



Supraclavicular Brachial Plexus Block-A Comparative Study between Ropivacaine and Bupivacaine

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Abstract

Supraclavicular brachial plexus block is a commonly used technique of regional anaesthesia for upper limb surgeries. Different types of local anaesthetic drugs have been used to perform this type of block. A comparatively newer long acting amide local anaesthetic drug Ropivacaine with better safety profile is used in this study and compared with commonly used local anaesthetic bupivacaine.

A prospective randomised double blind study was carried out in 60 patients posted for upper limb orthopaedic surgery. One group received 25 ml 0.75% ropivacaine and the other group received 25ml 0.5% bupivacaine. Patients were evaluated for sensory, motor characteristics of the block, haemodynamic variables and side effects at 5,30,60 mins and then hourly interval till block offset. It was observed that onset of sensory block was attained faster, and the duration was seen in group which received ropivacaine where as onset and peak of motor block was faster attained and duration is more in group which received bupivacaine.

Since prolonged sensory block provides excellent postoperative analgesia, and extended motor block is not desirable as it limits patient mobility, block with ropivacaine may be considered superior to bupivacaine.

Keywords: *Supraclavicular brachial plexus block, Bupivacaine, Ropivacaine.*

Introduction

Brachial plexus block is a commonly used regional anaesthesia technique for upper limb surgeries which provides motor block as well as excellent intraoperative and postoperative analgesia. The anatomy of brachial plexus with its three trunks confined to a much reduced surface area, allows for a high success rate of supraclavicular approach for achieving anaesthesia in the upper extremity.

Knowledge of anatomy, familiarity with simple landmarks, and meticulous technique are necessary to safely perform this highly efficacious technique of brachial plexus blockade.

The main drawback of local anaesthetic bupivacaine, is its unpredictable latency of nerve block when small volume of local anesthetic solution is injected. Also it has high risk for neuro and cardio toxicity when large volume of the drug is required.

Ropivacaine is a long acting amide local anesthetic agent, which has got potentially improved safety profile when compared to bupivacaine. Ropivacaine intravenous injection causes less cardiac depression and fewer CNS effects according to some trial studies. It suggests a clinical advantage of Ropivacaine over Bupivacaine during neural blockade when large volume of the drug is required.

This also enable the use of the solution with a

higher concentration to enhance the speed of onset and to prolong duration.

Objective

The rationale behind this study is to compare the effect of ropivacaine and bupivacaine in brachial plexus block.

Materials and Methods

Study Design: Randomised Double blind clinical trial

Study Setting: Study was conducted in Department of Anaesthesiology, Government Medical College Kottayam

Study Period: 12 months

Study Population: ASA-PS (American society of Anaesthesiologists–Physical Status) I and II patients in age group 18-60 years undergoing upper limb surgeries admitted in the department of orthopedics

Inclusion and Exclusion Criteria

Study population consists of 60 patients undergoing orthopedic procedures of upper limbs

Inclusion Criteria

1. ASA-PS I & II
2. Age group 18-60 years
3. Body weight between 60 and 90 kg

Exclusion Criteria

1. ASA-PS III & IV
2. Age group <18 Years, >60 years
3. Body weight <60 kg, >90 kg
4. Patients with history of cardiac, respiratory, hepatic and/or renal failure.
5. Pregnant or lactating women.
6. Patients known to sensitive to one of the study medications.
7. Patients with contraindications to brachial plexus block such as local site infections, clotting disorders.

Sample Size

60 patients who fulfilled the inclusion and exclusion criteria were randomly allocated into two groups of 30 each.

With available data sample size was calculated using the formula

$$N = \frac{2\sigma^2 \times (Z_{\alpha} - \alpha + Z_{\beta} - \beta)^2}{(\mu_t - \mu_s - \theta)^2}$$

$Z_{\alpha} = 1.96$ $Z_{\beta} = 0.834$ 5% significance at 80% error (β error = 20%)

Sampling Method: By block randomisation and allocation concealment by sealed envelope

Procedure in Details: This prospective randomized double blind study will be carried out in 60 patients aged 18-60 years of physical status ASA I or II, 60-90 kg body weight posted for upper limb orthopedic surgery.

In all patients weight, pulse rate, blood pressure were recorded. All patients were 8 hours nil per oral, had informed written consent and were premedicated with Tab. Ranitidine 150mg, Tab. Metochlopramide 10 mg, Tab. Alprazolam 0.25mg on previous night and morning 6am on day of surgery.

After recording the baseline vital parameters and securing intravenous access, midazolam 0.02 mg/kg were given 15 minutes before surgery. Monitoring consists of non-invasive blood pressure, pulse oximeter and electrocardiogram.

Patients were randomly allocated, by distributing sealed envelopes, to one of the two groups of 30 patients each, one group receiving 25 ml 0.75% Ropivacaine and other group receiving 25ml 0.5% Bupivacaine.

After appropriate positioning of the patient, brachial plexus block was performed by supraclavicular approach using a nerve stimulator. Patients were evaluated for sensory and motor characteristics of the block (onset, peak and duration), hemodynamic variables and side effects if any at 5, 30, 60 minutes and then, at hourly interval till sensory and motor block offset. Thereafter, patients were monitored at four hourly intervals for hemodynamic variations and side effects for next 24 hours. Sensory and motor effects were evaluated using grading.

The following criteria were assessed in the operating room

1. The time of onset of sensory blockade according to 3 point score
 - 0-Normal response to pinprick
 - 1-Dull response to pinprick (onset)

- 2-No response to pinprick (peak)
- 2. Individual muscle group test were
- 3. be done for assessing motor blockade
- 0-no motor blockade
- 1-partial blockade
- 2-Complete motor blockade
- 4. Systolic Blood pressure, Heart rate were measured throughout the study.
- 5. The quality of analgesia was assessed during surgery, in the recovery room and in surgical ward according to Visual analogue scale where score 0 represents no pain and score 10 represents worst possible pain

If patients starts experiencing pain it was considered that analgesic action of drug has been terminated. Adverse effects if any with special attention to haemodynamics were noted.

Statistical Analysis

Data was compared by using Mann Whitney test and Students t test.

The significance of this study was analyzed and data entered in EXCEL and analyzed using SPSS.

Results

The data was collected using a prestructural proforma.

Comparison of Demographic Variables

Table 1: Distribution as per age

Age	Test		Control	
	Count	Percent	Count	Percent
<40	13	43.3	10	33.3
40 – 50	11	36.7	11	36.7
>50	6	20.0	9	30.0
Mean ± SD	41.4 ± 8.3		44.5 ± 10.1	

t = 1.3, p = 0.199

Table 2: Comparison of sex based on group

Sex	Test		Control		χ^2	P
	Count	Percent	Count	Percent		
Male	20	66.7	23	76.7	0.74	0.390
Female	10	33.3	7	23.3		

In test group 66.7% were males and 33.3 % were females while in control group 76.7% were males and 23.3% were females.

P value determined was 0.390. So both groups were comparable.

Table 3: Comparison of group based on ASA-PS status

ASA	Test		Control		χ^2	P
	Count	Percent	Count	Percent		
Grade I	23	76.7	24	80.0	0.1	0.754
Grade II	7	23.3	6	20.0		

P value of 0.754 suggests no statistical difference between two groups.

Table 4: Comparison of group based on weight

Group	Mean	SD	N	t	p
Test	67.5	5.1	30	0.17	0.865
Control	67.7	5.5	30		

Mean weight of test group is 67.5 kg and control group is 67.7 kg. p value obtained is 0.865. so both the groups are comparable for weight.

Comparison of Clinical Variables

Table 5: Comparison of group based on onset of sensory block

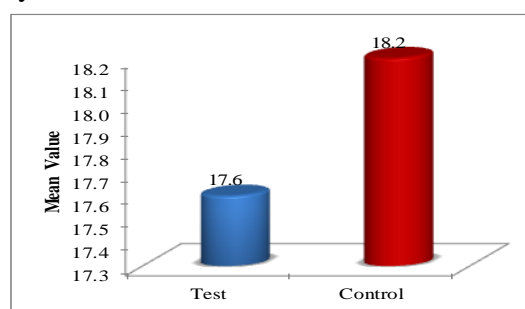
Group	Mean	SD	N	t	p
Test	6.1	1.1	30	26.33**	0.000
Control	13.8	1.2	30		

**:- Significant at 0.01 level

The mean of time taken for onset of sensory block is 6.1mins for test group and 13.8mins for control group.

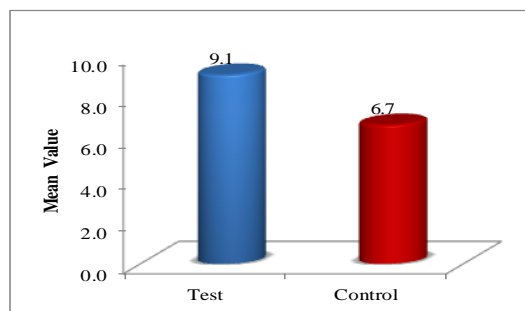
Here the t value obtained is 26.33 which is significant, so there is statistical difference between two groups.

Graph 1: Comparison of group based on peak sensory block.



The mean value of time of peak sensory block is 17.6 mins among test group, and 18.2 mins among control group. t value is 0.143 which is not significant, means peak of sensory block shows statistical no difference between two groups.

Graph 2: Comparison of duration of sensory block



Mean duration of sensory block among test group is 9.1hrs and among control group is 6.7hrs. t value is 10.7 which is significant.

Table 6: Comparison of onset of motor block

Group	Mean	SD	N	t	p
Test	17.6	1.5	30	10.49**	0.000
Control	13.0	1.8	30		

**:- Significant at 0.01 level

Table 7: Comparison of group based on peak motor block

Group	Mean	SD	N	t	p
Test	38.7	4.7	30	13.77*	0.00
Control	24.0	3.4	30	*	0

**:- Significant at 0.01 level

Mean of test group is 38.7mins and control group is 24mins and t value is 13.77, which is significant, so the peak of motor block shows statistical difference.

Table 8: Comparison of group based on duration of motor block

Group	Mean	SD	N	t	p
Test	6.6	0.8	30	4.3**	0.000
Control	7.4	0.7	30		

**:- Significant at 0.01 level

Mean of test group is 6.6 an control group is 7.4, t value is 4.3, which significant, so duration of motor block is more among control group.

Table 9: Comparison of group based on peak motor block

Group	Mean	SD	N	t	p
Test	38.7	4.7	30	13.77**	0.000
Control	24.0	3.4	30		

**:- Significant at 0.01 level

Mean of test group is 38.7 mins and control group is 24mins and t value is 13.77, which is significant, so the peak of motor block shows statistical difference.

Table 10: Comparison of group based on duration of motor block

Group	Mean	SD	N	T	P
Test	6.6	0.8	30	4.3**	0.000
Control	7.4	0.7	30		

**:- Significant at 0.01 level

Mean of test group is 6.6 an control group is 7.4, t value is 4.3, which significant, so duration of motor block is more among control group

Comparison of Heart Rate between groups

Table 11: Comparison of Mean BP based on group

Mean BP	Test			Control			t	p
	Mean	S	N	Mean	S	N		
Baseline	105.6	7.5	30	104.9	5.5	30	0.43	0.669
After 5 Mins	104.7	5.4	30	103.8	6.4	30	0.57	0.573
After 30 Mins	105.6	5.2	30	104.2	6.3	30	0.94	0.353
After 1hour	105.1	4.9	30	103.5	4.7	30	1.29	0.201

The p value for comparison of baseline mean blood pressure and mean blood pressure at 5mins, 30 mins, 1 hour between the two groups are 0.669, 0.573, 0.353, 0.201 respectively. so the two groups are comparable for their mean blood pressure

Discussion

Sessler et al; demonstrated that regional anaesthesia to upper extremity is a suitable alternative to general anaesthesia and confers significant benefit to patient improving safety^{1,2}.

The drug with fast onset long duration and minimal toxic profile could be an advantage.

Numerous studies abroad have compared Ropivacaine 0.5% or 0.75% in brachial plexus block with remarkable safety in favour of Ropivacaine³⁻⁸. Bupivacaine with its wide and unpredictable latency of nerve block and enhanced neuro and cardiotoxicity^{7,8} needed replacement with a drug of better safety profile.

Geiger and colleagues⁹ reported safe use of ropivacaine 1% up to 500mg. In many studies maximum dose of ropivacaine up to 5mg/kg was reported to be safe.^{10,11}

There were two groups of 30 patients each in the study. Considering the sociodemographic data there was no significant difference between the two groups with regard to age, sex and weight ($p>0.05$).

Also the test and control groups were comparable with respect to ASA-PS status and haemodynamic parameters.

In this study the test group received 25ml 0.75% Ropivacaine and control group received 25ml 0.5% Bupivacaine for supraclavicular brachial plexus block.

The two groups were compared based on onset, peak and duration of sensory block, motor block, heart rate and mean blood pressure.

The data collected were transformed into a master sheet one for each group.

In order to compare the data and to draw conclusions the mean and standard deviations of onset, peak, duration of sensory block, motor block, heart rate and mean blood pressure were calculated.

Data were analysed using computer software SPSS (Statistical Package of Social Sciences). Data were compared using Mann Whitney test and Student t test).

Sensory Block

The mean time onset of sensory block for group which received Ropivacaine was 6.1 minutes and for group which received Bupivacaine was 13.8 minutes. These results were compared to that obtained by Bertini et al⁵. The peak was attained around 17.6 minutes in test group and 18.2 minutes in control group. The total duration of sensory block was around 9.1 hours in test group and 6.7 hours in control group.

Thus it was observed that onset of sensory block was faster and duration was more in the group which received Ropivacaine. The time for attaining peak sensory block was comparable¹²⁻¹⁴.

Motor Block

The mean onset of motor block for test group was 17.6 minutes and for control group was 13 minutes.

Peak block was attained around 38.7 minutes for test group and 24 minutes for control group. Mean total duration for test group was 6.6 hours and control group was 7.4 hours. Thus it was observed that onset and peak of motor block was faster attained and duration is more in group which received Bupivacaine^{15,16}.

Conclusions

The study was done to compare the efficiency of local anaesthetics ropivacaine and bupivacaine in supraclavicular brachial plexus block.

The selection of optimal long acting anesthetics for brachial plexus block must take into consideration the available anesthetics, the time to onset and duration of blockade and side effect of each drug. The drug with fast onset, long duration and minimal toxic profile could be an advantage

As rapid onset of sensory block and prolonged post operative analgesia with stable hemodynamic without neuro and cardio toxicity are important goals in regional anesthesia, from this study it can be concluded that 0.75% 25ml of ropivacaine in supraclavicular brachial plexus block is a safe dose, allowing practitioner to produce a fast onset of sensory block and long duration of peripheral nerve block with excellent post operative analgesia and stable hemodynamics compared to bupivacaine.

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References

1. Sessler DI, Rubinstein EH, Moayer A. Physiological responses to mild perianesthetic hypothermia in humans. *Anesthesiology* 1991;75:594-610. [PubMed] [Google scholar]
2. Sessler DI. Perioperative hypothermia. *New England Journal of Medicine*. 1997; 336:1730- 77. [PubMed] [Google Scholar].

3. Casati A, Fanelli G, Aldegheri G, Berti M, Cedrati V, Torri G. Interscalene brachial plexus anaesthesia with 0.5%, 0.75% or 1% ropivacaine. *Br. journal of anaesth* 1999;83:872-5
4. Postoperative analgesic efficacy of peripheral Levobupivacaine and Ropivacaine *Anaesth. Analg* 2008;106:1559-1561.
5. Bertini L, Tagariello V, Mancini S, Ciashi A, Posteraro M, Benedetto P, et al. 0.75% and 0.5% ropivacaine for axillary plexus block. *Reg Anaesth Pain Med* 2000;25:659.
6. Reutsh YA, Boni T, Borgeat A. From cocaine to ropivacaine: the history of local anesthetic drug. *Current topics in Medicinal chemistry* 2001;1:175-182.
7. Laura Bertini, Vincenzo Tagriello, Stephania Mancini, Ima Ciaschi. 0.75% and 0.5% ropivacaine for axillary plexus block. *Regional Anesthesia and pain Medicine* 1999;24:514-518.
8. Capogna G, Celleno D, Laudano D, Giunta F. Alkalinization of local anesthetic. *Regional Anesth* 1995;20:369-77.
9. Geiger P, Oldenburger K, Ventour W, Mehrkens HH, Ropivacaine 0.5% vs 0.75% vs 1% for 3-in-1 block combined with sciatic nerve block in orthopaedic surgery. 7th Annual ESRA Congress. Geneva. 1998;47.
10. Klein SM, Greengrass RA, Steele SM. A comparison of 0.5% bupivacaine, 0.5% ropivacaine for interscalene brachial plexus block. *Anaesth Analg* 1998;87:1316-9.
11. Hickey R, Candido KD, Amamurthy S. Brachial plexus block with new local anesthetic 0.5% ropivacaine. *Can J Anaesth* 1990;37:732-8.
12. Vaghadia H, Chan V, Ganapathy S, Lui A, Zlimmer K. A multicentre trial of ropivacaine 7.5 mg/ml vs bupivacaine 5 mg/ml for supraclavicular brachial plexus anaesthesia. *Can J Anaesth* 1999;46:946-51.
13. Raeder J C, Drosal S, Klaasstad O, Isajksen B, Stromskag K E et al. Axillary plexus block with ropivacaine 7.5 mg/ml. A Comparative study with bupivacaine 5mg/ml. *Acta Anaesthesiol Scand.* 1999;43:794-8.
14. Lissanantti O, Lukkonen J, Rosenberg PH. High dose of bupivacaine, levobupivacaine and ropivacaine in axillary plexus block. *Acta Anaesthesiol Scand.* 2004;48:601-9.
15. Kallio H, Snall EV, Kero MP, Rosenberg PH. A comparison of intrathecal plain solutions containing ropivacaine 20mg or 15 mg versus bupivacaine 10mg. *Anaesth Analg* 2004;99:713-7.
16. Levin A, Datta S, Camann WR. Intrathecal ropivacaine for labour analgesia: A comparison with bupivacaine. *Anaesth Analg* 1998;87:507-600.