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Comparative study on efficacy of ropivacaine and bupivacaine for supraclavicular brachial plexus

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Abstract
Supraclavicular brachial plexus block is a very popular mode of anaesthesia for various upper limb surgeries, due to its effectiveness in terms of cost, performance, margin of safety and good post-operative analgesia. The study was a prospective randomized, double blind control study conducted on 60 patients aged 20 to 60 years, undergoing elective upper limb surgeries under supraclavicular brachial plexus block. Onset of sensory block between the two groups shows that onset of block is earlier in group B (Ropivacaine) with mean value of 11.93 min compared to group A(Bupivacaine) with a mean value of 14.33 min and is statistically significant. Onset of motor block is higher in Group A with mean value of 19.7 min compared to group B which has a mean value of 14.9 min and is statistically significant. Comparison of duration of block between the two groups shows that duration of sensory block is longer in group A with a mean value of 446.43 min compared to group B with a mean value of 420.37 min and is statistically significant. Duration of motor block is longer in group A with a mean value 406.97 min and is statistically significant.

Keywords: brachial plexus block, upper limb surgeries, bupivacaine, ropivacaine

Introduction
Supraclavicular brachial plexus block is a popular mode of anaesthesia for various upper limb surgeries due to its effectiveness in terms of cost, performance, margin of safety and better postoperative analgesia [1].
Regional anesthesia avoids the unwanted effect of anaesthetic drugs used during general anaesthesia and stress of laryngoscopy and tracheal intubation. Patients can have postoperative period free from nausea, vomiting and postoperative pain.
Brachial plexus blockade is widely used regional nerve block technique of upper limb surgeries.
Bupivacaine is commonly used as the local anesthetic for brachial plexus anesthesia which belongs to amide group. Bupivacaine binds to the intracellular portion of sodium channels and blocks sodium influx into nerve cells, which prevents depolarization [2]. It was observed that using racemic mixture of bupivacaine resulted in cardiac and central nervous system toxicity in some patients.
Ropivacaine is a local anesthetic agent with a chemical formula similar to that of other amino amides. Ropivacaine has been evaluated for brachial plexus block in humans in terms of efficacy and safety.
Ropivacaine is less lipophilic than Bupivacaine. It has selective action on the pain transmitting A β and c nerves rather than Aβ fibers, which are involved in motor function. Various studies shows that ropivacaine produces less cardiac as well as central nervous system toxic effects, less motor block and a similar duration of action of sensory analgesia as compared to bupivacaine [3, 4].
This study is to compare efficacy of Ropivacaine and Bupivacaine for supraclavicular brachial plexus block and to note down any other side effects of drugs.

Methodology
Informed and written consent was taken from selected patients. Following approval of institutional ethics committee, 60 patients aged 20-60 years, weighing more than 50 kgs were taken up for the study.

All the patients were evaluated thoroughly on the previous day of the surgery. A detailed history, complete physical examination and routine investigations were done for all patients were explained about procedure.
Informed consent was obtained from all the patients enrolled for the study.
Patients were kept Nil per orally for 6 hours before the time of surgery and on the previous night premeditated with Diazepam 5 mg and Ranitidine 150mg.
60 patients ASA I and ASA II were randomly allocated with sealed envelope method into two different groups of 30 each. Both observer and participant were blinded.
GROUP A- received (n=30) 25 ml of 0.5% bupivacaine
GROUP B -received (n=30) 25 ml of 0.5% ropivacaine
Patient was shifted to operating room, Standard monitors connected: Non- invasive blood pressure (NIBP) Heart rate (HR)-electro radiography (ECG), oxygen saturation using standard pulse oximeter (spo2) which were recorded at five minutes intervals during initial period.
An IV line secured in all patients.
Supraclavicular brachial plexus block was performed according to the technique described by Winnie, where observer and participant were blinded according to study.
Patients will be placed in supine position with the head turned away from the side to be blocked.
Arm to be anesthetized was kept in adduction and extended towards the ipsilateral knee as per as possible. Supraclavicular area aseptically prepared and draped.
An intradermal wheal raised about 1 cm above the midclavicular point. Subclavian artery palpable in supraclavicular fossa used as landmark.
Brachial plexus was approached by supraclavicular route using a 22 gauge needle behind the artery in a caudal, slightly medial and posterior direction till paraesthesia in the forearm elicited or the first rib is encountered.
On localization of brachial plexus, aspiration for blood should be performed before incremental injections of a total volume of around 25 ml of local anesthetic.
The following parameters were find out and discussed in the study.

- Vital parameters: Blood pressure, heart rate, oxygen saturation.
- Onset of action of sensory block: The time interval between the administration of local anaesthetic to loss of pin prick sensation.
- Onset of action of motor block: The time interval between administration of local anaesthetic to loss of motor movements.
- Duration of sensory block: Time interval between loss of pain prick sensation to appearance of pain prick sensation.
- Duration of motor block: Time interval between loss of movements to appearance of movements.

Sensory block was assessed by pinprick method.
Grade 0- sharp pain felt
Grade 1- analgesia, dull pain felt Grade 2- anesthesia, no sensation felt.
A modified Bromage scale for the upper extremity was used to assess motor function.

0- Able to raise the extended arm to 90^0 for a full 2 sec
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

Results

Table 1: Independent t test for comparison of mean Age and Weight of two groups

.	Group	N	Mean	Std. Deviation	T	Df	P value
Age	Bupivacaine	30	38.23	8.123	0.878	58	0.384
	Ropivacaine	30	36	11.326			
Weight	Bupivacaine	30	65.27	5.854	-0.699	58	0.487
	Ropivacaine	30	66.4	6.673			

The two groups were matched for age and body weight. They are comparable

Table 2: Onset time of sensory block

	Group	N	Mean	Std. Deviation	T	Df	P value
Sensory onset of block	Bupivacaine	30	14.33	1.561	7.205	47.722	<0.001
	Ropivacaine	30	11.93	0.944			

Sensory onset of block between the two groups shows that onset of block is earlier in group B with mean value of 11.93 min compared to group A with a mean value of 14.33 min and is statistically significant. This difference was statistically highly significant (p<0.001).

Table 3: Onset time of motor block

Motor onset of block	**Bupivacaine**	**30**	**19.7**	**1.557**	**14.526**	**47.139**	**<0.001**
	Ropivacaine	30	14.9	0.923			

Motor onset of block is higher in Group A with mean value of 19.7 min compared to group B which has a mean value of 14.9 min and is statistically significant. This difference is statistically highly significant (p<0.001).

Table 4: Duration of Sensory and Motor block in two groups

Sensory duration of block	**Bupivacaine**	**30**	**446.43**	**3.945**	**33.386**	**38.846**	**<0.001**
	Ropivacaine	30	420.37	1.65			
Motor duration of block	Bupivacaine	30	406.97	4.038	51.379	41.24	<0.001
	Ropivacaine	30	365.1	1.9			

Comparison of duration of block between the two groups shows that sensory duration of block is longer in group A with a mean value of 446.43 min compared to group B with a mean value of 420.37 min and is statistically significant. Duration of motor block is longer in group A with a mean value 406.97 min and is statistically significant. These differences in duration of block in two groups is statistically highly significant (p<0.001).

Discussion

After written and informed consent, 60 patients of ASA1 and 2 were allotted into two different groups, where patients in group A received 0.5% Bupivacaine and group B patients received 0.5% Ropivacaine. Vitals like HR, SBP and DBP were monitored intraoperatively and postoperatively.
Onset of sensory and motor block was faster in Ropivacaine in comparison to Bupivacaine. The duration of sensory and motor blockade was prolonged in Bupivacaine compared to Ropivacaine. There was a faster recovery of motor functions in Ropivacaine group compared to Bupivacaine group.
Demographic data like age, gender, male to female ratio and ASA status were taken into consideration. The groups were comparable in terms of age, gender and weight.

Comparison of gender distribution among the two groups shows that males were higher in both the groups when compared to the females, which was statistically not significant. (Male: female – 73.3%:26.7% and 76.7%:23.3% in group A and group B respectively).

ASA status in both groups are comparable. ASA 1 and 2 patients were taken for study. It was similar to the study by Gonuguntla SB in 2016 [6] who studied 60 patients aged between 18 and 60 years old of both sex of ASA I and II undergoing elective upper limb surgeries under supraclavicular brachial plexus block. Results of the their study too, did not show significant difference in the demographic data of the groups of patients as regard age, male to female ratio, ASA physical status.

The onset of sensory block was earlier in 0.5% ropivacaine with a value of 11.93 min compared to 0.5% bupivacaine with a value of 14.33 min. Motor onset of block was earlier in ropivacaine with a value of 14.9 min.

Duration of motor and sensory blockade was longer in bupivacaine. The results of our study support Kaur A *et al.* [7] in 2015 conducted a prospective randomized study in 50 patients aged between 18-55 years. They concluded that onset of action of sensory, motor block was early in ropivacaine group with faster recovery of motor functions as compared to Bupivacaine group.

Modak S *et al.*, in 2016 [6] conducted a prospective double blind randomized study involving 60 patients of either sex, ASA 1 and 2. They received 30 ml of ropivacaine 0.5% and bupivacaine 0.5%. Ropivacaine had earlier onset of sensory and motor blockade compared to Bupivacaine. The duration of block was longer in ropivacaine.

In comparison with our study, Mohan IR *et al.* in 2016 [7] Babu N *et al.* in 2014 [8] and Tripathi D *et al.* in 2012 [9] observed that onset of sensory and motor block was earlier in Bupivacaine group.

Hickey R *et al.* in 1991 observed that there were no much statistically and clinically differences in onset and duration of block in their study.

Gonuguntla SB in 2016 [10] and Babu N *et al.* in 2014 [8] observed adverse effects such as Nausea, vomiting, arterial puncture, tachycardia, seizures, horner's syndrome in their study. There were no such adverse effects in our study.

Conclusion

- The duration of sensory and motor blockade was prolonged in Bupivacaine compared to Ropivacaine.
- There was a faster recovery of motor functions in Ropivacaine group compared to Bupivacaine group.
- Both local anaesthetics are an effective and reliable choice for anaesthesia of the brachial plexus.

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