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A comparative study of Inj. Bupivacaine 0.5% and Inj. Ropivacaine 0.5% for Supraclavicular Brachial Plexus Block

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Abstract

Context: Bupivacaine is a commonly used local anesthetic in peripheral nerve blocks. Ropivacaine is a newer local anesthetic and has better safety profile. The study was done to compare the two drugs. *Aims:* To compare the effects of Inj. Bupivacaine 0.5% and Inj. Ropivacaine 0.5% as local anesthetic for supraclavicular brachial plexus block in upper limb orthopedic surgeries. *Study design:* Randomized comparative study. *Methods:* The study was done at a medical college hospital. The patients included in the study were randomized into two groups (Bupivacaine and Ropivacaine) and were given 30 ml of respective drug under ultrasound guidance. The drugs were compared in terms of time taken for onset of action, duration of sensory and motor block, side effects. *Statistical analysis used:* Chi-square test and student's t-test. *Results:* The time taken for onset of sensory block was less with Bupivacaine (16.6 + 3.2 min) than with Ropivacaine (19.9 + 4.0 min) (p=0.0001). The onset of motor block was earlier with Bupivacaine (21.4 + 2.6 min) in contrast to Ropivacaine (25.9 + 2.4 min) (p=0.001). The duration of sensory blockade (Bupivacaine– 343.8 + 44.4 min; Ropivacaine– 317.9 + 29.1 min) and motor blockade (Bupivacaine– 387.4 + 36.0 min; Ropivacaine– 368.7 + 33.1 min) was longer with Bupivacaine (p=0.003; p=0.019 respectively). There were no adverse effects in both the groups. *Conclusion:* At equal volumes, Bupivacaine has advantage over Ropivacaine for supraclavicular brachial plexus block.

Keywords: Supraclavicular brachial plexus block; Ropivacaine; Bupivacaine.

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Introduction

Brachial plexus block is preferred over general anesthesia for upper limb surgeries. It achieves complete relaxation, sympathetic block while maintaining stable intra-operative hemodynamics. Hence it is considered to be ideal. The sympathetic block decreases post-operative pain, vasospasm and edema. At supraclavicular level, the middle and lower plexus are blocked. Thus, it is suitable for upper limb surgeries. Ultrasound guided peripheral nerve block provides a higher rate of block success.

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Local anesthetic drugs have been traditionally used to provide anesthesia and analgesia in peripheral nerve blocks. Now, with evolving surgical procedures that are more complex, they need extended duration of anesthesia due to prolonged procedures. Hence, there is a need for increasing the duration of the block.

Bupivacaine has both properties of high quality block and longer duration of action. Hence, it is the preferred local anesthetic for peripheral nerve blocks. Ropivacaine is a newer drug that seems to be equal or superior to Bupivacaine in terms of neuronal blocking potential [1]. It has been shown in various studies that safety profile of Ropivacaine is better than Bupivacaine. It has lower central nervous system and cardiac toxicity [2]. Thus, it can be used in higher concentration. However, the limitation with Ropivacaine is that it has less intense motor block compared to Bupivacaine [3]. So this study was done to compare the efficacies of Bupivacaine and Ropivacaine in supraclavicular brachial plexus block.

Materials and Methods

The study was carried out in a medical college hospital from October 2013 to June 2015. It was a prospective randomized comparative study. The objective was to compare the effects of Inj. Bupivacaine 0.5% and Inj. Ropivacaine 0.5% in supraclavicular brachial plexus block for upper limb orthopedic surgeries. The two drugs were studied and compared with respect to onset time of sensory and motor blockade; duration of sensory and motor block; adverse effects, if any. The sample size was calculated using statistical formula at 0.05 alpha error and 0.2 beta error. The study was done after clearance from institutional ethical committee.

All the patients between 18 to 60 years of age, weighing 50 to 80 kilograms, with ASA grade I and II, posted for elective upper limb surgeries were included in the study. Patients with known hypersensitivity to the drugs used in the study were excluded. Patients with coagulopathy/ on anticoagulant medications, those with neuromuscular disorders, those with severe hepatic/renal/respiratory/cardiac diseases were excluded from the study. All those patients who had infection at the site where the block is given and those refused to give consent were also excluded. A total of 78 patients were included in the study. They were randomized to two groups of 39 each – Group B and Group R. It was done using computer generated randomization table.

During the pre-operative visit, basic demographic characteristics; detailed history including previous medical illness and allergies; examination findings; relevant investigations done were recorded. Written informed consent was documented from all the patients. At the time of surgery, the supraclavicular area was aseptically prepared and draped after placing the patient in proper position. The best possible view of brachial plexus was obtained by placing the ultrasound probe over supraclavicular fossa in coronal oblique plane. The probe used in the study was a linear 38 mm, high frequency 10-15 MHz transducer of Sonosite M Turbo ultrasound machine. After visualizing the brachial plexus, the block was given using a 5 cm 22G insulated block needle by lateral to medial "in plane" approach. The needle was advanced towards the target nerves along the long axis of transducer, while the needle shaft and tip were visualized in real time. After negative aspiration for blood, 30 ml of local anesthetic drug was injected to cause hydro dissection of the planes around the plexus. Patients in group B received 30 ml of 0.5% (5 mg/ml) Bupivacaine and those in group R received 30 ml of 0.5% (5 mg/ml) Ropivacaine. The spread of local anesthetic was observed and the needle repositioned as needed to ensure distribution around all the nerve trunks and divisions within the plexus sheath.

The quality of sensory block was assessed using 23G hypodermic needle by pin prick method along the dermatomes C4–T2. It was assessed once in every minute for first 30 minutes, then every 30 minutes till patient recovered normal sensation. It was recorded according to Visual Analog Scale (VAS) i.e., 0– no pain; 2– annoying (mild pain); 4– uncomfortable (moderate pain); 6– dreadful (severe pain); 8– horrible (very severe pain); 10– agonizing (worst possible pain).

The quality of motor block was examined at same intervals and rated according to Modified Lovett's Scoring i.e., Grade 6 – normal; Grade 5 – slightly reduced muscular force; Grade 4 – pronounced reduction; Grade 3 – slightly impaired mobility; Grade 2 – pronounced mobility impairment; Grade 1 – almost complete paralysis; Grade 0 – complete paralysis.

The time taken for onset of motor block was defined as interval between completion of injection of study drug and development of Lovett's grade 1 motor block. The time taken for onset of sensory block was defined as time span from completion of injection of study drug till VAS score of zero on pin prick testing. The duration of motor blockade was

defined as the gap between onset of motor block and complete recovery of motor power. It was assessed objectively as time taken from Lovett's grade 1 to Lovett's grade 6. The duration of sensory block was defined as time from onset of sensory block (VAS score of zero) till patient feels pin prick (VAS score of two).

Patients were monitored for any adverse effects like nausea, vomiting, bradycardia, convulsions, restlessness, disorientation, drowsiness and other complications.

Statistical analysis was done using student's t - test for non parametric data and chi square test for categorical data. A two tailed p value less than 0.05 was considered statistically significant.

Results

The present study was done on 78 patients between 18-60 years of age, who underwent elective upper limb surgeries lasting more than 30 minutes. Patients were randomized to two groups of 39 each. Group B received 30 ml of 0.5% Bupivacaine. Group R received 30ml of 0.5% Ropivacaine for brachial plexus block by ultrasound guided supraclavicular approach. There was no statistically significant difference between the two study groups with respect to baseline characteristics like age, gender, weight and duration of surgery (Table 1). The types of surgeries performed were almost identical in both the groups.

The mean onset time of sensory and motor blockade was 16.6 ± 3.2 min and 21.4 ± 2.6 min respectively in Bupivacaine group when compared to 19.9 ± 4.0 min and 25.9 ± 2.4 min respectively in Ropivacaine group. Thus, we found that onset of both sensory and motor blockade was earlier with Bupivacaine than with Ropivacaine (p=0.001) (Table 2).

The mean duration of sensory and motor blockade in Bupivacaine group was 343.8 ± 44.4 min and 387.4 ± 36.0 min respectively in contrast to Ropivacaine group having mean duration of sensory blockade and motor blockade of 317.9 ± 29.1 min and 368.7 ± 33.1 min respectively. Thus, we found that duration of sensory and motor blockade was longer with Bupivacaine (p=0.001; p=0.019 respectively) (Table 2).

Table 1: Baseline characteristics of patients in Bupivacaine and Ropivacaine group

Baseline characteristics	Bupivacaine (n=39)	Ropivacaine (n=39)	Level of significance #
Gender			
Male	26 (52.0%)	24 (48.0%)	0.637
Female	13 (46.4%)	15 (53.6%)	
Age	36.2 + 10.6*	36.9 + 9.1*	0.758
Weight			
50-60 kg	8 (61.5%)	5 (38.5%)	
61-70 kg	15 (44.1%)	19 (55.9%)	0.55
71-80 kg	16 (51.6%)	15 (48.4%)	
Duration of surgery	126.4 + 33.0*	116.2 + 36.5*	0.196

*Mean + SD

#p value obtained for assessing significant difference between the two groups with respect to baseline characteristics (Chi square test was used for categorical data and student t – test for non parametric data).

Table 2: Outcome measures in Bupivacaine and Ropivacaine groups

Outcome measures	Bupivacaine (n=39) Mean + SD	Ropivacaine (n=39) Mean + SD	Level of significance #
Onset of sensory blockade	16.6 + 3.2	19.9 + 4.0	0.0001
Onset of motor blockade	21.4 + 2.6	25.9 + 2.4	0.0001
Duration of sensory blockade	343.8 + 44.4	317.9 + 29.1	0.003
Duration of motor blockade	387.4 + 36.0	368.7 + 33.1	0.019
Adverse effects			
Nil	37 (94.9%)	39 (100%)	0.152
Vomiting	2 (5.1%)	0 (0%)	

SD- Standard Deviation

#p value calculated for statistically significant difference between Bupivacaine and Ropivacaine groups with respect to outcome measures (Chi square test was done for categorical data and students t-test for non parametric data)

In our study, 2 patients in the Bupivacaine group had vomiting and none in Ropivacaine group. The variations in hemodynamic parameters like heart rate, systolic and diastolic blood pressure were similar in both the groups (p=0.05) and all of them were hemodynamically stable. This signifies that adverse effects were not significant with either drug during the study.

Discussion

The brachial plexus block is one of the commonly used peripheral nerve block technique. The supraclavicular approach provides a successful blockade as it causes homogenous spread of anesthetic agent throughout the plexus. There is dissimilarity among various local anesthetics with respect to their duration and onset of action. Ropivacaine is a recently added long acting local anesthetic. It is shown to be equally potent as Bupivacaine, with lesser side effects.

In our study, we observed that onset of sensory and motor block was earlier with Bupivacaine than with Ropivacaine. This was similar to the study conducted by Tripathi D *et al.* [4]. They showed that the peak effect of sensory and motor blockade was earlier with Bupivacaine in contrast to Ropivacaine (p=0.05). Similarly, in another study by Narendra Babu *et al.* [5], the time of onset of sensory and motor block was less for Bupivacaine when compared to Ropivacaine.

In our study the duration of both sensory and motor block was found to be longer for Bupivacaine. Similar results were reflected in a study by Narendra Babu *et al.* [5]. In another study by Mc Glade *et al.* [6], they observed that quality of anesthesia was similar with both Bupivacaine and Ropivacaine. They also noted that motor block lasted for extended duration with Bupivacaine.

In the study led by Mclellankj *et al.* [7], they found Ropivacaine to be equally efficacious as Bupivacaine. Though Ropivacaine had lesser potential for motor block, it was better tolerated. So, they concluded Ropivacaine as preferred choice in view of it's lesser central nervous system and cardiac toxicity.

In a study by Singelyn FJ [2], it was inferred that Ropivacaine was as efficient as Bupivacaine in terms of duration and quality of analgesia, anesthesia and motor block. It was concluded that Ropivacaine was superior to Bupivacaine with earlier onset of sensory and motor block. However, this remains debatable.

In the study led by Reader *et al.* [8], 0.75% Ropivacaine was compared with equal volume of 0.5% Bupivacaine. The onset and duration were found to be identical in both the groups. They concluded that a concentration of 0.75% was required for Ropivacaine to provide anesthesia akin to equal volume of 0.5% Bupivacaine.

In our study, there was not much distinction between the two groups in terms of hemodynamic parameters monitored during surgery. This was akin to the study led by Tripathi D *et al.* [4]. In their study hemodynamics remained stable in both Bupivacaine and Ropivacaine groups. Singelyn FJ [2] in his study, found Ropivacaine to be safer due to lower neurologic and cardiac toxicity. Similarly, in another study by Mclellankj *et al.* [7], Ropivacaine was better tolerated and preferred choice due to reduced cardiotoxic potential. Vaghadia *et al.* [9], in their study also got similar results. They concluded that Ropivacaine lesser toxicity even in case of inadvertent intravenous injection. In our study as the block was given under real time ultrasound guidance, the drug was properly deposited avoiding intravascular injections. Thus, systemic side effects were almost negligible with both groups. The limitation of our study is that results cannot be generalized to situations where the block is given without ultrasound guidance.

Conclusion

From our study, we deduce that at equal volumes and concentration, Bupivacaine has an edge over Ropivacaine for ultrasound guided supraclavicular brachial plexus block. Bupivacaine has earlier onset and extended duration of sensory and motor block. We also infer that ultrasound guided technique allows the drug to be properly deposited and avoids intravascular injection. Thus, it minimizes the adverse effects of both the drugs.

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Conflict of interest: Nil

Abbreviations

ASA - American Society of Anesthesiologists

Inj. - Injection

mg - milligram

mm - millimeter

cm – centimeter

ml – milliliter

MHz – Mega Hertz

G – Gauge

VAS – Visual Analog Scale

Min – minutes

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