European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 08, Issue 04, 2021

ORIGINAL RESEARCH

To Compare the Effectiveness of Bupivacaine VersusLevobupivacaine in Supraclavicular Brachial Plexus Block

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ABSTRACT

Aim: To Compare the Effectiveness of Bupivacaine Versus Levobupivacaine in Supraclavicular Brachial Plexus Block.

Material and methods: This cross sectional comparative study conducted on 100 patients of ASA I & II status in the age group of 20-58 years given brachial plexus block by supraclavicular approach for various upper limb surgeries, were included in this study.

Result: There was no statistically significant difference between two groups in demographic data i.e. age, gender, weight, ASA status. The mean onset time of sensory block was 11.98 minutes in group B & 10.03 minutes in group L while the mean onset time of motor block was 13.9 minutes in group B & 12.01 in group L. Mean onset time of sensory and motor block were significantly shorter in group L than in group B. The mean duration of sensory block was 878.88±118.55 minutes in group B & 1029.35±139.77 minutes in group L while the mean duration of motor block was 929.55±108.58 minutes in group B & 1111.11±138.65 minutes in group L Mean duration of sensory and motor block are significantly longer in group L that in group B. The mean duration of analgesia was 911±118.27 minutes in group B and 1068.69±151.47 minutes in group L . The mean duration of analgesia was significantly prolonged in group L compared to group B.

Conclusion: We concluded that levobupivacaine has a faster onset of both sensory and motor blockade as compared to racemic bupivacaine. Also, the duration of both sensory and motor block is longer with levobupivacaine.

Keywords: Bupivacaine ,Levobupivacaine , Supraclavicular Brachial Plexus Block

INTRODUCTION

Supraclavicular brachial block is the popular and widely used nerve block technique for perioperative anesthesia and analgesia for surgery of upper extremity. The block is performed at the level of distal trunks and origin of the divisions, where the brachial plexus is confined to its smallest surface area, thus producing a rapid and reliable blockade of brachial plexus.

As a reliable alternative to general anesthesia, peripheral nerve blockade has attractedacceptance among specialists. Brachial plexus block (BPB) has been commonlyperformed for patients undergoing upper limb surgeries.[1]Regarding its less adverseeffects, BPB has been considered an ideal choice for patients with underlyingcardiopulmonary diseases.[2]There are various approaches to perform BPB, depending on the patient'scondition and the medical team's expertise.[3]The supraclavicular approach is anefficient and acceptable method for BPB.[4]Given the ease of procedure, high successrates, fast blockade onset time,[2]and high single-shot efficient blockade rates, thesupraclavicular approach under ultrasound guidance is a suitable choice for BPB.The addition of various drugs as adjuvants to the local anesthetic has been shownto have clinical and pharmacologic merits.[5-7] Prolonged duration of analgesia, fasterblockade onset, and

decreased total anesthetic usage, thus an extended safety margin ofthe block, are among the advantages.[8]

Bupivacaine is available in a commercial preparation as a racemic mixture (50:50) of its two enantiomers: levobupivacaine, S (−) isomer and dextrobupivacaine, R (+) isomer. The pure S (−) enantiomers of bupivacaine, i.e., ropivacaine and levobupivacaine were introduced into the clinical anesthesia practice due to less central nervous system and cardiovascular adverse reactions reported in the literature after inadvertent intravascular injection or intravenous regional anesthesia than R (+) isomer of bupivacaine.[9]

Various adjuvants have been clinically used so far, including clonidine, midazolam, neostigmine, hyaluronidase, bicarbonate, and dexamethasone along with local anesthetic (LA) for brachial plexus block.[10,11] Addition of any of the above agents is supposed to prolong the analgesic effect without any untoward systemic effects. For their sedative, analgesic, perioperative sympatholytic, and cardiovascular stabilizing effects with reduced anesthetic requirements, α-2 adrenergic receptor agonists have been the focus of interest and are used as epidural, intrathecal, and parenteral injections, either alone or in combination with another drug to prolong and intensify the anesthesia.

Material and methods

This cross sectional comparative study conducted in the, Department ofAnaesthesia after taking the approval of the protocol review committee and institutional ethics committee.

Inclusion criteria

100 patients of ASA I & II status in the age group of 20-58 years given brachial plexus block by supraclavicular approach for various upper limb surgeries, were included in this study.

Exclusion criteria

Patients allergic to any of the study drugs; on anticoagulants or with altered coagulation profiles; local infection at the site of injection; history of psychiatric, neuromuscular, cardiovascular, pulmonary, renal, hepatic disease; drug abuse; patients requiring bone graft; on chronic analgesic therapy, difficult anatomical landmarks, diaphragmatic paralysis &/or pneumothorax on the contralateral side and patients who did not give consent for the procedure were excluded from the study.

Patients did not receive any sedative premedication before arrival in the operation theatre. In the operation theatre, baseline pulse, blood pressure, oxygen saturation and respiratory rate were noted. The patient was positioned and need for cooperation was emphasized.

We used the classical approach to supraclavicular block using a single-injection, nerve-stimulator technique. An experienced anesthesiologist performed the block using a nerve locator with all aseptic precautions. Local infiltration of 1ml of 2% lignocaine was given at the puncture site by raising a skin wheal using a 24G 1.5-inch needle. Stimuplex HNS 12® was used as a nerve stimulator and Stimuplex A was used as a block needle. We aimed to elicit an isolated muscle twitch in all fingers either in flexion or extension. Once the elicited motor response of the fingers was obtained at 1mA, the current was gradually decreased up to 0.5mA while advancing the needle until maximum contraction was elicited; the study drug was injected after gentle aspiration with repeated aspiration every 5ml. During the conduct of block and thereafter, the patient was observed vigilantly for any toxicity to the drugs injected or complications of the block. Patients who received bupivacaine were included in group B and those who received levobupivacaine were included in group L. As per the operation theatre's routine protocol, patients in group B received 20ml bupivacaine (0.5%), 10ml

lignocaine (2%) with adrenaline (1:200,000) while those in group L received 20ml levobupivacaine (0.5%), 10ml lignocaine (2%) with adrenaline (1:200,000).

Heart rate and blood pressure were documented every 5 minutes up to half an hour and then every 15 minutes up to 2 hours & then half hourly up to 6 hours. Variation in hemodynamics >20% from baseline was considered significant.Patients were observed for any side effects and complications like CNS toxicity, cardiac arrhythmias, pneumothorax, hematoma and post block neuropathy etc. Patients with complete failure of the block or unsatisfactory block (inadequate analgesia), inadequate relaxation and patients requiring either intravenous sedation or general anesthesia were excluded from the study.

The assessment for onset of sensory and motor block was done every minute from the time of injection of drug until the block was completely established. Time "0 minute" was taken as the time of completion of injection. Dermatomes C5 to T1 were assessed using cotton soaked in spirit.

Onset time of sensory block was the time to diminished response to cold in any dermatome while onset time of motor block was the time elapsed from injection of drug to inability to flex the forearm or wrist. Surgery was commenced after complete motor block when the patient was unable to move the upper limb.

Duration of sensory block (time elapsed between injection of the drug and return of cold sensation in any dermatome) and duration of motor block (time elapsed between injection of drug to ability to flex the forearm or wrist) was recorded. Intensity of postoperative pain was assessed using the NRS explained to the patient preoperatively. NRS was assessed postoperatively every half hourly until a score of 3 was attained. Rescue analgesia was given in the form of diclofenac sodium (1.5 mg/kg) intravenously at NRS of 3 and the time of administration was noted. Duration of analgesia was considered as the time from onset of sensory block till NRS score of 3 was achieved.

Statistical analysis

All the data noted was entered in Microsoft excel sheet and was double checked. SPSS 24.0 software was used to analyze the collected data. The categorical variables were tabulated as frequency and percentages. Continuous variables were presented as Mean Standard deviation. Independent sample T-$_{\pm}$test was used to measure the association between the vitals at different times. Chi-square test was applied to assess the relationship between the categorical variables. $P<0.05$ was considered as statistically significant.

Results

There was no statistically significant difference between two groups in demographic data i.e. age, gender, weight, ASA status. (Table 1)

Table-1: demographic profile of the patients in group B and group L

Demographic profile	Group B (n=50)	Group L (n=50)	P value
Age (years)	35.85±7.58	34.96±7.66	>0.69
Weight (kg)	62.11±6.22	63.55±6.13	>0.59
ASA I:II	35:15	32:18	>0.05

The mean onset time of sensory block was 11.98 minutes in group B & 10.03 minutes in group L while the mean onset time of motor block was 13.9 minutes in group B & 12.01 in group L. Mean onset time of sensory and motor block were significantly shorter in group L than in group B. (Table 2)

Table-2: Mean onset time of sensory and motor block

Time of sensory and motor block	**Group B (mean ± SD)**	**Group L (mean ± SD)**	**P value**
Onset of sensory block	11.98±3.83	10.03±2.34	0.007
Onset of motor block	13.9±3.41	12.01±2.55	0.01

The mean duration of sensory block was 878.88±118.55 minutes in group B & 1029.35±139.77 minutes in group L while the mean duration of motor block was 929.55±108.58 minutes in group B & 1111.11±138.65 minutes in group L Mean duration of sensory and motor block are significantly longer in group L that in group B. (Table 3)

Table-3: Mean duration of sensory and motor block in group B and group L

Duration of sensory and motor block	**Group B (mean±SD)**	**Group L (mean±SD)**	**P value**
Duration of sensory block (minutes)	878.88±118.55	1029.35±139.77	<0.001
Duration of motor block (minutes)	929.55±108.58	1111.11±138.65	<0.001

The mean duration of analgesia was 911±118.27 minutes in group B and 1068.69±151.47 minutes in group L . The mean duration of analgesia was significantly prolonged in group L compared to group B (Table 4)

Table-4: Mean duration of analgesia in group B and group L.

Duration of analgesia	**Group B (mean±SD)**	**Group L (mean±SD)**	**P value**
Duration of analgesia (minutes)	911±118.27	1068.69±151.47	<0.001

Discussion

Supraclavicular brachial plexus blockade (SCBPB) is the common approach to provide surgical anesthesia of upper limb, was first described by Kulenkampff in 1911. Nowadays, SCBPB has gained importance as a regional anesthetic technique of choice for surgical, diagnostic, and therapeutic purposes in interventional pain management. As here (cervical plexus) nerves are most compactly arranged, less amount of anesthetic solution required to block.[12]Brachial plexus block is close to the ideal anaesthetic technique for upper limb surgeries as it provides good intraoperative anaesthesia& postoperative analgesia. Racemic bupivacaine is the most commonly used local anaesthetic agent for brachial plexus block. However, reports of fatalities through cardiovascular (CVS) & central nervous system (CNS)[13] toxic effects were noted after accidental intravascular administration of racemic bupivacaine which were attributed to the dextro (R+) enantiomer.[13] Thereafter, levobupivacaine, the pure s-enantiomer of bupivacaine emerged as a safer alternative with similar clinical profile as racemic bupivacaine & better safety profile.[14]

Several studies have demonstrated & explained the mechanism of toxicity of bupivacaine.[14,15] Bupivacaine has been shown to cause indirect depression of cardiac conduction (AV conduction, QRS complex) & contractility by blocking mainly inactivated state of sodium channels.16 [12] Studies demonstrate dextro (R+) enantiomer has 2.4 times higher affinity for cardiac sodium channels & dissociates from it slowly as compared to levo (S+) enantiomer.[16,17] This explains the higher cardiac toxicity of racemic bupivacaine as compared to its levo isomer. Also, levobupivacaine causes less rapid blockade of the cell firing in nucleus tractus solitaries (NTS)[15] which explains its lower CNS toxicity compared to

racemic bupivacaine. One more factor for difference in toxicity between the two enantiomers can be explained on the basis of their pharmacokinetics. The protein binding of levobupivaine is >97% as against 95% in case ofbupivacaine. This means <3% of levo is free in plasma to have action on other tissues causing undesired toxic effect.[13,14,17]

The above studies prove that levobupivacaine has a better safety profile than its racemic mixture. We therefore chose to study and compare the effectiveness of racemic bupivacaine &levobupivacaine for supraclavicular brachial plexus block. In this prospective observational study, we compared the effectiveness of bupivacaine versus levobupivacaine for supraclavicular brachial plexus block. A total number of 100 patients in the age group of 20–58 years were included in the study. The study population was divided into 2 groups with 50 patients in each group. Both the groups were comparable with respect to age, gender, weight & ASA grade.

The onset time of sensory block was assessed by diminished response to pinprick in C5-T1 dermatome. The mean onset time of sensory block was 11.98 minutes in group B & 10.03 minutes in group L while the mean onset time of motor block was 13.9 minutes in group B & 12.01 in group L. Mean onset time of sensory and motor block were significantly shorter in group L than in group B.

JyotiPushkarDeshpande et al[18] evaluated and compared the differences in onset of sensory blockade of racemic bupivacaine versus levobupivacaine in supraclavicular brachial plexus block. They found that the onset of sensory block was earlier with levobupivacaine as compared to bupivacaine which was statistically significant. (P<0.001) Jose Ricardo Pinotti Pedro et al[19] , 2009, found that the onset of sensory blockade was faster in the levobupivacaine group and the difference was statistically significant. (p<0.05) Cacciapuoti et al[20] , 2002, compared the clinical profiles of levobupivacaine, racemic bupivacaine and ropivacaine at equipotent doses in axillary brachial plexus block in the orthopaedic surgery of wrist and hand. They found that the onset of sensory block was faster with levobupivacaine as compared to bupivacaine.

FüsunEroğlu et al[21] carried out a study to investigate whether there is significant difference between the block of morphine adjuncted bupivacaine and levobupivacaine in axillary perivascular brachial plexus block. They found that the onset of sensory block was faster with levobupivacaine than bupivacaine and the difference was statistically significant (p<0.0001).

Our findings are in concordance with these studies. However, in the study conducted by CenkIlham[22] et al, the onset of sensory block was faster with bupivacaine while Cox CR et al[23] found no difference in the onset times between the two groups.

The duration of sensory block was assessed by return of pinprick sensation in C5-T1 dermatome. The mean duration of sensory block was higher in the levobupivacaine group i.e. 1029.35±139.77 minutes versus 878.88±118.55 minutes in the bupivacaine group.

The results of our study are in concordance with the results of JyotiPushkarDeshpandeet al.[18], Cacciapuoti et al[20]&Charu J Pandya et al. However, we differed from CenkIlhamet al[22] and Cox CR et al[23] who found no significant difference between the two groups. The onset of motor block was the time from injection of the drug to inability to flex the forearm or wrist. We found a statistically significant difference in the mean onset time of motor block between bupivacaine (13.9 minutes) and levobupivacaine (12.01 minutes). On the contrary, in a study conducted by CinkIlham et al, the onset was faster with bupivacaine (19.64±10.70 minutes) as compared to levobupivacaine (25.66±10.72 minutes). However, our results were similar to JyotiPushkarDeshpande et al[18] (p<0.001) and Cacciapuoti et al.[20]

Although there was a statistically significant difference in the onset of sensory and motor block in the bupivacaine group, we believe that this may not make much of a difference clinically.

The time from onset of motor block to ability to flex the forearm or wrist was considered as the duration of motor block. The mean duration of analgesia was 911±118.27 minutes in group B and 1068.69±151.47 minutes in group L. This shows that the duration of motor block was significantly prolonged in the levobupivacaine group. Similarly, JyotiPushkarDeshpandeet al.[18], 2014 found the duration of motor block with levobupviacaine to be 1048.32±97.24 minutes and that with bupivacaine to be 900.41±177.74 minutes. Cacciapuotiet al[20], 2002 also found a significantly prolonged duration of motor block with levobupivacaine.

Levobupivacaine has vasoconstrictor action as demonstrated in Aps Reynolds[24] study which could explain the prolonged duration of action. However, in surgeries where early return of motor activity is desired, it may not be a suitable choice. Duration of analgesia was considered as the time taken to reach an NRS score of 3 &rescue analgesia was given at this time. The duration of analgesia was The mean duration of analgesia was 911±118.27 minutes in group B and 1068.69±151.47 minutes in group L. it was prolonged in the levobupivacaine group and the difference was statistically significant. Prolonged duration of analgesia could also be due to prolonged action of levobupivacaine due to its vasoconstrictor action as concluded by Aps Reynolds et al.[24] On the contrary, in the study conducted by Cline et al[25] , duration of analgesia with levobupivacaine was less (833 minutes) as against 1048.32 minutes in our study. This difference could be attributed to the difference in technique, as brachial plexus block in their study was given by the transaxillary approach. Our findings corroborated the results of JyotiPushkarDeshpande et al.[20] , 2014 and Cacciapuoti et al[20] , 2002. ($p<0.001$) We did not find any incidence of adverse effects like hemodynamic instability, local anesthetic toxicity, cardiac arrhythmias, pneumothorax etc. in either group.

Conclusion

We concluded that levobupivacaine has a faster onset of both sensory and motor blockade as compared to racemic bupivacaine. Also, the duration of both sensory and motor block is longer with levobupivacaine.

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