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Original research article

A Comparative Study of the Effectiveness of 0.5% Ropivacaine Versus 0.5% Bupivacaine in Supraclavicular Brachial Plexus Block in Upper Limb Orthopaedic Surgeries

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Abstract

Background: Brachial plexus block provides surgical anaesthesia and analgesia and also provides postoperative analgesia. Nowadays regional blocks are increasingly used because of a higher success rate due to USG guidance and peripheral nerve stimulators. Regional blocks overcome the disadvantages of general anaesthesia like upper airway instrumentation and the use of multiple drugs. The supraclavicular approach for brachial plexus is the most consistent method of analgesia below the shoulder joint. Commonly used local anaesthetics are lignocaine and Bupivacaine. Ropivacaine is an amide local anaesthetic drug. The lower cardiotoxic potential, more rapid clearance and reduced motor block seen with Ropivacaine compared to Bupivacaine is advantageous especially when larger doses are required. The aim of my study is to assess the effectiveness of Ropivacaine compared to Bupivacaine in supraclavicular brachial plexus block.

Materials and methods: 100 patients in the age group 20 to 65 years were divided into two groups of 50 each. Group A received 25 ml of 0.5%Bupivacaine. Group B received 25 ml of 0.5% Ropivacaine. The total dose was not exceeded the recommended dose as per the body weight.

Results: Duration of analgesia was prolonged in Ropivacaine group (550.4+/_26.3 minutes) compared to Bupivacaine group (450.7+/-26.9 minutes). Duration of motor block was comparable in both groups.

Conclusion: Ropivacaine has advantages over Bupivacaine for supraclavicular block due to its long analgesic duration without significant side effects.

Keywords: Ropivacaine, Bupivacaine, Supraclavicular brachial plexus block

Introduction

Regional blocks are increasingly performed at present due to several advantages over general anaesthesia and also due to the technology ensuring a high rate of success like USG guidance and peripheral nerve stimulator.[1 2] Various approaches to brachial plexus have been described, but the supraclavicular approach is the most consistent method for anaesthesia below shoulder joint.[3 4]

Commonly used local anaesthetics are lignocaine and Bupivacaine. Ropivacaine is an amide local anaesthetic drug. Bupivacaine has a butyl group, and Ropivacaine has a propyl group on the piperidine nitrogen atom. Commercial Bupivacaine is a 50:50 racemic mixture of S and R-enantiomers. Compared to S-enantiomer, R-Bupivacaine binds 3 times more firmly to the sodium channel and unbinds 4.4 times slowly. Ropivacaine is unique amongst this group in that it is prepared for clinical use as the pure S-enantiomer rather than a racemic mixture. Ropivacaine is less lipid-soluble and has a smaller volume of distribution, greater clearance and shorter elimination half-life than Bupivacaine[2 5]. The two drugs have similar *PKA* and plasma protein binding. Ropivacaine blocks nerve fibres involved in pain transmission (A-delta and C fibres) to a greater degree than those controlling motor function (A-beta fibres). [1 6] Compared with Bupivacaine, Ropivacaine produces a similar pattern of sensory block and equipotent or less potent motor block. The lower cardiotoxic potential, more rapid clearance and reduced motor block seen with Ropivacaine compared to Bupivacaine is advantageous especially when large doses are administered. [7, 8, 9]

Methods

The study was a prospective cohort study to study the effectiveness of 0.5% Ropivacaine versus 0.5% Bupivacaine in supraclavicular brachial plexus block in elective upper limb orthopaedic surgeries done in the Department of Anaesthesiology, Government Medical College, Thiruvananthapuram over a period of 3 months. The objectives of the study were to compare the analgesic efficacy between two groups as measured by the duration of analgesia using visual analogue score, to compare the onset of sensory block and to compare the onset and duration of motor block. The study was approved by the Institutional Research Committee and Ethical Committee and written informed consent was obtained from all patients. 100 patients belonging to ASA 1/11/11(American SocietyIL of anaesthesiologists physical status classification,20-65 years, weighing 60 to 80 kg of either sex were included in the study. After getting the consent the patients satisfying the inclusion criteria will be enrolled into one of the two groups alternatively. Group A will receive 25 ml of 0.5%Bupivacaine and group B will receive 25 ml of 0.5% Ropivacaine. The total dose will not exceed the recommended dose as per the body weight. Patients having drug allergy to local anaesthetics, those with anatomical abnormalities of shoulder and neck regions, alcoholic, psychiatric or uncooperative patients, those with any bleeding disorders, patients in whom the blockade was unsuccessful due to total failure or missed dermatomes which needed intravenous supplementation or general anaesthesia were excluded from the study.

A detailed preanaesthetic checkup was done. All patients were fasted for 8 hours. Standard monitors ECG, pulse oximeter, and NIBP are attached.18Gcannulanula was inserted for all patients and normal saline infusion was started. All patients were premedicated with 0.02mg/kg IV midazolam. Supraclavicular brachial plexus block was performed using peripheral nerve stimulator using classic approach [3]. The total volume of anaesthetic solution is injected at incremental dose of 5 ml after negative aspiration.

Patient vitals are monitored. Sensory and motor block was assessed by HOLLMEN SCALE. For **Sensory b ck** scale 1=normal sensation of pinp ck scale, 2=pin prick felt as sharp pointed

but weaker compared with same area in the other upper limb scale3=pin prick recognized as touch with blunt object scale4=no perception of pin.
For Motor block scale1=normal muscle function scale2=slight weakness in function scale3=very weak muscular action scale4=complete loss of muscle action
VAS score for analgesia
0-3 : Good analgesia
3- 6:Moderate analgesia
6-10: Poor analgesia
Sensory block was considered complete when scores were grade 4 in Hollmen that will be checked by pinprick method over C5 TO T1 dermatomes. Motor block was considered complete at a score of grade 4 in Hollmen. Duration of analgesia is taken as the time between onset of analgesia and the reappearance of pain (6-10 cms in VAS) or request for pain relief**.** Duration of motor block It is taken as the time between complete motor block and return of the normal muscle function.
The block was considered to have failed if complete sensory and motor block was not achieved after 30 minutes and the failed block was converted to GA and it was recorded.

Statistical Analysis
To compare the statistical difference in the age, sex, duration of analgesia, quality of analgesia students t tests and chi-square analysis were used.

Results
The patient groups were comparable in terms of age, gender, weight and ASA class.
The onset sensory block was comparable in both groups. Mean onset time was 15.2+/-1.8 min in group A(Bupivacaine) and 15.3+/-1.9 minutes in group B.(Ropivacaine).
Duration of analgesia was 550.4 $\pm$ 26.3 minutes in Ropivacaine group and 450.7 $\pm$ 26.9 minute in Bupivacaine group. This shows a significant prolongation of analgesia in Ropivacaine group.
Onset of motor block was prolonged in Ropivacaine group (20.3 $\pm$2.6 min) compared to Bupivacaine group (18.6 $\pm$ 2.4 min). This was found to be statistically significant. Duration of motor block was comparable in both the groups.
No serious side effects were observed in either group and vital parameters were stable throughout.

Thus, based on the study Ropivacaine shows advantages over Bupivacaine for supraclavicular block due to its long analgesic duration without significant side effects.

Table 1: Comparison of demographic parameters

Parameters	Group A (Bupivacaine)	Group B (Ropivacaine)	p
Age in years (mean+/- SD)	41.9+/- 12.6	41.4 +/- 11.3	0.842
Sex (M/F)	28/22	27/23	0.841
Weight in kg (Mean +/- SD)	69.4 +/- 6.2	69.3 +/- 6.2	0.936
ASA 1/2/3	35/13/2	42/5/3	0.111

Table 2. Comparison of block characteristics

Block parameters	Group A Bupivacaine (Mean +/- SD)	Group B (Ropivacaine (mean +/- SD)	p
Sensory block onset (min)	15.2 +/- 1.8	15.3 +/- 1.9	0.663
Motor block onset (min)	18.6 +/- 2.4	20.3 +/- 2.6	0.001
Motor block duration (min)	401.2 +/- 26.3	398.3+/- 34.5	0.637
Duration of analgesia (min)	450.7 +/- 26.9	550.4 +/- 26.3	0.000

Discussion

Patients belonging to American society of anesthesiologists (ASA) class 1,2 and 3 were included in the study. In this study majority of patients were ASA class1.

Patients between the age group 20 and 65 years were included in the study so that patient related factors played a minimum role. The Mean age of the group A (Bupivacaine group) was 41.9± 12.6 years and that of group B (Ropivacaine group) was 41.4± 11.3 years. Majority of the patients were males in both the groups.56% in group A and 54% in group B.

In a prospective randomized trial Anna Angelica[9] reported a faster onset of sensory block for Ropivacaine than Bupivacaine in a prospective randomized trial of 60 patients scheduled for axillary plexus block.

A.casati[10] and colleagues concluded that interscalene brachial plexus block performed with 20 ml of either 0.75% or 1% Ropivacaine allows for a prolonged postoperative pain relief similar to that of Bupivacaine 0.5% with shorter onset of surgical anaesthesia.

Laura Bertini, Vincenzo and colleagues[11] concluded that Ropivacaine showed advantage over Bupivacaine for axillary plexus block. Mean peak time was shorter with Ropivacaine than Bupivacaine. Quality of anaesthesia was higher with Ropivacaine as measured by the intraoperative needs for opioids and overall patient satisfaction. In this current study onset of the sensory block was comparable in both the groups. Mean onset time was 15.2± 1.8 min in group A(Bupivacaine) and 15.3± 1.9 min in group B.(Ropivacaine).

In this current study mean duration of analgesia obtained in Bupivacaine group was 450.7 minutes with SD of 26.9 and that of Ropivacaine group was 550.4 minutes with SD 26.3. The data was analyzed using students t-test and yield a *p* value of <0.05 which is statistically significant.

Anna Angelica[11] in a prospective randomized trial reported a prolongation of analgesic effect by about 5 hours in Ropivacaine (18.62 hours)group compared to Bupivacaine group(13.11 hours). In this current study the onset of motor block in Ropivacaine group was 20.3 ± 2.6 min compared to 18.6 ± 2.4 min in Bupivacaine group. This was found to be statistically significant when compared by students t-test. However the clinical relevance is doubtful. This may be attributed to the differential sensory and motor blockade of Ropivacaine compared to Bupivacaine.

The duration of motor block as analyzed by students t-test was found to be non-significant. Duration of motor block for Bupivacaine group was 401.2 ± 26.3 min and Ropivacaine group was 398.3 ± 34.5 min.

Conclusion

Thus, based on the study Ropivacaine shows advantages over Bupivacaine for supraclavicular block due to its long analgesic duration without significant side effects. As prolonged sensory block provides excellent postoperative analgesia and extended motor block is not desirable as it limits patient mobility, nerve block with Ropivacaine is considered superior than Bupivacaine.

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