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A COMPARATIVE STUDY BETWEEN BUPIVACAINE (0.5%) AND LEVOBUPIVACAINE (0.5%) IN USG GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK.

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ABSTRACT

Objectives: To compare bupivacaine(0.5%) and levobupivacaine(0.5%) in usg guided supraclavicular brachial plexus block with respect to onset and duration of sensory and motor block, duration of analgesia, and the presence of adverse events.

Methods: The present study was conducted in random 60 patients of either sex, aged between 18yrs and 60 yrs undergoing hand, forearm and upper arm surgery having ASA grade 1 and 2. The patients were randomly allotted into two groups each having 30 patients. Group L – inj. Levobupivacaine 0.5% 20 ml Group B– inj. Bupivacaine 0.5% 20 ml and the effects were assessed.

Results: There was significant difference in duration of motor block (<0.05), and analgesia (<0.05) in both the groups. The average duration of motor block was 490.67±75.75 minutes in L Bupivacaine group whereas it was 617.97±90.86 minutes in Bupivacaine group which was significant statistically. The average duration of analgesia was 677.50±68.19 minutes in L bupivacaine group as compared to 633.47±94.26 minutes in Bupivacaine group which was also statistically significant. None of the groups showed adverse effects due to drugs(cardiovascular and CNS toxicity) or mechanical or other effects of technique, such as needle trauma.

Conclusion: Bupivacaine(0.5%) provides a better motor blockade whereas levobupivacaine(0.5%) has added advantage of prolonged postoperative analgesia for supraclavicular block added with accuracy of ultrasound imaging.

KEYWORDS : : Supraclavicular block, Bupivacaine, Levobupivacaine, Ultrasound.

INTRODUCTION:

Brachial plexus block is a time tested technique for upper limb surgeries[1]. Among the various approaches of brachial plexus block, supraclavicular approach is considered easiest and most effective. The classical approach using paresthesia is a blind technique & may be associated with high 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[3,4]. However, this technique may not be foolproof with persistent risk of injury to surrounding structures, especially vascular structures, nerves[5] and pleura leading to pneumothorax[6]. The application of ultrasound technique for exact localization of nerves / plexus[6] has revolutionized the regional anesthesia field where in ultrasound probes with suitable frequencies have been successfully tried. The success rate and the mean time of onset of anesthesia are significantly better under ultrasound guidance. Bupivcaine, a racemic mixture of the 2 stereo enantiomers dextrobupivacaine and levobupivacaine, frequently is used as the local anaesthetic for brachial plexus block because it offers the advantage of providing a long duration of action and a favourable ratio of sensory to motor neural block. 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, which were attributed to the dextrobupivacaine enantiomer. This prompted researchers to develop new local anesthetic agents with a profile that contained all the desirable aspects of bupivacaine without the undesirable toxic effects. Levobupivacaine, the S-enantiomer of bupivacaine produce less cardiotoxicity and neurotoxicity than bupivacaine, while still possessing a similar duration of sensory blockade. Therefore, the purpose of this study is to compare the effectiveness, duration and quality of sensory and motor blockade between groups of patients receiving a supraclavicular brachial plexus block with 0.5% bupivacaine or 0.5% levobupivacaine under ultrasound guidance.

AIM:

To compare the effectiveness, duration, and quality of sensory and motor blockade between groups of patients receiving a supraclavicular brachial plexus block with 0.5% bupivacaine or 0.5% levobupivacaine under usg guidance.

OBJECTIVES- To study and compare

1. Onset time and duration of sensory block
2. Onset time and duration of motor block
3. Overall quality of block
4. Duration of post-operative analgesia
5. To study adverse effects and complications if any like nausea, vomiting, dysrhythmias, hypotension, convulsions, pneumothorax, pruritis, Horner's syndrome, hypersensitivity reaction for the study drug.
6. To study volume of drug under ultrasound guided block.

MATERIAS AND METHODS:

A prospective randomized double- blind clinical study was undertaken at our institution. Sixty patients aged between 18yrs and 60yrs of physical status ASA grade 1 and ASA grade 2 undergoing elective upper limb surgeries were included in the study after ethical clearance from the college ethical committee. Each patient was visited pre-operatively and the procedure explained and written informed consent was obtained. Complete blood count, blood grouping, blood sugar, bleeding time, clotting time, liver function test, blood urea, serum creatinine, serum electrolytes(sodium, potassium, chloride), chest x-ray, ECG were done.

GROUP B (N=30) - B group receives 2mg/kg bupivacaine 0.5% (5mg/ml) not exceeding maximum recommended dose

GROUP L (N=30)- L group receives 2mg/kg Levobupivacaine 0.5% (5mg/ml) not exceeding maximum recommended dose

INCLUSION CRITERIA:

Patients aged between 18yrs and 60yrs
Physical status ASA grade 1 and ASA grade 2
Scheduled for elective upper limb surgeries

EXCLUSION CRITERIA:

Patient's refusal
Traumatic nerve injury
History of respiratory disorders
History of neuromuscular diseases
History of cardiovascular diseases
Bleeding disorders or patient on anticoagulant therapy
Hepatic or Renal failure
Pregnant women
Known allergy to local anesthetic agents

All necessary equipment and drugs needed for administration of general anesthesia and resuscitation were kept ready in order to manage failure of block and any complications.

Procedure:

On arrival of patient in operating room intravenous access was

obtained in the limb opposite to that undergoing surgery with an intravenous cannula-18G. Standard monitors, ECG, pulse oximeter, non-invasive blood pressure, were connected and monitored continuously in all the patients and recorded prior to incision(basal), after injection, at 5 minutes, at 10 minutes and at interval of 5 minutes in the first hour and every 30 minutes thereafter till the end of surgery. Patient was made to lie supine with head turned opposite to side of intended block and arm adducted & pulled down gently. A small pillow was placed below the shoulder to make the field more prominent. The supraclavicular space was then prepared using aseptic technique with povidone iodine (Betadine) solution, and the subclavian artery was identified by palpation. The skin was anesthetized with 1 ml of 1% lidocaine solution. Then 13 Mega Hertz probe of ultrasound machine was initially placed in mid line to identify trachea and later it was slid laterally till ultrasound image displayed posterior border of sternocleidomastoid. The roots of brachial plexus were identified as round hypo echoic structures emerging between origins of scalenus anterior and scalenus medius. These structures were traced caudally till supraclavicular space and subclavian artery was identified as a pulsating structure. The brachial plexus at this level appeared as a bunch of hypo echoic round structures lying postero laterally in ultrasound image. It was approached using a 22G, 1.5 inch needle by in plane approach. Negative aspiration of blood was confirmed. Then the remaining anesthetic was administered in 5-mL increments following aspiration. The needle was removed, and firm digital pressure was held at the site for 5 minutes to assist in proximal spread of the anesthetic. Sensory block was assessed by pinprick with 23G hypodermic needle in skin dermatomes C5-T1 once in every 5 minutes for initial 30 minutes and at 4, 6, 8, 10 and 12 hours post-operatively till patient regained normal sensations. Pain was assessed by using an 11-point (0-10) verbal numeric rating scale (VNRS) in which a score of "0" indicated "no pain" and a score of "10" indicated the "worst-ever pain." The VNRS measurements were obtained at baseline (before placement of the block), at the time of skin incision, at the completion of the surgical procedure, and at 4, 6, 8, 10 and 12 hours following placement of the block. Quality of motor blockade was assessed at the same intervals and graded according to modified bromage scale for upper limb.

A modified Bromage scale for the upper extremity

0, able to raise the extended arm to 90° for a full 2 seconds;

1, able to flex the elbow and move the fingers but unable to raise the extended arm;
2, unable to flex the elbow but able to move the fingers;
3, unable to move the arm, elbow, or fingers.

QUALITY OF OVER ALL BLOCK: an overall assessment of quality of block will be made as a three point scale as follows :
Complete failure. (no sensory loss in any of dermatomes, no motor loss at shoulder, elbow and wrist joints for 45 minutes after injection requiring general anesthesia)

Unsatisfactory block (inadequate analgesia, inadequate relaxation, patients requiring general anesthesia because of restlessness).
Satisfactory block.

DEFINITIONS:

Onset of sensory blockade: Sensory block was assessed as loss of pinprick sensation using the blunt needle. Dermatomes C5 to T1 was assessed. Onset time is the time from the completion of injection of study drug to first loss of pinprick sensation in any of the area of distribution of the nerves.

Onset of motor blockade: Onset time of motor blockade is defined as the time from the completion of injection of study drug to first loss of motor power of the four nerves graded with modified bromage scale for upper extremity.

Duration of sensory blockade: Duration of sensory blockade is the time from the onset of sensory blockade to complete recovery of sensation in all the areas of nerve distribution.

Duration of motor blockade: Duration of motor blockade is the time from the onset of motor blockade to complete recovery of motor power.

Adverse effects: Patients were monitored for any sign of central nervous system toxicity (tingling and numbness in perioral region, tinnitus, convulsion, loss of consciousness) and cardiovascular toxicity (like changes in heart rate, rhythm, signs and symptoms of CNS stimulation).

Duration of post-operative analgesia was taken till the time patient asked for rescue analgesia. Inj. Paracetamol 1g was given by slow IV infusion.

The data was entered & analyzed by computer Software Statistical Package of Social Science (SPSS version 15.0) for windows. Mean difference between the 2 groups regarding age and weight were calculated using Unpaired t- test. Chi-square test was used to analyze difference between gender. Unpaired t -test was applied for assessment of onset & duration of motor & sensory block. Results were considered stastically significant if $p < 0.05$.

RESULTS:

After taking informed consent 60 ASA class I and II patients posted for elective upper limb forearm surgeries were grouped randomly into either Levobupivacaine group (L group) or Bupivacaine group (B group). Under aseptic precaution's ultrasound guided supraclavicular brachial plexus block was done with either 0.5% Bupivacaine or 0.5% Levobupivacaine and various parameters were studied. There was no statistically significant difference between two groups with regard to age, weight, sex distribution and duration of surgery (p value >0.05). There was no significant difference between both the groups in heart rate & arterial pressure. ECG & SPO2 were maintained throughout the surgery in both groups. The onset of sensory block in our study was studied at various dermatomal levels. The mean(median) onset of sensory block was earlier in C5 dermatome –7.23(5) min. and delayed at T1 dermatome – 10.93(10) min. in B group whereas onset of sensory block was earlier in C5 dermatome – 6.10(5) min and delayed at T1 dermatome – 11.37(10.5) min. in L group. It was found that mean onset of sensory block was delayed in patients receiving levobupivacaine in C6, C8, T1 dermatomes as compared to bupivacaine. As such, there was no statistically significant difference between 0.5% Bupivacaine and 0.5% Levobupivacaine regarding the onset of sensory block with p value >0.05. The onset of motor block was evaluated using modified bromage scale for upper extremity. There was a statistically significant difference ($p < 0.05$) between the two groups regarding the onset of motor blockade and in the time taken for complete motor blockade(Figure1). The mean duration of sensory block was 538.33±93.10 minutes with bupivacaine and 543.70±115.85 minutes with levobupivacaine and was not found to be statistically significant with p value >0.05. The duration of motor block was 617.97±90.86 minutes (mean±sd) in bupivacaine group and 490.67±75.75 minutes (mean ± sd) in levobupivacaine group and the difference was found statistically significant as p value <0.05(Figure2). Similarly, the mean duration of analgesia in Bupivacaine group was 633.47± 94.26 minutes whereas in Levobupivacaine group it was 677.5± 68.19 minutes and was significantly prolonged. This was found to be statistically significant as p value was <0.05(Figure3). The block was satisfactory in all the patients in either group accounting for 100% in B group and 100% in L group. All patients achieved sensory block with the higher dermatomes blocked more reliably. Similarly, all patients achieved a Grade 2 motor block which the was most common grade reached. None of the patients showed partial block or inadequate block. None of the patients was given general anaethesia as a rescue measure due to inadequate block. Any side effect like bradycardia, hypotension, nausea, vomiting etc. was not observed. Also, complications like pneumothorax, hematoma etc. were not seen in any of the group.

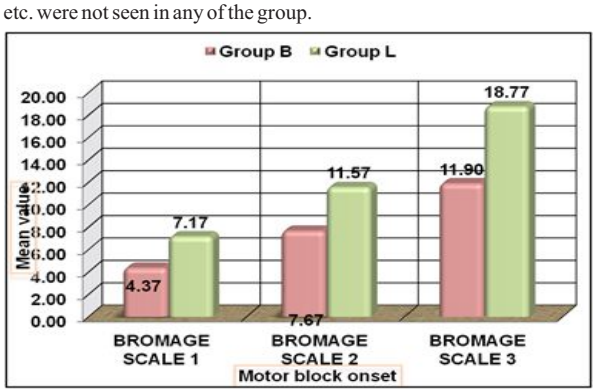

Figure 1. Comaprison among study group for Onset of Motor block(min)

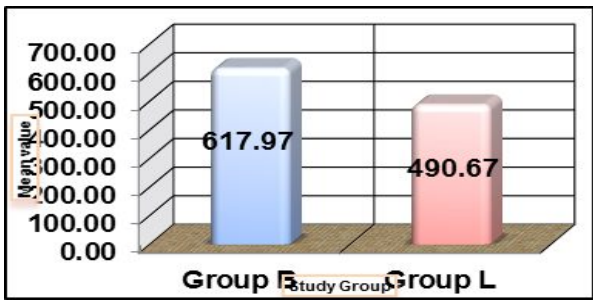

Figure 2. Comaprison among study group for Duration of Motor Block(min)

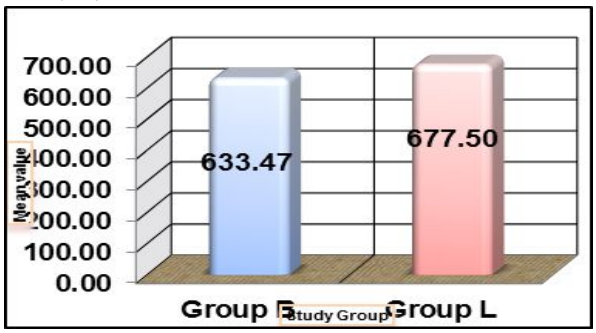

Figure 3. Comaprison among study group for Duration of Analgesia (min)

DISCUSSION:

We studied and compared the sensory and motor blocking properties of Bupivacaine with Levobupivacaine under usg guided supraclavicular brachial plexus block in our institute. Levobupivacaine is the latest local anesthetic agent that has significantly less cardiac and neural toxic effects than bupivacaine, while still possessing a similar duration of sensory blockade. Numerous comparative studies between levobupivacaine and bupivacaine suggested that levopivacaine produced less cardiac and central nervous system toxic effects, less motor block, and a prolonged duration of action of sensory analgesia. Therefore, these two local anesthetics with their comparable safety profile was selected in our study. Chemical compounds which are highly lipophilic tend to penetrate the nerve membrane more easily, as a result of which a strict correlation exists between the lipid solubility of the local anesthetic and its potency as well as toxicity due to which fewer molecules are required for conduction blockade resulting in enhanced potency. Several studies comparing bupivacaine with other local anaesthetics for different peripheral nerve blocks showed that nerve blocks produced by bupivacaine have a clinical profile similar to that obtained by levobupivacaine, when used at similar concentrations and doses; on the contrary increasing the concentration and dose of levobupivacaine at 0.5%-0.75% concentration speed up the onset time and prolonged the duration and quality of levobupivacaine's nerve block as compared to bupivacaine. Hence, we selected 0.5% bupivacaine and 0.5% levobupivacaine for comparison in our study. In 1998, COX CR et al[7]. Conducted a prospective randomized study to compare clinical efficacy of Levobupivacaine with Bupivacaine used in brachial plexus block in 75 patients undergoing elective hand surgeries in which they used 0.25%, 0.5% of S(-) Bupivacaine or 0.5% RS Bupivacaine. Supraclavicular block was done using nerve stimulator using 0.4ml/kg of the study drugs. They concluded that there was no significant differences between groups in onset time, maximum grade, or duration of motor block. However, there was an overall lower success rate with 0.25% drug.

In our study we kept doses and volume of both local anesthetics same i.e. 100 mg and 20 ml of 0.5% in each group in order to avoid exceeding maximum recommended doses of these drugs and less volume of drug was sufficient to produce sensory and motor blockade due to the use of ultrasound which allows accurate visualization of brachial plexus and drug spread in relation to nerve structures of brachial plexus. In 2014, Jyoti Pushkar et al[8]. Did a study comparing bupivacaine with levobupivacaine using 0.5% 0.4 ml/kg of either drug in patients undergoing supraclavicular brachial plexus block under USG guidance. In 1994, Stephan Kapral, et al[9] .Conducted a prospective study on 40 patients (ASA grades 1-11) undergoing surgery of the forearm and hand and they concluded that ultrasonography-guided approach for supraclavicular block combines the safety of block with the larger extent of block of the supraclavicular approach.

Levobupivacaine produced sensory block of longer duration as compared to bupivacaine. There was no difference between the two drugs with regard to onset of sensory block. The onset of motor block with bupivacaine was found to be earlier than levobupivacaine. There was statistically significant difference ($p < 0.05$) between the two groups regarding the onset of motor blockade and in the time taken for complete motor blockade and this finding was comparable to studies done by Cenk Ilham et al. 2014[10] and by Charu Pandya et al. 2014[11].

The duration of motor block was prolonged with Bupivacaine which was 617.97±90.86 min as compared to levobupivacaine of 490.67±75.75 min and this difference was found to be statistically significant. Similar study conducted by Cenk Ilham et al. 2014[10], showed prolonged motor blockade with bupivacaine as compared to levobupivacaine. However, duration of analgesia was prolonged in Levobupivacaine group which was 677.50±68.19 min as compared to bupivacaine group having 633.47±94.26 min and this difference was also found to be statistically significant. This finding was similar to a study conducted by Sinardi D, Chillemi S et al. (2002)[12] when they founded a longer duration of postoperative analgesia(13 hrs), with 40 ml of 0.25% levo-bupivacaine in Interscalene block.

The following table shows the results obtained in the present study (Table 1). None of the patients in either group B or group L showed presence of any adverse reactions like bradycardia, hypotension, nausea, vomiting etc and were haemodynamically stable. Also, complications like pneumothorax, hematoma etc. were not seen in any of the group as USG guided block is shown to improve success rate & also reduce complication. In our study, because of correct needle position and the distention of the plexus sheath which was visualized by ultrasound in all patients, volume of drug was fixed as 20 ml in group L and in group B which was necessary to produce satisfying motor and sensory block in nearly all patients. Also, the onset of sensory and motor blocks was faster in our study as compared to the studies in which this block was performed by conventional or nerve stimulator technique. This was similar to the study published by McNaught et al[13], 2011 who concluded that ultrasound reduces the number of attempts, local anaesthetic volume, and postoperative pain when compared with nerve stimulator for interscalene brachial plexus block. In another study done by Marhofer P, et al[14].Demonstrated early onset of sensory block under ultrasound guidance. Also ,in study done by Jeon DG et al.[15] 2010, the time of onset in ultrasound group (12.6 ± 4.4 min) was shorter than that in patients in whom brachial plexus was not visualised (23.1 ± 5.1 min) ($P < 0.05$).

Table 1: Summary of results obtained in present study

Serial no.	Parameter	0.5% Bupivacaine					0.5% Levobupivacaine					p value
1	Sensory block onset (mean in minutes)	C5	C6	C7	C8	T1	C5	C6	C7	C8	T1	>0.05
		7.23	7.67	10.33	9.93	10.93	6.10	7.87	8.50	10.03	11.37	
2	Sensory block duration (mean in minutes)	538.33					543.70					>0.05
3	Motor block onset (mean in minutes)	1		2		3	1		2		3	>0.05
		4.37		7.67		11.90	7.17		11.57		18.77	
4	Motor block duration (mean in minutes)	617.97					490.67					<0.05
5	Overall quality of block	Satisfactory (100%)					Satisfactory (100%)					>0.05
8	Haemodynamic changes	Comparable					Comparable					>0.05
9	Duration of Analgesia(mean in minutes)	633.47±					677.50±					<0.05
10	Adverse Effects	NONE					NONE					

CONCLUSIONS:

From the present study it can be concluded that

- The onset of sensory block with bupivacaine 0.5% and levobupivacaine 0.5% are similar.
- Bupivacaine 0.5% has an early onset of motor blockade as compared to Levopivacaine 0.5%.
- Levobupivacaine 0.5% has long duration of sensory blockade but duration of motor blockade is more prolonged in bupiv acaine 0.5%.
- Use of ultrasound for performing brachial plexus block allows accurate nerve localization and reduces the dose and volume of drug.
- Analgesia due to levobupivacaine is of longer duration as compared to bupivacaine due to longer duration of sensory block.
- Use of bupivacaine and levobupivacaine both produce stable haemodynamic parameters intraoperatively when used for supraclavicular brachial plexus block.

Hence, it can be concluded that Bupivacaine 0.5% or levobupivacaine 0.5% for supraclavicular brachial plexus block produces satisfactory sensory and motor blockade added with accuracy of ultrasound imaging.

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