered Bupivacaine rather than those administered levobupivacaine. In our study however, there was no significant difference in the onset of the motor blockade among the two groups [25].

In group L, The VAS score in our study was 0 for 5 hours, with the requirement of rescue of analgesia after 12 hours while in Group R, for 2 hours the VAS score 2 was 0 and rescue analgesia was needed after 6 hours itself. In a study by Chauhan *et al.*, the findings were similar, with VAS score 0 for 2 hours in patients with Ropivacaine and till 5 hours in patients with levobupivacaine. The rescue anaesthesia was given to patients in Group R after 6 hours while in group L it was considered after 9 hours [20].

In our study, there were no cases of complications. In a study by Casati *et al.*, Horners syndrome was observed in 1 patient while the same syndrome was seen in 7 patients in a study by Altintas *et al*. [26, 27]

In studies with varying dosage of the drugs, a higher dose of levobupivacaine had a faster onset with longer duration and less complications [28]. Future studies can concentrate on the evaluation of this aspect. Limitations of this study was the inclusion of only ASA Grade I and II patients. If Grade II and IV patient could also be involved, the assessment of the efficacy of these two drugs as anesthetic and analgesic agents would have a better conclusion.

Conclusion

There is a faster onset of sensory block, longer durations of anaesthesia and analgesia in the patients administered Levobupivacaine rather than those with ropivacaine. Since it has minimum or no side effects, the number of hospital days and cost is reduced. Thus, Levobupivacaine can be used as a preferred drug for supraclavicular brachial plexus block for surgeries involving upper limb

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