

Effect of 0.5% Bupivacaine Versus 0.75% Ropivacaine - Onset, Duration and Quality of Brachial Plexus Block through Supraclavicular Approach

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Abstract

Introduction: The brachial block can be employed in upper limb surgery such as soft tissue surgery, bone surgery, and in plastic surgery. Local anesthetics are drugs that block reversibly the conduction of impulses in the peripheral nervous system. The aim of the present study is to compare the efficacy of 0.5% bupivacaine and 0.75% ropivacaine - the onset, duration and quality of the brachial plexus block through supraclavicular approach.

Materials and Methods: A total of 60 patients belonging to ASA Grades 1 and 2 between 20 and 60 years age of either sex were included in this study. The onset of sensory and motor block were tested every 1 min interval for a maximum of 35 min after injection of local anesthetics through supraclavicular plexus block. All patients were kept under observation for 24 h. All the observed characteristics were analyzed.

Results: The actual difference between mean duration of the onset of sensory and motor blockade in Group A and in Group B was 1.6 and 2.7 min, respectively. Duration of analgesia of Groups A and B were 678.75 ± 187 and 648.17 ± 180.91 , respectively. The most number of cases attained Grade IV that means complete block of sensory and motor functions among both Groups A and B. Complete blockade was more in Group B when compared to Group A about 66.67% and 58.62%, respectively.

Conclusion: There were no much clinical differences in onset, duration and analgesia among 0.5% bupivacaine and 0.75% ropivacaine when injected in equal volumes for brachial plexus block by the supraclavicular approach. Ropivacaine has potentially improved safety profile compared with bupivacaine.

Key words: Bupivacaine, Ropivacaine, Supraclavicular plexus

INTRODUCTION

The brachial block can be employed in upper limb surgery such as soft tissue surgery, bone surgery, and in plastic surgery.

The advantages of regional anesthesia are that it is simple, easy to learn and practice and no untoward effects of

general anesthesia agents. It can be employed in patients with a systemic disease where general anesthesia is hazardous. It is used in prolonged duration of surgery by a continuous infusion technique. It gives prolonged duration of post-operative analgesia.

Local anesthetics are drugs that block reversibly the conduction of impulses in the peripheral nervous system. Local anesthetics may be combined for rapid onset of action (chloroprocaine) and prolonged duration of action (bupivacaine). Local anesthetics toxicity of combination of drugs is additive rather than synergistic.¹

Bupivacaine has been used for all the types of nerve blocks, lumbar and caudal epidurals, paracervical blocks and intravenous regional analgesia. Bupivacaine is available

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for clinical use as racemic mixtures (50:50 mixtures) of enantiomers. Local anesthetics prevent transmission of nerve impulses (conduction blockade) by inhibiting passage of sodium ions through ion-selective sodium channels in nerve membranes² so that action potential is not propagated. Bupivacaine rarely causes allergic reactions about <1%.³

Ropivacaine is new, long-acting local anesthetics, pure (S-isomer) enantiomer. Ropivacaine is chemically similar to bupivacaine, the butyl group being replaced by a propyl group. Though it has similar structure, pharmacology and pharmacokinetics to that of bupivacaine, ropivacaine has lower potential for the toxic effect. One mg basis ropivacaine shows greater selectivity for the sensory blockade and a lower systemic toxicity as compared to bupivacaine.

When clinically effective doses and concentrations are used, there are no clinically relevant differences in the comparative efficacy of ropivacaine and bupivacaine.^{4,5} With a mean dose of ropivacaine shows maximum tolerable central nervous system (CNS) effect,^{6,7} maximum tolerated total venous plasma concentration⁶ and higher arterial unbound plasma concentration⁷ of ropivacaine when compared to bupivacaine.

Both bupivacaine and ropivacaine can be used for all types of nerve blocks, epidural, Spinal anesthesia, infiltration of field block, acute pain management. They can cause minimal side effects which are depending on plasma concentration of drug,⁸ such as numbness of tongue and circumoral tissues, restlessness, tinnitus, vertigo, slurred speech, seizures, hypotension, cardiac arrhythmias,⁹ cardiac arrest,¹⁰ hepatotoxicity.¹¹

The aim of the present study is to compare the efficacy of 0.5% bupivacaine and 0.75% ropivacaine - the onset, duration and quality of the brachial plexus block through supraclavicular approach.

MATERIALS AND METHODS

After institutional approval, a prospective comparative study was conducted in the Department of Anesthesiology, Government General Hospital, Siddhartha Medical College, Vijayawada for 2 years - 2010 and 2011.

Inclusion Criteria

A total of 60 patients belonging to ASA Grades 1 and 2 between 20 and 60 years age of either sex were included in the study, scheduled for various surgical procedures on below elbow, forearm and hand.

Exclusion Criteria

Include patients with local infection, pneumothorax, peripheral neuropathy, severe liver or kidney disease, history of previous adverse reactions to local anesthetic drugs and coagulopathy.

After explaining the details of the procedure, written consent was taken from each patient. Pre-operative assessment was carried out in every patient 1 day before surgery. All the patients were premedicated in the night before doing surgery with tablet diazepam 10 mg and tablet ranitidine 150 mg.

The patients were randomly allocated into two groups according to the drug received.

Group A: Patients were given 30 ml of 0.5% bupivacaine

Group B: Patients were given 30 ml of 0.75% ropivacaine

Maximum care was taken in proper positioning of the patient. Before injecting the local anesthetics, the patient was explained about the accidental paraesthesias that may occur during the introduction of needle. By following aseptic precautions either bupivacaine or ropivacaine was injected into supraclavicular brachial plexus.

As soon as the block was given, the patient was kept comfortably with arm by the side. Electrocardiogram, blood pressure, pulse rate, respiratory rate, and arterial saturation were noted every 5 min. Signs for drug toxicity were observed.

The onset of sensory and motor block were tested every 1 min interval for a maximum of 35 min. All patients were kept under observation for 24 h. All the observed characteristics were analyzed.

Statistical Analysis

The patient data were analyzed using the unpaired *t*-test, $P < 0.05$ is considered as statistically significant.

RESULTS

A total of 60 patients were studied in the age group of 20-60 years of either sex. A most number of surgeries were performed in the age group of 20-30 years about 53.3%. A more number of males were underwent surgeries when compared to females about 80% and 20%, respectively.

The onset of sensory blockade was measured from the commencement of injection of anesthetic solution until the loss of pinprick sensation. The onset of motor blockade was measured from commencement of injection

of anesthetic solution until the loss of finger movements. The actual difference between mean duration of onset of sensory blockade and motor blockade in Group A and in Group B was 1.6 min and 2.7 min, respectively (Table 1).

Duration of sensory blockade was measured from the time of sensory loss of pinprick sensation to the time of return of pinprick sensation. Duration of motor blockade was measured from the time of loss of finger movements to time of return of finger movements. The actual difference between mean duration of sensory and motor blockade in Groups A and B was 36.36 and 14.51 min, respectively (Table 2).

The duration of analgesia of Groups A and B were 678.75 ± 187 and 648.17 ± 180.91 , respectively. The difference in duration between two groups is 30.58 min.

Grading of sensory and motor blockade was assessed in both groups and results were tabulated in Table 3. Most number of cases attained Grade IV which means complete block of sensory and motor functions among both Groups A and B. Sensory blockade in Grade IV was observed in more number of patients about 72.8% when compared to Motor blockade about 62.7%.

Quality of blockade was assessed which is expressed in terms of complete blockade, incomplete blockade and

failure (Figure 1). Complete blockade was more in Group B when compared to Group A about 66.67% and 58.62%, respectively. Incomplete block observed in 41.37% of Group A and 26.67% of Group B patients. Failures were not observed in Group A, but in Group B failures were 2 patients (6.66%).

Drug supplementation is needed in few patients and the requirement of supplementation with drugs like ketamine or pentazocine or midazolam among Groups A and B (Table 4). The Chi-square test shown not significant.

Complications were noted during and after surgery in both groups. Various complications occurred were depicted

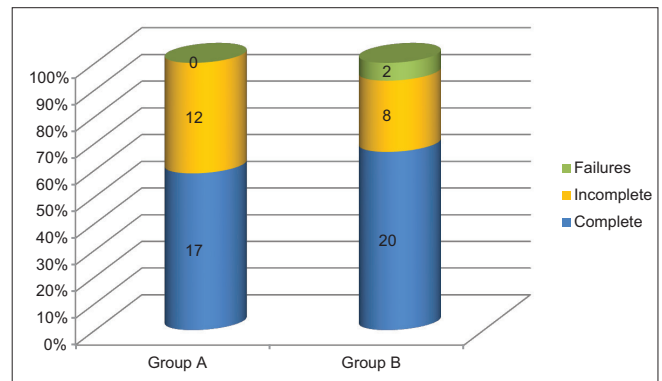


Figure 1: Representing quality of blockade of bupivacaine and ropivacaine

Table 1: Onset of sensory and motor blockade in minutes

Parameter	Time in minutes		t value	P value	Significance
	Group A	Group B			
Loss of pinprick sensation (mean±SD)	14.06±4.13	12.46±2.28	1.7998	>0.05	NS
Loss of finger movements (mean±SD)	19.48±6.0	16.78±4.63	1.8921	>0.05	NS

SD: Standard deviation, NS: Not significance

Table 2: Duration of sensory and motor blockade in minutes

Parameter	Time in minutes		t value	P value	Significance
	Group A	Group B			
Recovery of pinprick sensation (mean±SD)	612.82±150.3	576.46±179.3	0.899	>0.05	NS
Recovery of motor paralysis (mean±SD)	478.79±143.4	464.28±187.6	0.328	>0.05	NS

SD: Standard deviation, NS: Not significance

Table 3: Grade of sensory and motor blockade in both groups

Grade of blockade	Group A				Group B				Total number of cases	
	Number of cases		% of cases		Number of cases		% of cases		Sensory	Motor
	Sensory	Motor	Sensory	Motor	Sensory	Motor	Sensory	Motor		
Grade I	0	0	0	0	2	2	6.67	6.67	2	2
Grade II	8	1	27.59	3.44	6	0	20	0	14	1
Grade III	0	11	0	37.93	0	8	0	26.66	0	19
Grade IV	21	17	72.41	58.63	22	20	73.33	66.67	43	37
Total	29	29	100	100	30	30	100	100	59	59

in Table 5. Hematoma, horners syndrome, bradycardia, hypertension, brachial neuritis, pneumothorax, hemothorax not occurred in the present study.

DISCUSSION

The selection of optimal long-acting local anesthetic and concentration for brachial plexus block must take into consideration the available anesthetics, the time to onset, duration of blockade and side effects of each drug and dose.

A most number of surgeries were performed in the age group of 20-30 years about 53.3%. Many studies^{12,13} observed that most number of surgeries was performed in the age group of 21-30 years. Male predominance was seen in this study. This may be due to males in younger age group go for outside works, they are more prone for trauma.

In the present study, the onset of sensory and motor blockade was faster with 0.75% of ropivacaine when compared to 0.5% of bupivacaine. Duration of sensory and motor blockade is lesser with 0.75% ropivacaine when compared with 0.5% of bupivacaine. However, there is no much clinical difference in onset, duration of sensory and motor blockade and duration of analgesia.

In line with this study Misolek *et al.*,¹⁴ Vainionpää *et al.*,¹⁵ Hickey *et al.*,¹⁶ Katz *et al.*¹⁷ also concluded that there was no important clinical difference between 0.75% ropivacaine and 0.5% bupivacaine in terms of onset, duration and quality of analgesia.

Few studies such as Raeder *et al.*,¹⁸ McCrae *et al.*,¹² documented that the onset time of both sensory and motor blockade between 11 and 20 min. Other studies like Bertini *et al.*¹⁹ were observed prolonged time about 23-48 min and

Klein *et al.*²⁰ observed less time about <6 min than our study. These differences may be attribute to the anatomic location of the different nerve blocks (supraclavicular, interscalene, and subclavicular) and the technical procedure used. Akerman *et al.*,²¹ ropivacaine is longer acting than bupivacaine upon infiltration, equally effective in peripheral nerve block and slightly shorter acting in subarachnoid and epidural anesthesia.

As per this study, 58.62% of patients in Group A and 66.67% of cases in Group B had complete block. 41.37% in Group A and 26.67% cases in Group B had incomplete block. There are no failures in Group A, but Group B has 66.6% of failure cases (2 patients) in the present study. In the study by Raeder *et al.*,¹⁸ axillary brachial plexus block with 40 ml of 0.75% ropivacaine versus 0.5% bupivacaine found that, there was significantly higher quality scores for anesthesia, partial and complete motor block in ropivacaine patients, whereas analgesia scores were similar.

In the present study, 41% of patients in Group A needed further supplementation whereas 26.67% of cases in Group B needed further supplementation of drugs. Hematoma, Horners syndrome, bradycardia, hypertension, brachial neuritis, pneumothorax, hemothorax not occurred in the present study. One case of convulsions noted with bupivacaine. Arterial puncture and tachycardia was observed with bupivacaine and also ropivacaine.

Scott⁶ documented that ropivacaine caused less CNS symptoms and was at least 25% less toxic than bupivacaine. The majority of symptoms occurred early and as a maximum effect with bupivacaine ($P < 0.05$). Chazalon *et al.*,¹⁰ Huet *et al.*²² reported that cardiopulmonary resuscitation following ropivacaine injection was successful. In contrast, this Long *et al.*,²³ Tsai *et al.*,²⁴ documented that cardiac arrest is difficult to treat and may require cardiopulmonary bypass. In this study, there was no incidence of ropivacaine toxicity.

Although appears to be a considerable difference, when these results are subjected to statistical analysis by using Chi-square test, they are statistically insignificant.

CONCLUSION

About 30 ml of 0.5% bupivacaine or 30 ml of 0.75% ropivacaine for supraclavicular brachial plexus block produced satisfactory and comparable sensory, motor block related to onset, duration, quality and duration of analgesia. The lower CNS and cardiotoxicity of ropivacaine may help in reducing risk to the patient. There were no much clinical differences in onset, duration and analgesia among

Table 4: Need of further drug supplementation

Group	Supplementation of drug		Total
	Required	Not required	
A	12	17	29
B	8	22	30
Total	20	39	59

Table 5: Complications due to bupivacaine and ropivacaine injections

Complications	Group A (n=30)	Group B (n=30)	Total
Arterial puncture	2	1	3
Tachycardia	6	4	10
Seizures	1	0	1

0.5% bupivacaine and 0.75% ropivacaine when injected in equal volumes for brachial plexus block by supraclavicular approach. Hence, the choice of local anesthetic should not be based on onset and duration time alone. Ropivacaine has potentially improved safety profile compared with bupivacaine, it may offer an advantage.

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