**ORIGINAL RESEARCH**

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

[1]Dr. Shilpa Agarwal, [2]Dr. Manbahadur Rajpoot[3]Dr. Neeti Agrawal

[1]Assistant Professor, Department of Anaesthesiology, SRVS Medical College, Shivpuri,Madhya Pradesh, India
[2]Assistant Professor, Department of Community Medicine, SRVS Medical College, Shivpuri,Madhya Pradesh, India
[3]Assistant Professor, Department of Surgery, SRVS Medical College, Shivpuri,Madhya Pradesh, India

**Corresponding Author**
Dr. Neeti Agarwal
Assistant Professor, Department of Surgery, SRVS Medical College, Shivpuri,Madhya Pradesh, India
**Email:** neetia2@gmail.com

Received: 10 February, 2023 Accepted: 15 March, 2023

## ABSTRACT

**Background:** Brachial plexus block is the commonest form of regional anaesthesia being used for upper limb surgeries Bupivacaine and Ropivacaine have been extensively studied & their properties with respect to onset, duration and quality of block.**Aim:** The aim of this study was to compare of onset, duration of sensory-motor block and any adverse effects between 0.5% Bupivacaine and 0.5% Ropivacaine in brachial plexus block **Materials & Methods:**A total of 80 patients were enrolled and randomized into two groups. Group I with 40 patients was given 30mL of 0.5% bupivacaine and Group II with 40 patients were given 30 mL of 0.5%, Ropivacaine drugs were used for giving supraclavicular brachial plexus block. Parameters assessed were onset and duration of sensory and motor block, duration of analgesia, and any adverse events other parameters were assessed. **Results:** The onset of blockade, both & motor was earlier in Bupivacaine as compared to Ropivacaine group. Mean duration of blockade, both sensory & motor and duration of post-operative analgesia was more in the Bupivacaine group. Adverse events and hemodynamic status was same in both the groups. **Conclusions:** Ropivacaine was less effective than bupivacaine, regarding onset of blockade, duration of blockade and postoperatively duration of analgesia No significant adverse effects were noted in these two groups.

**Key words:**Bupivacaine, ropivacaine, sensory block, motor block, brachial plexus block



## INTRODUCTION

Regional anesthesia provides site specific, effective, long lasting anesthesia. 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 nausea, thereby resulting in a lesser hospital days [1-2].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 [3-4].Bupivacaine is frequently used as the local anaesthetic for brachial plexus anaesthesia because it offers the advantage of providing a long duration of action and a favorable ratio of sensory to motor neural block [5-6].Bupivacaine has been associated with cardiac toxicity when used in high concentration or when accidently administered intravenously,which was due to dextro-bupivacaine enantiomer [7-8].Ropivacaine is a new long acting amino-amide local anaesthetic agent. It is a monohydrate of the hydrochloride salt of 1-propyl-2',6'pipecoloxylidide& is prepared as a pure s-enantiomer. It differs from bupivacaine in substitution of propyl for butyl group on the piperidine group. Such changes in molecular formulation hoped that ropivacaine would modulate potential cardio toxic effect and also improves sensory & motor block profiles [9]. Ropivacaine and Levobupivacaine are propyl homologues of Bupivacaine. They have low lipid solubility, short elimination half time, higher

plasma clearance, lesser affinity to cardiac tissues than parent drug Bupivacaine. Levobupivacaine is also a safe and effective local anaesthetic drug for spinal and epidural anaesthesia [10].This type of block mainly avoids the untoward effects of general anaesthesia like the upper airway instrumentation and mainly helps in achieving ideal operating conditions by producing muscular relaxation, maintaining stable intraoperative hemodynamic condition and sympathetic block which reduces postoperative pain, vasospasm and edema, analgesia and shortened hospital stay and reduced side effects [11].Successful regional anaesthesia depends on accurate deposition of local anaesthetic around nerves. Previous techniques like eliciting paraesthesia or peripheral nerve stimulator were dependent on surface landmarks for accurate drug deposition [12].

**AIMS & OBJECTIVES**: This study was done to compare the effectively of bupivacaine 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.

## MATERIAL AND METHODS

This prospective study was carried out in Department of Anaesthesiology and Critical Care of a tertiary care hospital, central India, over a period of 18 months. All the subjects undergoing surgery for upper extremity using brachial plexus block and fulfilling the following inclusion criteria were included in the study.

### INCLUSION CRITERIA

- Patients aged between 18-60 years.
- Scheduled for elective surgery under brachial plexus block.
- No history of allergy or sensitivity to any of the studied local anaesthetics.
- Given written inform consent for the study.
- ASA grade1 and 2 physical status.

### EXCLUSION CRITERIA

- Previous nerve deformity or brachial plexus injury.
- Hypersensitivity to amide local anesthetics.
- Local infections.
- Coagulopathies & uncooperative or unwilling patient.

Demographic details, examination findings, laboratory and radiological investigations were noted. Pre anaesthetic evaluation and fitness done, Fit patients were kept nil per orally for 6 hrs before the scheduled surgery. The nature of study was explained to the patient and his attendants in their own language and written informed consent was obtained from the patient for participation in present study. A total of 80 patients were randomly allocated to one of the two groups (40 in each group).

**Group I:** (N=40) Patients proposed to undergo upper limb surgery under brachial plexus block using 30 ml of 0.5% bupivacaine.

**Group II:** (N=40) Patients proposed to undergo upper limb surgery under brachial plexus block using 30 ml of 0.5% ropivacaine.

Under all strict aseptic precautions, patients were given USG guided Supraclavicular brachial plexus block with any one of the study drugs.

**STATISTICAL ANALYSIS**: The collected data entry was done in Microsoft Excel and analyzed using SPSS software version 22. Descriptive statistics were represented with percentages; Mean with SD depends on nature of the data. $p \leq 0.05$ was considered as statistically significant.

## RESULTS

A total of 80 patients were enrolled in the present study, each were randomly allocated into group I and group II (40 patients in each group). Group I peoples using bupivacaine and group II using ropivacaine. General demographic characteristics such as age, gender, BMI, ASA status and duration of surgery were comparable in both the groups, there is no statistically significant difference was found in below mentioned variables in both the group ($p>0.05$) [Table:1].

**Table 1: Demographic distribution of study subjects**

| Variable | Group I (N=40) | Group II (N=40) | Total | P-Value |
|---|---|---|---|---|
| Gender | | | | |
| Male | 23 | 25 | 48 | 0.648 |
| Female | 17 | 15 | 42 | |
| ASA grade | | | | |
| Grade I | 26 | 24 | 50 | 0.644 |
| Grade II | 14 | 16 | 30 | |
| Mean age ± SD (years) | 35.62±10.59 | 34.41±9.14 | | 0.583 |
| Mean BMI (kg/m2) | 24.15 ± 4.28 | 25.02 ± 5.13 | | 0.412 |
| Mean Duration of surgery (Min) | 93.30 ± 19.45 | 95.48 ± 24.39 | | 0.659 |

The onset of the sensory blockade was significantly lesser in Group I (4.71 ± 0.37 minutes) rather than Group II (5.92 ± 1.28 minutes) while there was no significant difference in the onset of the motor blockade (8.04 ± 1.75 minutes in Group I and 8.22 ± 2.31 minutes in Group II). The duration of the sensory blockage was significantly more in Group I (12.13 ± 2.10 hours) than Group R (9.14 ± 1.44 hours) and also significant difference in the duration of the motor blockade ($p<0.05$). The duration of analgesia was 11.40 ± 2.07 in Group I and 9.55 ± 1.79 hours in Group II, which was statistically significant. (Table: 2)

**Table 2: Comparison of Sensory and motor blockade in both the groups**

| Blockade characteristics | Group I | Group II | P value |
|---|---|---|---|
| Sensory Blockage onset (minutes) | 4.71 ± 0.37 | 5.92 ± 1.28 | < 0.05 |
| Motor Blockage onset (minutes) | 8.04 ± 1.75 | 8.22 ± 2.31 | 0.434 |
| Duration of sensory blockade (Hours) | 12.13 ± 2.10 | 9.14 ± 1.44 | < 0.05 |
| Duration of Motor Blockade (Hours) | 8.34 ± 0.53 | 8.92 ± 0.44 | < 0.05 |
| Duration of analgesia (Hours) | 11.40 ± 2.07 | 9.55 ± 1.79 | < 0.05 |

**Table 3: Adverse Effects in both groups of study participant**

| Adverse Effects | Group I (N=40) | Group II (N=40) |
|---|---|---|
| Hematoma | 3 | 2 |
| Pneumothorax | 0 | 0 |
| Phrenic nerve block | 0 | 0 |
| Nausea and Vomiting | 3 | 2 |
| LA toxicity | 0 | 0 |
| Postoperative paresthesias | 0 | 0 |
| Bruising | 2 | 1 |

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

## DISCUSSION

Peripheral nerve blocks have become important in clinical practice because of their role in post-operative pain relief and shortening outpatient recovery. Axillary brachial plexus block is one of the most widely used regional anesthesia technique for upper limb surgeries. It offers many advantages over general anesthesia [13].

Both the groups were comparable with respect to age, gender, BMI, ASA physical status, and duration of surgery, in the present study; there was no significant difference in the above mentioned demographic details of the patients. Similar results was found in another study by Rathore*et al.* [14], Chauhan *et al.*[15] and Sirisha T, *et al.* [16].

In our study, we found that the onset of sensory block was earlier in bupivacaine group and statistically significant ($p<0.05$) than that in ropivacaine group which was concordance with the Kim *et al.* [17] and Bangera A *et al.* [18].

Onset of motor blockade was slightly earlier in group I then group II, but statistically not significant ($p>0.05$), accordance to the Cline *et al.*[19] and Noulas N*et al.* [20]. This may be due to the fact that in the present study peripheral nerve stimulator guidance was used, which enabled targeted drug delivery and hence, the difference in the results.

In current study the duration of sensory block was greater in bupivacaine group as compared to ropivacaine group, which was statistically significant ($p<0.05$), our finding consistent with the Kaur *et al.* [21], Sejpal NN *et al.* [22] and Tripathi*et al.*[23].

Present study observed longer duration of motor block in bupivacaine group as compared to ropivacaine group, our finding was comparable with the Akansha*et al.* [24] and Wasim*et al.* [25].

These differences may be accounted to the fact that in our study, accurate needle localization was determined by motor response to a nerve stimulator compared with elicitation of paraesthesia, as used in other studies.

Postoperative analgesia was prolonged with bupivacaine as compare to the analgesic effect of ropivacaine in supraclavicular brachial plexus block, similar finding also reported by Barsagade M *et al.* [26] and Anupreet*et al.* [27].

There were no significant differences between ropivacaine and bupivacaine group regarding hemodynamic and adverse effects such as nausea, vomiting, haematoma formation and bruising, concordance to the Anita Kumari*et al.* [28] and Priyanshu*et al.* [29].

In present study, no difference in VAS scores between two groups was observed at any post-operative time interval. Similarly, no significant difference between two groups was observed by Thornton *et al.* [30] and Mageswaran[31].

## CONCLUSION

Both ropivacaine and bupivacaine were equally effective for brachial plexus block in patients undergoing upper limb surgeries. However, Ropivacaine is more effective in terms of early onset of sensory and motor block, better quality of anaesthesia intraoperative and analgesia postoperatively as evident by lesser use of number of top ups postoperatively without any side effects. Due to its better cardiotoxic profile, it has also an important edge over bupivacaine for its use in brachial plexuses and other regional blocks where the potential for intravascular injection exists.

**CONFLICTS OF INTEREST:**None.

**SOURCE OF FUNDING:**None.

## REFERENCES

1. McCartney CJ, Brull R, Chan VW, Katz J, Abbas S, Graham B, *et al*. Early but no long-term benefit of regional compared with general anesthesia for ambulatory hand surgery. Anesthesiology. 2004;101:461-7.
2. Kumar S, Palaria U, Sinha AK, Punera DC, Pandey V. Comparative evaluation of ropivacaine and ropivacaine with dexamethasone in supraclavicular brachial plexus block for postoperative analgesia. Anesth Essays Res. 2014;8:202-08.
3. Atkinson RS, Rushman GB, Lee JA. A synopsis of anaesthesia. 10th edn. Bristol: Wright; c1987. p. 618.
4. Esmaoglu A, Yegenoglu F, Akin A, Turk CY. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. Anesth. Analg. 2010;111:1548-51.
5. Jong RD. Local anesthetic pharmacology. In: Brown DL, editor. Regional Anesthesia and Analgesia. Philadelphia: PA: Saunders; c1996. p. 124-42
6. Chin KJ,AlakkadH,AdhikarySD, Singh M. Infraclavicular brachial plexus block for regional anaesthesia of the lower arm. Cochrane Database Syst. Rev. 2013;28:CD00-5487. https://doi.org/10.1002/14651858.CD005487.pub 3.
7. Simonetti MPB, Batista RA, Ferreira FMC. Estereoisomeria: Ainterface da tecnologia industrial de medicamentos e da racionalizaçãoterapêutica. Rev Bras Anestesiol. 1999;48:390-99.
8. Jarboo K, Batra YK, Panda NB. Brachial plexus block with midazolam and bupivacaine improves analgesia. Can J Anaesth. 2005;52:822-6.
9. Bertini L, Tagariello V, Mancini S, Ciasehi A, Posteraro CM. 0.75% and 0.5% ropivacaine for axillary brachial plexus block: A clinical comparison with 0.5% bupivacaine. Reg. Anesth. Pain Med.1999;24:514-8.
10. Brull R, Wijayatilake DS, Perlas A, *et al*. Practice patterns related to block selection, nerve localization and risk disclosure: a survey of the American Society of regional Anesthesia and Pain Medicine. Reg. Anesth. Pain Med. 2008;33:395-403.
11. Liu SS, Strodtbeck WM, Richman JM, Wu CL. A comparison of regional versus general anesthesia for ambulatory anesthesia: a meta-analysis of randomized controlled trials. AnesthAnalg. 2005 Dec;101(6):1634-42.
12. Gohiya S, Gohiya V. A Comparative study of efficacy of fentanyl added to Bupivacaine versus Bupivacaine alone used in supraclavicular brachial block for upper limb surgeries. J Pharm Biomed Sci. 2013 Aug;33(33):1573-1576.
13. Pavlin DJ, Rapp SE, Polissar NL, Malmgren JA, Koerschgen M, Keyes H. Factors affecting discharge time in adult outpatients. Anesthesia Analgesia. 1998 Oct;87(4):816-26.
14. AnujaRathore, Jyotsna P Bhosale. A comparative double-blinded study of levobupivacaine and ropicvacaine USG Guided supraclavicular brachial plexus block. Meedpluse-Int. Med Journal. 2019:24(4):598-603.
15. Chauhan AP, Pandya J, Jain A. Comparison of block characteristics and postoperative analgesia of 0.5% Levobupivacaine with 0.5% Ropivacaine in ultrasound guided supraclavicular block for orthopedic forearm surgery-a prospective, comparative, randomized, clinical study. Indian J ClinAnaesth. 2020;7(3):399-404.
16. Sirisha T, Varaprasada Rao T. A comparative study of levobupivacaine and ropivacaine as supraclavicular brachial plexus block in patients undergoing upper limb surgery,European Journal of Molecular & Clinical Medicine, 2022, 09(02). ISSN 2515-8260.
17. Ha-Jung Kim, Sooho Lee, Ki Jinn Chin, Jing Sun Kim, Hyungtae Kim Young Jin Ro, Won UkKoh. Comparison of the onset timebetween 0.375% ropivacaineand 0.25% levobupivacainefor ultrasound guided Infraclavicular brachial plexusblock: a randomized-controlledtrial, Scientific Reports. 2021;11:4703.
18. Bangera A, Manasa M, Krishna P. Comparison of effects of ropivacaine with and without dexmedetomidine in Axillary brachial plexus block: A prospective randomized double-blinded clinical trial. Saudi J Anaesth. 2016;10:38-44.
19. Cline E, Franz D, Polley RD, Maye J, Burkard J, Pellegrini J. Analgesia and effectiveness of Levobupivacaine compared with Ropivacaine in patients undergoing an axillary brachial plexus block. ANA J. 2004;72(5):339-45.
20. Noulas N, Kaliakmanis D, Graikiotis A, Kouvalakidou A. Comparison of levobupivacaine 0.5% versus ropivacaine 0.5% for digital nerve blocks in ambulatory surgery. Eur. JAnaesthesiol. 2011;28:120.

21. Kaur A, Singh RB, Tripathi RK, Choubey S. Comparison between bupivacaine and ropivacaine in patients undergoing forearm surgeries under axillary brachial plexus block: a prospective randomized study. J ClinDiagn Res. 2015 Jan;9(1):UC01-6. Doi: 10.7860/JCDR/2015/10556.5446. Epub 2015 Jan 1. PMID: 25738062; PMCID: PMC4347153.
22. Sejpal NN, Bande BD, Sejpal KN, Rajdeo RN. A comparative study on the effectiveness of bupivacaine and ropivacaine for supraclavicular block. Int. J Res Med Sci. 2019;7:3803-7.
23. Tripathi D, Shah K, Shah C, Shah S, Das E. Supraclavicalar brachial plexus block for upper limb orthopedic surgery: A randomized, double blinded comparison between ropivacaine and bupivacaine. Internet J Anesthesiol., 2012 Nov, 30(4).
24. Akansha Jain, Deepesh Gupta, Aditya Agarwal,Saurabh Trivedi. Clinical Comparative Evaluation of Bupivacaine with Fentanyl and Ropivacaine with Fentanyl in Upper Limb Surgery Under Supraclavicular Brachial Plexus Block, MedicaInnovatica, 2022 Jul-Dec,11(2).
25. WasimKhursheedMIR, Vipin Kumar Varshney MD, ShahbazAlam,Prateek SinghGS, Jheetay, Aditya Samudrala. A Prospective Randomized Study to compare Levobupivacaine and Ropivacaine in Patients Undergoing Forearm Orthopaedic Surgeries under Ultrasound-Guided Supraclavicular Brachial Plexus Block, PJMHS. 2021 Jul;15(7):20-75.
26. Barsagade W, Tarkase AS, Gate H. Comparative Study of Ropivacaine 0.5% with fentanyl and Bupivacaine 0.5% with fentanyl in Interscalene Brachial Plexus Block. Int. J of Biomed & Adv. Res [Internet]. 2016 Nov;7(11):543-6. 28 [cited 2022 Dec. 31].
27. AnupreetKaur, Raj Bahadur Singh, TripathiRK. Sanjay ChoubeyInvolved, Comparision Between Bupivacaine and Ropivacaine in Patients Undergoing Forearm Surgeries Under Axillary Brachial Plexus Block: A Prospective Randomized Study, Journal of Clinical and Diagnostic Research. 2015 Jan;9(1):UC01-UC06.
28. Anita Kumari, Anandini Rajput, Lakshmi Mahajan, Ruchi Gupta, PankajSarangal. A study to evaluate the effectiveness of Bupivacaine (0.5%) versus Ropivacaine (0.5%, 0.75%) in patients undergoing upper limb surgery under brachial plexus block, Indian Journal of Clinical Anaesthesia. 2017;4(2):153-159.
29. Priyanshu Sharma, AmbikaNegi, Richi Chauhan, Lalit Mohan Negi. Comparative study of onset and duration ofsensory block with magnesium sulphate and bupivacaine versus bupivacaine only in axillary brachial plexus block under ultrasound guidance. MedPulse International Journal of Anesthesiology. 2021Dec;20(3):141-143.
30. Thornton KL, Sacks MD, Hall R, Bingham R. Comparison of 0.2% Ropivacaine and 0.25% Bupivacaine for axillary brachial plexus blocks in paediatric hand surgery. PaediatrAnaesth.2003;13:409-12.
31. Mageswaran R, Choy YC. Comparison of 0.5% Ropivacaine and 0.5% Levobupivacaine for Infraclavicular Brachial Plexus Block. Med J Malaysia. 2010;65:300-03.