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RESEARCH ARTICLE
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A COMPARATIVE STUDY OF LEVOBUPIVACAINE AND ROPIVACAINE FOR PERIOPERATIVE ANALGESIA IN PATIENTS UNDERGOING UPPER LIMB SURGERY BY SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

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ABSTRACT

Background: According to clinical research, levobupivacaine and ropivacaine are more beneficial in regional anaesthesia procedures because they have fewer negative effects on the central nervous system and cardiovascular system. Regarding their comparative clinical statistics, there is less information accessible. Levobupivacaine and ropivacaine have only been compared in a small number of studies for brachial plexus blocks.

Methods: This was a randomized parallel group double-blind controlled study conducted over a period of 12 months involving 64 ASA Grade-I or Grade-II status patients belonging to the age group 18-60 years undergoing orthopedic surgery of the elbow, forearm, and hand. Group A (n=35): received 30 ml of 0.5% levobupivacaine; group B (n=35): received 30 ml of 0.5% ropivacaine. Both the groups received supraclavicular brachial plexus block with nerve stimulation.

Results: Regarding the duration of sensory and motor block, the maximum and minimum times of duration of sensory and motor block were much higher in group A than in group B, and the differences were statistically significant. Post-operative VAS (Visual Analogue Score) scale after 1 hour, 6 hours, and 12 hours after completion of surgery. After 1 hour, the VAS score was 0 in both groups. After 6 hours, group A had a maximum score of 2 and a minimum score of 0. But in group B, the maximum score was 2 and the minimum score was 0. 12 hours postoperatively in group A, maximum and minimum VAS were 3 and 0, respectively, whereas in group B, maximum and minimum VAS were 10 and 5, respectively.

Conclusion: Levobupivacaine in supraclavicular brachial plexus block improves the quality of postoperative analgesia and the duration of sensory and motor block without producing significant adverse effects in patients undergoing orthopedic procedures of the elbow, forearm, and hand in comparison to ropivacaine.

Keywords: Levobupivacaine, Ropivacaine, Brachial Plexus Block.

INTRODUCTION

The need for regional procedures has grown as a result of factors such as patient satisfaction, safety, a positive postoperative recovery profile, and the growing need for affordable anaesthesia.[1] Peripheral nerve plexus blocks are essential to contemporary anesthesia because they guarantee that operation can be carried out safely and without serious side effects.[2] Significant intraoperative pain reduction is provided by peripheral nerve blocks, which result in dependable postoperative pain management.[3] Emergency procedures and elective orthopedic or reconstructive upper limb surgeries benefit from BPB (Brachial Plexus Block).[4] The best local anaesthetic for BPB has not yet been determined, nevertheless.

Due to its long duration of action, bupivacaine is used most frequently among the local anaesthetic drugs for brachial plexus block.[4] In spite of that, brachial plexus block provides postoperative analgesia of varying duration when used alone.

The newest local anaesthetic drug to enter clinical use in our nation is levobupivacaine, which is the S-enantiomer of bupivacaine. In contrast to racemic bupivacaine, it is less cardiotoxic. The amino-amide local anaesthetic ropivacaine, the s-enantiomer of S-1-propyl-2, 6-pipecolaylidide, shares a chemical structure with bupivacaine.

An essential weapon in the anesthesiologist's toolbox is brachial plexus anaesthesia. According to clinical research, levobupivacaine and ropivacaine are more beneficial in regional anaesthesia procedures because they have fewer negative effects on the central nervous system and cardiovascular system. Regarding their comparative clinical statistics, there is less information accessible. Levobupivacaine and ropivacaine have only been compared in a small number of studies for brachial plexus blocks.

Hence, this study was conducted to compare the onset of sensory block and motor block as well as the duration of analgesia and motor block in the levobupivacaine (0.5%) and ropivacaine (0.5%) groups in the supraclavicular brachial plexus block.

MATERIALS & METHODS

This was a randomized parallel group double-blind controlled study conducted over a period of 12 months involving ASA Grade-I or Grade-II status patients belonging to the age group 18-60 years undergoing orthopedic surgery of the elbow, forearm, and hand.

Patients having hypertension/diabetes mellitus/neuropathy/peripheral nerve injury/allergy to local anesthetic agent, pregnant and uncooperative patients were excluded from the study. The study population was divided into two groups: Group A (n=35) received 30 ml of 0.5% levobupivacaine, and Group B (n=35) received 30 ml of 0.5% ropivacaine. Both the groups received supraclavicular brachial plexus block with nerve stimulation.

After injection, patients were assessed for onset of sensory blockade by using the pin-prick method. The duration of the sensory block (the time taken between the injection of the drug and the appearance of pain requiring analgesia) was recorded. The onset of motor block was evaluated based on the modified Bromage Scale (0 = no paralysis, 1 = wrist flexion, 2 = elbow flexion, 3 = complete block). The onset of motor block was considered when the Bromage score was more than 2. Block was considered failed when sensory block could not be achieved within 30 minutes, and those patients were excluded from the study. During the operative procedure, heart rate, noninvasive blood pressure, and oxygen saturation were monitored every 5 minutes up to the end of surgery, and patients were maintained using monitored anaesthesia care as per standard protocol.

No other analgesic was given during the operative period. Pain has been assessed using VAS, and an injection of tramadol (1.5 mg/kg) i.v. was given upon the patient’s demand and/or a VAS score of more than 4. All participants were asked to record the moment they were able to move their fingers on the blocked extremity for the first time in order to calculate the duration of motor blockage. Raw data was loaded into an MS Excel spreadsheet and subjected to statistical analysis using SPSS (statistical software version 16). Categorical data were analyzed by Chi-square test, and numerical

data were analyzed by unpaired t-test. All analyses were two-tailed and a p-value <0.05 was taken to be statistically significant. The power of the study was 90%, and the type I error was less than 5%.

RESULTS

According to Table 1 analysis, there was no discernible difference in the age distribution between the study group (Gr. B) and control group (Gr. A) (p = 0.600). There was no significant difference in sex distribution (p = 0.621) between the study group (Gr. B) and control group (Gr. A).

Age	Group A	Group B
Minimum age (yrs.)	18	18
Maximum Age (yrs.)	60	58
Total	32	32
Mean	35.78	34.16
Standard Deviation	12.83	11.81

Table 1: Age Distribution of the Patients

There was no statistically significant (p value 0.558) difference regarding the onset of sensory block in both groups, as shown in the analysis of Table 2.

Onset of Sensory Block	Group A	Group B
Minimum time (min)	13	15
Maximum time (min)	21	19
Total	32	32
Mean	17.187	17.468
Standard Deviation	2.442	1.135

Table 2: Onset of Sensory Block

Analysis by student's independent samples t–test.

SE	0.476
95% CI	-1.240 to 0.678
t value	-0.591
DF	43.80
P-Value	0.558

There was no statistically significant (p value 0.531) difference regarding the onset of motor block in both groups, as shown in the analysis of Table 3.

Onset of Motor Block	Group A	Group B
Minimum time (min)	16	17
Maximum time (min)	24	21
Total	32	32
Mean	19.50	19.75
Standard Deviation	1.951	1.107

Table 3: Onset of Motor Block

Analysis by student's independent samples t-test.

SE	0.396
95% CL	-1.046 to 0.546
T value	-0.63
DF	49.09
P-Value	0,531

The duration of sensory block was longer in group A than in group B, which was statistically significant (p-value < 0.0001).

Duration of Sensory Block	**Group A**	**Group B**
Minimum time (min)	750	510
Maximum time (min)	865	620
Total	32	32
Mean	820.937	583.156
Standard Deviation	37.079	24.364
Table 4: Duration of sensory block		

Analysis by student's independent samples t–test.

SE	7.843
95% CL	222.053 to 253.508
t-value	30.317
DF	53.563
P-Value	<0.0001

Duration of motor block was more in group A than in group B, which was statistically significant (p-value < 0.0001).

Duration of Motor Block	**Group A**	**Group B**
Minimum time (min)	885	685
Maximum time (min)	915	710
Total	32	32
Mean	898.437	695.165
Standard Deviation	9.873	9.112
Table 5: Duration of Motor Block		

Analysis by student's independent samples t–test.

SE	2.375
95% CL	198.532 to 208.029
t- value	85.588
DF	61.606
P-Value	< 0.0001

Duration of analgesia was more in group A than in group B, which was statistically significant (p-value < 0.0001).

Duration of Analgesia	Group A	Group B
Minimum time (min)	745	480
Maximum time (min)	842	600
Total	32	32
Mean	802.156	564.843
Standard Deviation	28.165	28.956
Table 6: Duration of Analgesia		

Analysis by student's independent samples t–test.

SE	7.140
95% CL	223.037 to 251.587
t-value	33.233
DF	61.953
P-value	< 0.0001

VAS score at 1 hour and 6 hours after surgery (V6) was comparable in both groups, and the difference was statistically not significant (p value 0.195). VAS score 12 hr after surgery (V12) was lower in group B than in group A, and the difference is statistically significant (p-value <0.0001) as shown in the analysis of Table 7.

V12	Group A	Group B
Minimum	5	0
Maximum	10	3
Total	32	32
Mean	7.03	1.46
Standard Deviation	0.707	0.7
Table 7: VAS Score 12hr after Completion of Surgery (V12)		

Analysis by student's independent samples t–test.

SE	0.175
95% CI	-5.92 to -5.22
t value	-31.829
DF	62
P-Value	<0.0001

DISCUSSION

This study was carried out to compare the efficacy of levobupivacaine and ropivacaine for perioperative analgesia in patients undergoing upper limb surgery by supraclavicular brachial plexus block. Both the groups were comparable with respect to age and sex distribution as well as surgical parameters.

Regarding the onset of sensory block, the maximum and minimum times of onset of sensory block were comparable in both groups. Group A (patients receiving levobupivacaine) and group B (patients receiving ropivacaine). The minimum and maximum times of onset of sensory block were 13 and 21 minutes, respectively, in group A, whereas they were only 15 and 19 minutes, respectively, in group

B. There was no difference between the groups with respect to the onset of motor block. Whereas in group A the mean time for onset was 19.50±1.951 minutes, it was 19.75±1.107 in group B.

Regarding the duration of sensory block, the maximum and minimum times of duration of sensory block were more in group A (patients receiving levobupivacaine) than in group B (patients receiving ropivacaine). The minimum and maximum time of duration of sensory block was 750 and 865 minutes, respectively, in group A, whereas it was 510 and 620 minutes, respectively, in group B. Our study result corresponds to a study done by Eric et al., in 2004. They showed sensory analgesia was significantly longer in the levobupivacaine group. Regarding the duration of motor block, the maximum and minimum times of duration of motor block were more in group A (patients receiving levobupivacaine) than in group B (patients receiving ropivacaine). The minimum and maximum time of duration of motor block was 885 and 915 minutes, respectively, in group A, whereas it was 685 and 710 minutes, respectively, in group B. Our study result corresponds to a study done by Eric et al., in 2004. They demonstrated that the ropivacaine group's restoration to motor activity was noticeably quicker.[5]

Levobupivacaine-treated subjects showed a statistically significant quicker onset of sensory and motor blockade than ropivacaine-treated patients in the Kulkarni et al. research.[6] Mageswaranand Choy obtained similar findings.[7] Conversely, Nodulas et al. discovered that the beginning of action of 0.5% ropivacaine and 0.5% levobupivacaine was comparable.[8] In the study by Kulkarni et al.[6] Group L experienced sensory and motor blockage for a longer period of time than Group R. It was determined that the variation in motor blockade duration was statistically significant ($p=0.0001$). The findings of Casati et al. are comparable to this discovery.[9] Similarly, Deshpande et al.'s study indicated that levobupivacaine 0.5% caused sensory and motor block to start early with statistically significant results. Compared to 0.5% ropivacaine in a supraclavicular brachial plexus block, levobupivacaine extended the duration of sensory, motor block, and postoperative analgesia. In the Kulkarni et al.,[6] study, intraoperative and postoperative hemodynamic parameters were also studied. The groups' intraoperative and postoperative pulse rates, systolic and diastolic blood pressures, and oxygen saturation levels were similar. They were determined to be $p>0.05$, or statistically insignificant. Similar findings regarding hemodynamic parameters were reported in research by Deshpande et al., which also indicated that blood pressure and heart rate did not significantly alter between the two groups and that SpO_2 and ECG were maintained during the procedure.[10] Fusun and colleagues also note the same results.[11]

In the Thalamati et al.,[12] investigation, the start time for motor block with ropivacaine and levobupivacaine was not statistically significant. Compared to the ropivacaine group, the levobupivacaine group experienced sensory blocking for a longer period of time. Cline et al. have achieved similar outcomes.[5] Comparing levobupivacaine to the work by Ilham et al., the duration of motor blockage was shorter.[13] However, compared to their study and the trial conducted by Biswas et al., the levobupivacaine group experienced a longer period of motor block, most likely because of the use of a targeted strategy involving nerve stimulators and ultrasound.[14] Despite using a different methodology, the results of the Cho et al. trial, which involved a longer duration of motor block with levobupivacaine, were comparable to the current investigation.[15]

In our investigation, we found that the levobupivacaine group (A) experienced a statistically significant longer duration of analgesia than the ropivacaine group (B). The minimum and maximum time of duration of analgesia was 745 and 842 minutes, respectively, in group A, whereas it was 480 and 600 minutes, respectively, in group B. In our study, we observed the postoperative VAS scale after 1 hour, 6 hours, and 12 hours after completion of surgery. After 1 hour, the VAS score was 0 in both groups. After 6 hours, group A had a maximum score of 2 and a minimum score of 0. But in the group, the maximum score was 2 and the minimum score was 0. Our study result corresponds to a study done by R. Mageswaran et al.[7] There was no difference in the ineffectiveness of analgesia 6 hours post-operatively between the two drugs. 12 hours postoperatively, VAS was significantly higher in group B than in group A. In group A, maximum and minimum VAS were 3 and 0, respectively,

whereas in group B, maximum and minimum VAS were 10 and 5, respectively, which was statistically significant.

The duration of analgesia in the Kulkarni et al.,[6] investigation was defined as the interval between the delivery of the supraclavicular block and the beginning of pain (VAS >4) necessitating the administration of a rescue analgesic. If the VAS was more than 4, 75 mg of injection diclofenac was administered intravenously. Group L required 13.233±1.1651 hours for the first rescue analgesia, which was longer than group R's (10.866±0.9185 hours), and the difference was statistically significant (p=0.0001). Patients who got levobupivacaine had a lower VAS. It was shown that the difference in pain scores was statistically significant (P<0.05), particularly after the eighth hour. Similar findings had been reported by Cline et al. and Fournier et al.[5,16]

In the Thalamati et al,[12] trial, levobupivacaine produced a longer duration of analgesia than ropivacaine. Few trials comparing ropivacaine and levobupivacaine for supraclavicular blocks were found in the literature research; nevertheless, the findings differed.[8] Watanabe et al.'s study[17] found no discernible difference in the two local anaesthetics' duration of analgesia. Additionally, Mageswaran and Choy's investigation[7] found no variations in analgesic effectiveness. Our investigation, which demonstrated a prolonged analgesic effect with levobupivacaine, was comparable to the findings with Cline et al.[5] In the aforementioned trials, brachial plexus blocks were carried out using a variety of techniques (interscalene, supraclavicular, and axillary approaches) and dosages. The authors came to the conclusion that additional randomised controlled studies using comparable methodologies and medication dosages will shed more light on the current situation.

According to a meta-analysis by Alharran, Abdullah et al.,[18] compared to ropivacaine, levobupivacaine is significantly associated with a longer duration of sensory and motor block in patients undergoing BPB for upper limb surgery, while maintaining a similar safety profile. The meta-analysis included 16 RCTs and 939 patients. The time it took for the sensory or motor block to start, however, was the same.

Following surgery, patients were closely watched for any side effects, such as headaches, myonecrosis, hypotension, bradycardia, postoperative discomfort, paresthesia, and allergic responses. The dosages utilized in this study have not been associated with any problems, and our results support the findings. Therefore, compared to ropivacaine, levobupivacaine often demonstrated higher quality analgesia with a shorter onset and longer recovery time for both sensory and motor blockage. A potential consequence of trying a supraclavicular block is pneumothorax. Using paraesthesia for nerve identification and the traditional supraclavicular technique, the reported incidence of pneumothorax ranges from 1% to 4%. However, our investigation revealed no such complications.

Compared to levobupivacaine, ropivacaine has the benefit of accelerating the recovery of motor function following surgery. Levobupivacaine does have the disadvantage of a delayed motor block, but it has benefits in terms of a longer sensory block. Levobupivacaine should therefore be considered if reducing postoperative pain is the primary priority; nevertheless, if a speedy return of motor function is sought, it might not be the best choice.[19]

The small sample size and the inclusion of only individuals with ASA I and II physical status were the study's shortcomings. To support the safety of these medications, a study of high-risk patients must be conducted. Also, an insight into the hemodynamic profile of the two drugs would have better substantiated the advocacy of one drug over the other.

CONCLUSION

Levobupivacaine in supraclavicular brachial plexus block improves the quality of postoperative analgesia and the duration of sensory and motor block without producing significant adverse effects in patients undergoing orthopedic procedures of the elbow, forearm, and hand in comparison to ropivacaine.

REFERENCES

[1] Sessler DI, Rubinstein EH, Moayeri A. Physiological responses to mild perianesthetic hypothermia in humans. Anesthesiology 1991;75(4):594-610.

[2] Shahid R, Prasad MK, Alam MA, Jain P, Reddy MN, Jheetay GS. A prospective randomized study to compare levobupivacaine and ropivacaine in ultrasound-guided supraclavicular brachial plexus block for forearm orthopedic surgery. Anaesth Pain Intensive Care 2021;25(5):613-9.

[3] 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. AANA J 2004;72(5):339-45.

[4] Murphy DB, McCartney CJL, Chan VWS. Novel analgesic adjuncts for brachial plexus block: a systematic review. Anesth Analg 2000;90(5):1122-8.

[5] 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. AANA Journal 2004;72(5):339-46.

[6] Kulkarni SB, Pimpare M, Govardhane BT. Comparison of levobupivacaine with ropivacaine for supraclavicular brachial plexus block. Int J Res Med Sci 2016;4(9):3789-96.

[7] Mageswaran R, Choy YC. Comparison of 0.5% ropivacaine and 0.5% levobupivacaine for infraclavicular brachial plexus block. Med J Malaysia 2010;65(4):300-3.

[8] Nodulas N, Kaliakmanis D, Graikiotis A, Kouvalakidou A. Comparison of Levobupivacaine 0.5% and Ropivacaine 0.5% for digital nerve block in ambulatory surgery. European Journal of Anaesthesiology 2011;28:120.

[9] Casati A, Borghi B, Fanelli G, Montone N, Rotini R, Fraschini G, et al. Interscalene brachial plexus anesthesia and analgesia for open shoulder surgery: a randomized, double-blinded comparison between levobupivacaine and ropivacaine. Anesth Analg 2003;96(1):253-9.

[10] Deshpande JP, Ghodaki PS, Sardesai S. Comparative clinical study Between Racemic Bupivacaine and Levobupivacaine in Supraclavicular brachial plexus block. Indian Journal of Applied Research 2014;4(5):451-4.

[11] Fusun E, Berit GC, Sinem SAK, Mehmet T, Tolga A, Lutfi Y. Comparative study of two agents in axillary brachial plexus block: bupivacaine Vs levobupivacaine. Smyrna Tip Dergisi 2011:27-34.

[12] Thalamati D, Sambandam KG, Karthekeyan RB, Vakamudi M. Comparison of Ropivacaine and Levobupivacaine in Supraclavicular Brachial Plexus Blocks-A Double Blinded Randomized Control Study. Turk J Anaesthesiol Reanim 2021;49(4):278-83.

[13] Ilham C, Bombaci E, Yurtlu S, Çolakoglu S. Efficiency of levobupivacaine and bupivacaine for supraclavicular block: a randomized double-blind comparative study. Rev Bras Anestesiol 2014;64(3):177-82.

[14] Biswas S, Das RK, Mukherjee G, Ghose T. Dexmedetomidine an adjuvant to levobupivacaine in supraclavicular brachial plexus block: a randomized double blind prospective study. Ethiopian Journal of Health Sciences 2014;24(3):203-8.

[15] Cho CK, Kim JY, Jung SM, Kwon HU, Kang PS, Kim CW, et al. Comparison of vertical infraclavicular brachial plexus block with 0.5% levobupivacaine and 0.5% ropivacaine for upper limb surgery. Korean Journal of Anesthesiology 2009;56(2):162-8.

[16] Fournier R, Faust A, Chassot O, Gamulin Z. Levobupivacaine 0.5% provides longer analgesia after sciatic nerve block using the Labat approach than the same dose of ropivacaine in foot and ankle surgery. Anesth Analg 2010;110(5):1486-9.

[17] Watanabe K, Tokumine J, Lefor AK, Moriyama K, Sakamoto H, Inoue T, et al. Postoperative analgesia comparing levobupivacaine and ropivacaine for brachial plexus block: a randomized prospective trial. Medicine 2017;96(12):e6457.

[18] Alharran AM, Alotaibi MN, Alenezi YY, Alharran YM, Alahmad AA, Alqallaf A, et al. Levobupivacaine versus ropivacaine for brachial plexus block: a systematic review and meta-analysis of randomised controlled trials. Indian Journal of Anaesthesia 2025;69(2):179-90.

[19] Khursheed Mir W, Varshney VK, Alam MS, Singh P, Jheetay GS, Samudrala A. A prospective randomized study to compare levobupivacaine and ropivacaine in patients undergoing forearm orthopaedic surgeries under ultrasound-guided supraclavicular brachial plexus block. Pak J Med Health Sci 2021;15(7):2075-81.