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Original Research Article

A Clinical Comparative Study Between Levobupivacaine and Ropivacaine by Neurostimulation Guided Supraclavicular Brachial Plexus Block for Upper Limb Surgeries

Preeti More[1], Shubhangi Omase[2]

[1]Professor, Anaesthesiology, K. J. Somaiya Medical College & Research Centre, Mumbai, Maharashtra, India.

[2]Ex Student, ESI- PGIMSR & Model Hospital, Andheri, Mumbai, Maharashtra, India.

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Corresponding author: Dr. Preeti More

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Abstract

Introduction: Brachial plexus blockade is a time tested technique for upper limb surgeries. Supraclavicular approach with peripheral nerve stimulator using local anaesthetics for brachial plexus block is most suitable for upper limb surgeries and post-operative analgesia. A combination of local anaesthetics is used to increase the onset of duration and also prolong the duration of action of the block, most commonly used combination being lignocaine with bupivacaine. This clinical study was to compare the onset, duration, quality of sensory and motor blockade and postoperative analgesia between groups of patients receiving supraclavicular brachial plexus block with 0.5% ropivacaine or 0.5% levobupivacaine with 1% lignocaine under neurostimulation guidance using a peripheral nerve stimulator

Methods and Materials: For this prospective study, 60 patients of both sexes ASA I/II were enrolled and divided into two groups, and supraclavicular brachial plexus block was performed using levobupivacaine 0.5% with 1% lignocaine and ropivacaine 0.5% with 1% lignocaine using peripheral nerve stimulation. The onset of sensory and motor block, their duration of action and postoperative analgesia were recorded.

Results: No statistically significant difference was observed in the onset of sensory block in both the groups. Onset of motor blockade was significantly faster with ropivacaine (9.50 ± 2.403 min) as compared to levobupivacaine (12.33 ± 2.537 min; $P < 0.05$). Duration of sensory and motor block was significantly short for ropivacaine than levobupivacaine ($P < 0.05$). Levobupivacaine has significantly longer duration of analgesia (12.56 ± 1.30 h) as compared to ropivacaine (9.93 ± 1.7 h; $P < 0.05$).

Conclusions: Levobupivacaine, a novel long-acting local anesthetic agent, has a better profile in terms of duration of analgesia, with a delayed wearing off of the motor blockade thus offers an alternative to ropivacaine for brachial plexus block in upper limb surgeries

Keywords: Supraclavicular brachial plexus block, Levobupivacaine, Ropivacaine.

Introduction

Brachial plexus block is the most commonly practiced peripheral nerve block. Brachial plexus block provides very good intraoperative anaesthesia as well as postoperative analgesia without any systemic side effects.[1]

Among the various approaches of brachial plexus block, supraclavicular approach is considered easiest and most effective. The

classical approach using paraesthesia technique is a blind technique and may be associated with higher failure rate and injury to the nerves and surrounding structures [2] To avoid some of these problems use of peripheral nerve stimulator was started which allowed better localization of the nerve/plexus[3] and with the use of neurostimulation guidance technique, its success rate has increased over the years. Ultrasonography guidance is being used nowadays but due to limited availability of the USG machine at our institute we used peripheral nerve stimulator guided supraclavicular brachial plexus block. Many local anaesthetics are being used (e.g. lignocaine, bupivacaine, levobupivacaine, ropivacaine) in brachial plexus block. Bupivacaine, a racemic mixture of the two stereo enantiomers dextrobupivacaine and levobupivacaine, frequently is used as the local anesthetic for brachial plexus anesthesia because it offers the advantage of providing a long duration of action and a favourable ratio of sensory to motor neural block.[4] However, with clinical use, it was noted that using this racemic mixture of bupivacaine resulted in cardiac and central nervous system toxic effects in some patients,[5] which were attributed to the dextro bupivacaine enantiomer.[6] This prompted researchers to develop new local anesthetic agents with a profile that contained all of the desirable aspects of bupivacaine without the undesirable toxic effects. One of the first local anesthetic agents that emerged as a possible replacement for bupivacaine was ropivacaine.

Numerous comparative studies between ropivacaine and bupivacaine suggested that ropivacaine produced less cardiac and central nervous system toxic effects, less motor block, and a similar duration of action of sensory analgesia.[7-12] This favourable clinical profile prompted many clinicians to switch from bupivacaine to ropivacaine for all types of neural blockade. However, with clinical use, it was discovered that ropivacaine's latency of sensory analgesia was approximately two thirds that of bupivacaine; therefore, it was not as effective in promoting prolonged postoperative analgesia.[8]

Materials and Methods

With Ethical Committee approval and written informed consent, a prospective, randomized, double blind and comparative study was planned among 80 patients (2 groups of 40 each) American Society of Anesthesiologists (ASA) Grade I and II, in the age group of 18-70 years, posted for elective upper limb surgeries under brachial plexus block using supraclavicular approach with peripheral nerve stimulation. Exclusion criteria included, history of bleeding disorders, local infection at the site of block, documented neuromuscular disorders, obstructive and restrictive respiratory diseases, known allergy to local anaesthetic drugs and patients who did not consent

Eighty patients were divided into two groups of forty each.

Group L: Patients received 0.5% levobupivacaine (20ml) + 1% lignocaine (10ml)

Group R: Patients received 0.5% ropivacaine (20ml) +1% lignocaine (10ml)

Random sampling using a computer generated table of random numbers was prepared allotting equal number of patients in each group. Patients were explained the procedure and were informed about paraesthesia and the motor twitch of muscles produced by nerve stimulator. Visual Analogue scale was also explained for pain assessment. Proper pre anaesthetic checkup with clinical examination and adequate investigations done, informed consent taken, starvation confirmed. In the operation theatre, IV line was secured, monitors attached [ECG, SpO2 and NIBP] followed by recording of vital parameters. Heart rate [HR], non- invasive arterial

systolic blood pressure [SBP], diastolic blood pressure [DBP], mean arterial pressure [MAP], peripheral oxygen saturation(SpO2), respiratory rate(RR) was recorded. Pre-medication with IV inj. glycopyrrolate 0.004mg/kg IV, inj. ondansetron 0.1mg/kg IV, inj. midazolam 0.03-0.05mg/kg was given

Procedure

Supraclavicular block was given using a 22 gauge, 5cm stimuplex needle attached to peripheral nerve stimulator (stimuplex, B Braun) after identification of the anatomical landmarks and elicitation of muscle twitches. The location end point was a distal motor response, that is, the movement of the fingers and the thumb with an output current of 0.5 mA, when the drug was injected. The study drug solutions were prepared and recorded by senior anaesthetist who was not involved in the study. During injection of the drug solution, negative aspiration done every 5 ml to avoid intravascular injection. Plexus block was considered successful when at least two out of the four nerve territories (ulnar, radial, median, and musculocutaneous) were effectively blocked for both sensory and motor block.

Sensory block (four nerve territories) was assessed by pin prick test using a 3-point scale

Grade 0: normal sensation

Grade 1: loss of sensation of pin prick (analgesia)

Grade 2: loss of sensation of touch (anaesthesia).

Motor block was determined by thumb abduction (radial nerve), thumb adduction (ulnar nerve), thumb opposition (median nerve), and flexion of elbow (Musculocutaneous nerve) according to the modified Bromage scale using a 3-point scale;

Grade 0: Normal motor function with full flexion and extension of elbow, wrist, and fingers

Grade 1: Decreased motor strength with ability to move the fingers only

Grade 2: Complete motor block with inability to move the fingers

Both sensory and motor blocks assessed after the completion of injection every three minutes from their onset and then at an interval of 15, 30, 45, 60, 90 and 120 mins; and then hourly postoperatively, till complete regression of the block by noting the pain, relaxation and patient comfort during the surgery and postoperative pain relief

Assessment of complete recovery of both sensory and motor blockade was done for at least 12 hours post operatively.

The onset of sensory and motor blockade were noted.

All patients received oxygen (O2) through Hudson's mask at the rate five to six litres/min throughout the procedure and postoperatively in PACU. They were monitored with continuous pulse rate, systolic blood pressure, diastolic blood pressure, ECG, SPO2, respiratory rate every 15 mins intraoperatively till the end of surgery

Following completion of surgery, the patients were monitored to assess the quality and duration of post-operative analgesia. Thus, the patients were asked to classify analgesia as no pain, mild pain, moderate pain or severe pain every hour for the first 6 hours and then again at 8, 10 & 12hrs. At the time of each subsequent assessment, patients were observed and/or questioned about any subjective and/or objective side effects (nausea, vomiting or respiratory depression) and other complications

If supplementation with IV analgesics or general anaesthesia was required due to inadequate/ partial block or failure of

block, these patients were not included in the study.

At the end of the study, decoding of patients was done and the following data were analysed for comparing the two groups. Demographic data like distribution of age in years, sex, weight (kgs) and ASA grading, onset of sensory and motor level of block, duration of sensory and motor level of block and postoperative analgesia. Haemodynamic changes in the form of pulse rate, blood pressure, respiratory rate and oxygen saturation (spo2) in two groups were noted. Comparison between the two groups was done with all values expressed as the mean ± standard deviation (SD) or numbers and percentages. A p value of < 0.05 was considered statistically significant. Results were statistically analysed using the chi-square test and Fischer exact test. Non parametric values were analysed using student t test

Results

This prospective, randomized, comparative study was conducted on 80 patients aged between 18-70 years posted for upper limb surgeries. Patients are divided into two groups to compare the effects levobupivacaine+ lignocaine(Group L) and ropivacaine + lignocaine(Group R) combinations for supraclavicular brachial plexus block in terms of onset, duration of sensory and motor blockade respectively, postoperative analgesia, haemodynamic parameters (PR, RR,SBP, DBP) and complications. Group L: Patients receiving 0.5% levobupivacaine (20ml) + 1% lignocaine (10ml). Group R: Patients receiving 0.5% ropivacaine(20ml) + 1% lignocaine (10ml). Observations were made in terms of demographic data, ASA grading, onset of sensory and motor blockade, duration of sensory and motor blockade and haemodynamic parameters (HR, BP, RR) The demographic data (age, gender, weight, ASA status) were comparable in both the groups and there was no statistically significant difference between them ($p>0.05$) Table 1 & 2.

Table 1: Comparison of age and weight distribution between the two groups

Group		WGT (kg)	AGE (yrs)
L	Minimum	50	18
	Maximum	86	66
	Mean	64.40	38.98
	Std. Deviation	9.922	14.375
R	Minimum	50	18
	Maximum	89	64
	Mean	65.55	38.93
	Std. Deviation	10.046	12.350
P Value		0.608	0.987

ASA Grade Distribution In Two Groups

Table 2: ASA grade distribution

Group	ASA	Frequency	Percent (%)
L	I	26	65.0
	II	14	35.0
	Total	40	100.0
R	I	29	72.5
	II	11	27.5
	Total	40	100.0

Sensory Block Onset:

The mean time of onset of sensory blockade in group L was 6.0 ± 1.013 min. In group R it was 7.55.03±0.986 min. There is significantly delayed onset of sensory blockade in group R which is statistically significant (p value <0.05) Table 3, fig 1

Table 3: Onset of sensory blockade in the two groups

	Onset of sensory blockade (mins)		
Group	**Mean**	**Std. Deviation**	**Std. Error Mean**
L	6.00	1.013	0.160
R	7.55	0.986	0.156
P Value	0.000		

Motor Block Onset:

The mean time of onset of motor blockade in group L was 9.23 ± 0.920 mins. In group R it was 11.25±1.296 mins. There is significantly delayed onset of motor blockade in group R which is statistically significant (p value <0.05) Table 4, fig 1

Table 4: Onset of motor blockade in the two groups

	Onset of motor blockade (mins)		
Group	**Mean**	**Std. Deviation**	**Std. Error Mean**
L	9.23	0.920	0.145
R	11.25	1.296	0.205
P Value	0.000		

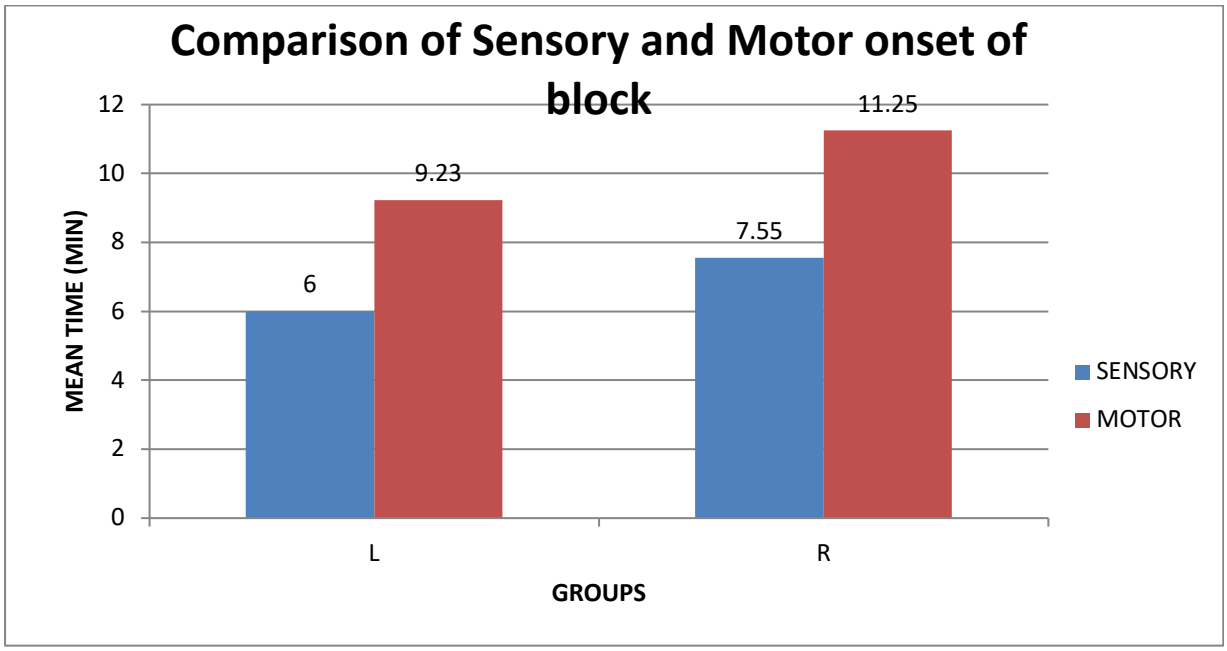

Figure 1: Diagram of Onset of sensory and motor block in two groups

Sensory Block Duration:

In group, L the mean duration of sensory blockade was 778.25 ± 38.986 mins and in group R 667.63 ± 35.246 mins. The duration of sensory blockade was shorter in group R when compared to group L, which is statistically significant (p value <0.05) Table 5, fig 2

Table 5: Duration of sensory blockade in the two groups

	Duration of sensory blockade (min)		
Group	**Mean**	**Std. Deviation**	**Std. Error Mean**
L	778.25	38.986	6.164
R	667.63	35.246	5.573
P value	0.000		

Motor Block Duration: In group, L the mean duration of motor blockade was 683.13±34.524 min whereas in group R it was 494.50±35.133 min. The duration of motor blockade was shorter in group R when compared to group L & it was statistically significant. (p value <0.05) Table 6, fig 2

Table 6: Duration of motor blockade in the two groups

	Duration of motor blockade (mins)		
Group	**Mean**	**Std. Deviation**	**Std. Error Mean**
L	683.13	34.524	5.459
R	494.50	35.133	5.555
P Value	0.000		

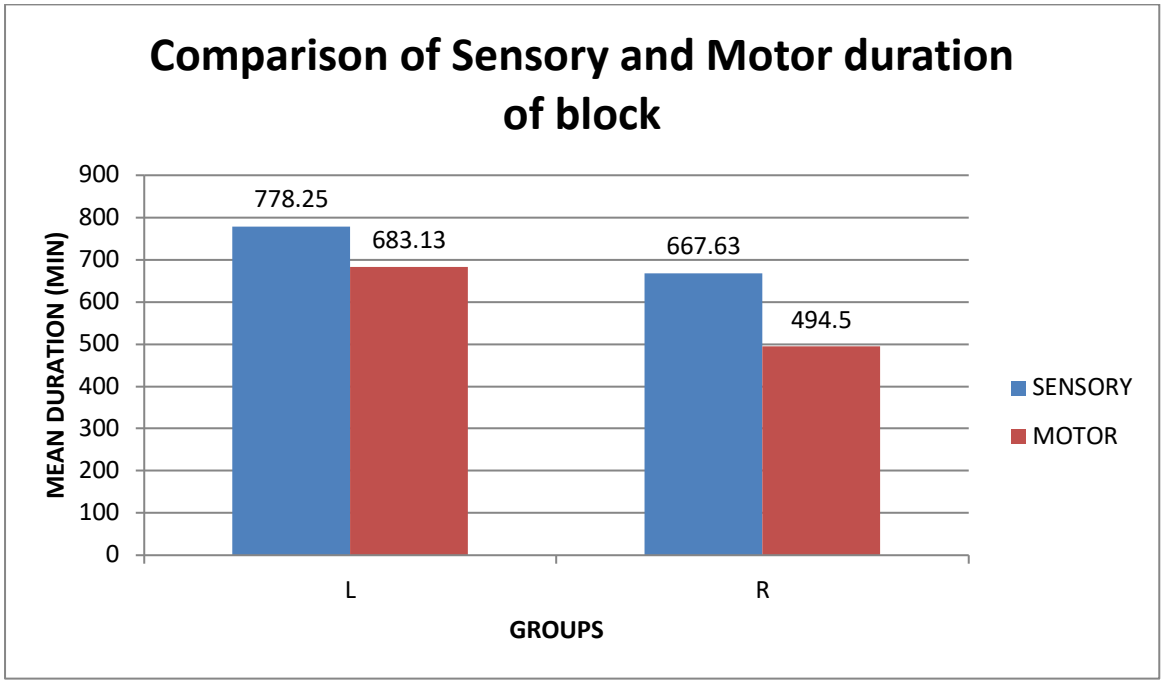

Figure 2: Diagram of Average duration of sensory and motor block

Haemodynamic Parameters:

Effects on haemodynamic parameters including pulse rate, respiratory rate, systolic BP (SBP), diastolic BP (DBP) monitored at 0,3,6,9,12,15,30,45,60,90 and 120 minutes showed no overall significant changes among both groups.

Mean pulse rate decreased in both groups after 15 minutes, but no significantly over all differences in two group. Pulse rate decreases in group L from base value 84.53 ± 11.834 to 72.68 ±9.507 and in group R from 82.10 ± 8.952 to 67.15 ±10.299 (p=0.000) There is no significant drop in systolic and diastolic BP & no statistically significant difference in both groups. There is no incidence of hypotension in both groups.

Both the groups were comparable for respiratory rate and SpO2 at each interval, and the results were statistically insignificant. Both group patients achieved sedation score of 2 (cooperative, oriented and tranquil).

Discussion

In this prospective, randomized , double blind study, we compared the effects and efficacy between levobupivacaine(0.5%) + lignocaine(1%) and ropivacaine (0.5%) + lignocaine(1%), in supraclavicular brachial plexus blocks under PNS guidance for patients undergoing upper limb surgeries with respect to onset and duration of sensory and motor blockade and duration of postoperative analgesia.

Brachial plexus block is an easy and relatively safe procedure for upper limb surgeries. Supraclavicular approach to brachial plexus block is associated with rapid onset and reliable anaesthesia[13,14] It is widely used in our practice for elective forearm and hand surgeries. It provides good intra-operative anaesthesia and post-operative analgesia. Many local anaesthetic drugs are used for brachial plexus block.[4] The commonly, used local anaesthetic drugs are lignocaine and bupivacaine. Racemic mixture of bupivacaine causes cardiac and central nervous system toxic effects in some patients,[5] which were attributed to the dextrobupivacaine enantiomer[6] so ropivacaine and levobupivacaine, the S (-) enantiomers are being routinely used for brachial plexus block because of lesser toxicity and similar action profile as bupivacaine[7,15]

A study by Casati A, et al.[8] in which they clinically compared ropivacaine 0.75%, ropivacaine 1% or bupivacaine 0.5% for interscalene brachial plexus anaesthesia and concluded that ropivacaine had less cardiac and central nervous system toxic effects, less motor block, and a similar duration of action of sensory analgesia as bupivacaine. Another study by Cox CR, et al,[16] compared S (–) bupivacaine with racemic (R)-bupivacaine in supraclavicular brachial plexus block and concluded that S (-) enantiomer had significantly less cardiac and neural toxic effects than bupivacaine with similar action profile.

Piangatelli et al[17] showed a faster onset of infraclavicular brachial plexus block with 0.5% levobupivacaine than with 0.5% ropivacaine.

Cline et al[18] compared 0.5% levobupivacaine and 0.5% ropivacaine in combination with 1:200,000 epinephrine for axillary brachial plexus block, and found that sensory analgesia was significantly longer with levobupivacaine than with ropivacaine, but ropivacaine patients showed a faster recovery of motor function, while several different studies compared the use of levobupivacaine for sciatic nerve block for foot surgery with bupivacaine, ropivacaine, and levobupivacaine at concentrations ranging between 0.5% and 0.75% showing a substantially similar clinical profile at 0.5% concentrations; while the use of 0.75% levobupivacaine provided a shorter onset time and longer duration of postoperative analgesia than the same volume of 0.75% ropivacaine, also reducing total consumption of rescue tramadol during the first 24 hour. Piangatelli et al[19] compared the clinical profile of psoas compartment and sciatic nerve blocks performed with either 0.5% levobupivacaine or 0.75% ropivacaine in patients undergoing lower extremity surgery, and found that levobupivacaine showed a faster onset time with a larger differentiation between the duration of sensory and motor blocks than ropivacaine, resulting in less rescue analgesia request postoperatively.

Another, comparative study by Dr. V.Sai Dilip, et al[20] titled supraclavicular block with 0.5% levobupivacaine and 0.5% ropivacaine, where they concluded that the onset of sensory and motor blockade was

earlier with levobupivacaine when compared to ropivacaine and the duration of sensory and motor blockade was longer in levobupivacaine than ropivacaine

Prerana p.mankad et al[21] studied comparison of ropivacaine with levobupivacaine in supraclavicular brachial plexus block and found that sensory onset time was almost similar in both the groups with P> 0.05, which was not significant while motor onset blockade time was longer in levobupivacaine group compared with ropivacaine with p<005 which was statistically significant

In our study, we investigated the effect of levobupivacaine + lignocaine and ropivacaine + lignocaine combination for supraclavicular brachial plexus block. Our primary end points were the onset time and duration of motor and sensory blocks, haemodynamic parameters and postoperative analgesia. Results, showed that the onset of sensory and motor blockade in Levobupivacaine (L) group was earlier when compared to Ropivacaine (R) group. The mean onset of sensory and motor blockade in group L was 6.0 and 9.23 mins, group R was 7.55 and 11.25 minutes respectively(p<0.05)which was statistically significant

The duration of sensory and motor blockade was significantly increased (p<0.05) in Levobupivacaine (L) group compared to Ropivacaine (R) group. The mean duration of sensory and motor blockade in L group was 778.25 and 683.13 minutes respectively and in R group was 667.63 and 494.50 minutes respectively

The hemodynamic parameters like pulse rate, systolic blood pressure and diastolic blood pressure recorded at regular intervals showed no statistically significant changes in both the groups. Post-operative analgesia, which was a continuation of the sensory block after surgery was adequate in both the groups and patients were comfortable and did not complain of pain. Rescue analgesia was required post-operatively after 10 to 12 hours in ropivacaine group and after 12 to 14 hours in levobupivacaine group.

Conclusion

Newer local anaesthetic drugs like levobupivacaine and ropivacaine are increasingly used in brachial plexus blocks, due to their safety, efficacy, potency and lesser toxicity. In our study, we compared the effects of levobupivacaine with lignocaine and ropivacaine with lignocaine for supraclavicular brachial plexus block under peripheral nerve stimulation guidance for upper limb surgeries. From our study, we conclude that due to faster onset of sensory and motor blockade and prolonged duration of post-operative analgesia with stable hemodynamic parameters and no significant complications, makes levobupivacaine a good drug of choice for supraclavicular brachial plexus block.

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