Original Research Article

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Comparison of Bupivacaine 0.375% and Ropivacaine 0.375% in Supraclavicular Block under Ultrasound Guidance for Upper Limb Surgeries

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Abstract

Background: Regional anesthesia is comparatively safer than general anesthesia. Regional anesthesia can be safely used in outpatient anesthesia, patients with full stomach, diabetic patients, associated cardiac, pulmonary, hepatic or renal damage and polytrauma. Bupivacaineroutinely used has side effects relatedto cardiovascular and central nervous system. Ropivacaine a recent addition has the ability to produce differential blockade with less motor blockade and reduce cardiovascular and neurological toxicity. Ultrasound imaging has increased the success rate and has helped in reducing the complications as it gives real time visual image.

Materials and Methods: A prospective, randomized single blinded study was undertaken in patients posted for upper limb surgeries under Supraclavicular block under ultrasound guidance. 60 patients of ASA class I and II were randomly grouped into two groups. Group R will receive 30ml Ropivacaine 0.375% and Group B will receive 30ml of Bupivacaine 0.375% in supraclavicular brachial plexus blockade. Onset of motor and sensory blockade, duration of motor, sensory blockade and duration of post-operative analgesia were studied. Hemodynamic changes over time were recorded.

Results: Group R patients had earlier onset of sensory and motor block compared to Group B patients. There was no difference in duration of sensory and motor block and duration of analgesia between both the groups.

Conclusion: Ropivacaine is a safer alternative to Bupivacaine with earlier onset of both sensory and motor block and if used along with ultrasound guidance has a higher success rate and lowers the incidence of complications

Keywords: Brachial Plexus; Bupivacaine; Ropivacaine; Ultrasound.

Introduction

Regional anesthesia is comparatively safer than general anesthesia. Regional anesthesia has some advantages over general anesthesia such as it can be used in outpatient anesthesia, for patients with full stomach, for diabetic patients, associated cardiac, pulmonary, hepatic or renal damage and polytrauma. Regional nerve blocks are based on the concept that pain is conveyed by nerve fibers, and the transfer of pain can be interrupted along their pathway. Other important advantages are postoperative analgesia, early ambulation, no airway manipulation, early resumption of oral feeding and decreased postoperative pulmonary, gastrointestinal and thrombo-embolic complications [1]. More over regional anesthesia offers ideal operating conditions by producing complete muscle relaxation, stable intraoperative hemodynamics and the associated sympathetic block.

Brachial plexus blocks are among the most commonly performed peripheral neural blocks for upper extremity surgeries. Supraclavicular blocks are the most commonly performed brachial plexus blocks

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as the typical feature of these blocks include rapid onset, predictable and dense anesthesia, along with its high success rate [2]. Bupivacaine which is routinely used nowadays is known for its wide and unpredictable latency of nerve block when small volume of local anesthetic solution is injected and associated with a number of side effects, including cardiovascular and central nervous system toxicity. Ropivacaine which is a recent addition has the ability to produce differential blockade with less motor blockade and reduced cardiovascular and neurological toxicity [3].

The first supraclavicular brachial plexus block was performed in 1912 by Kulen Kampff. The conventional paresthesia technique being a blind technique may be associated with higher failure rate and injury to nerves and surrounding structures. Ultrasound (US) visualization of anatomical structure is the only method offering safe blocks of superior quality by optimal needle positioning. US allows direct visualization of peripheral nerves, the block needle, and local anesthetic distribution

The first literature description of the use of ultrasound for supraclavicular block was by La Grange and colleagues in 1978 for needle positioning. In the conventional technique the insulated needle is advanced near to the nerve blindly and the anesthetic delivered. It has the disadvantage of vascular and nerve injury and pulmonary complications such as pneumothorax. Ultrasound guidance provides real time images and the advantage to minimize complications. After skin and transducer preparation, a linear 38 mm, high frequency 10-15 MHz transducer is placed firmly over the supraclavicular fossa. Nerves in supraclavicular region appear hypo-echoic and are round or oval. The brachial plexus is identified as a compact group of nerves similar to a bunch of grapes located over the first rib. The needle is advanced along the long axis of the transducer in the same plane as the ultrasound beam. Local anesthetic is injected so as to cause hydro dissection of the nerve [4].

Methods

Sixty patients belonging to ASA I or II, with age between 18 and 65 years were recruited for randomized study. Hospital ethics committee approval and written informed from all patients were taken. The patients posted for surgeries around elbow, forearm and hand were randomized into two groups Group B: 30 subjects will receive 30ml Bupivacaine 0.375% and Group R: 30 subjects will receive 30ml of mixture of Ropivacaine 0.375. Patients who are known to have hypersensitivity reaction to local anaesthetics, patients with coagulopathies, patient who has local infection at the site of proposal puncture for supraclavicular block, pregnant or lactating women are exclude from study. Detailed history, general physical examination and routine investigations were done prior to the day of surgery. Patients were premedicated with Tab. Ranitidine 150mg and Tab.Metoclopramide 10mg and Tab.Alprazolam 0.5mg previous night of surgery orally.

After patient shifted to operation room, large bore IV line secured. Standardmonitoring like ECG, SpO_2, and NIBP were connected and recorded. Thepatient is positioned supine and made to face the contralateral side. After skin and transducer preparation, a linear 38-mm, high frequency 10-15 MHz transducer is placed firmly over the supraclavicular fossa in the coronal oblique plane to obtain the best possible transverse view of the subclavian artery and brachial plexus. Nerves in the supraclavicular region appear hypo-echoic and are round or oval. The brachial plexus is located lateral and superficial to the pulsatile subclavian artery and superior to the first rib. The subclavian artery is identified first the subclavian vein lies more medially. The first rib is identified as a hyper-echoic structure lying deep to the vessels, and giving a bony shadow. The brachial plexus is consistently found lateral and superficial to the subclavian artery and above the first rib. The needle is advanced along the long axis of the transducer in the same plane as the ultrasound beam. This way, the needle shaft and tip can be visualized in real time as the needle is advanced towards the target nerves. Local anaesthetic solution is injected so as to cause hydro dissection of the planes around the plexus. The volume of local anaesthetic used is 30 ml. The onset of anesthesia was evaluated by the pin prick with a 23 gauge needle. The time of onset was defined as the time between injection and complete loss of pinprick sensation. The temperature was tested by using the spirit soaked cotton on the skin. The time of onset of complete sensory blockade was recorded.

Heart rate, noninvasive blood pressure and oxygen saturation were monitored at an interval of 0 min, 5 min, 10 min, 15 min, 30 min, 45 min, 60 min, 90 min, and 2 hrs during the surgery. Duration of sensory block which is the time elapsed between the injection of drug and appearance of pain requiring analgesia and duration of motor block was also recorded.

Sensory block will be graded asGrade 0: Sharp pin felt, Grade 1: Analgesia, dull sensation felt, Grade 2: Anaesthesia, no sensation. Motor blockwill be

determined according to a modified Bromage scale for upper extremities on a 3-point scale. Grade 0: Normal motor function with full flexion and extension of elbow, wrist and fingers

Grade 1: Decreased motor strength with ability to move the fingers only,

Grade 2: Complete motor block with inability to move the fingers.

Duration of motor block is from onset of motor blockade (Grade II) to the time patient could first move their fingers. Duration of sensory block is from onset of sensory blockade (Grade II) to the time of sensory recovery (pin prick). Duration of analgesiais from Grade I sensory block to the first demand of analgesia.

Postoperatively all the patients will be asked to mark their postoperative pain on 0-10 numerical scale [VAS], Where 0=no pain, 1-3=mild pain, 4-6=moderate pain, 7-9=severe pain, 10=worst imaginable pain. Diclofenac sodium intra muscular injection will be used as rescue analgesic whenever patients complained of pain. (First demand for analgesia).

Statistical Analysis

The data thus obtained was compiled and analyzed using Statistical Package for Social services. (SPSS version 20). Quantitative data was analyzed by using student't' test. Qualitative data was analyzed using Chi – Square test. A p value of less than 0.05 was considered as statistically significant.

Results

Time of onset of sensory block

There was significant difference in onset of sensory block between the group B (11.4 ± 2.71) and group R (9.53 ± 2.64) by t test (p = 0.009)

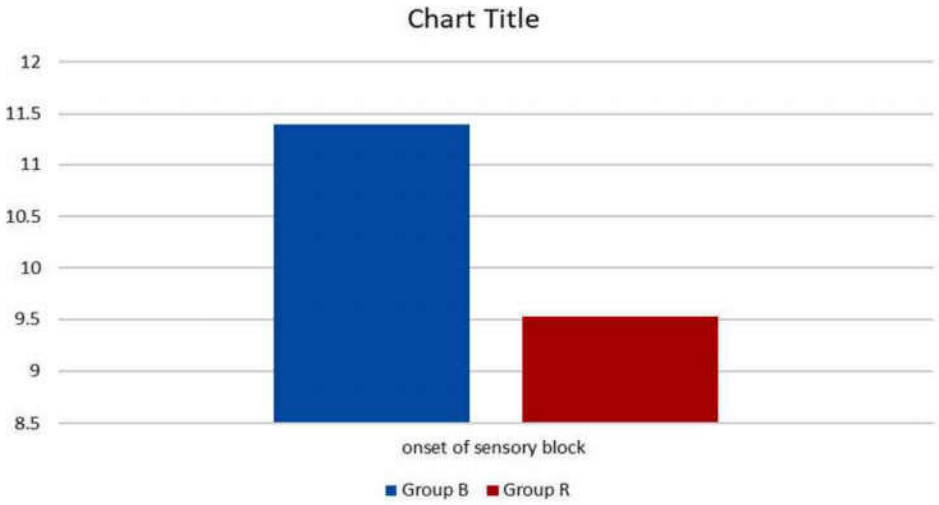

Fig. 1: Comparison onset of sensory block in minutes

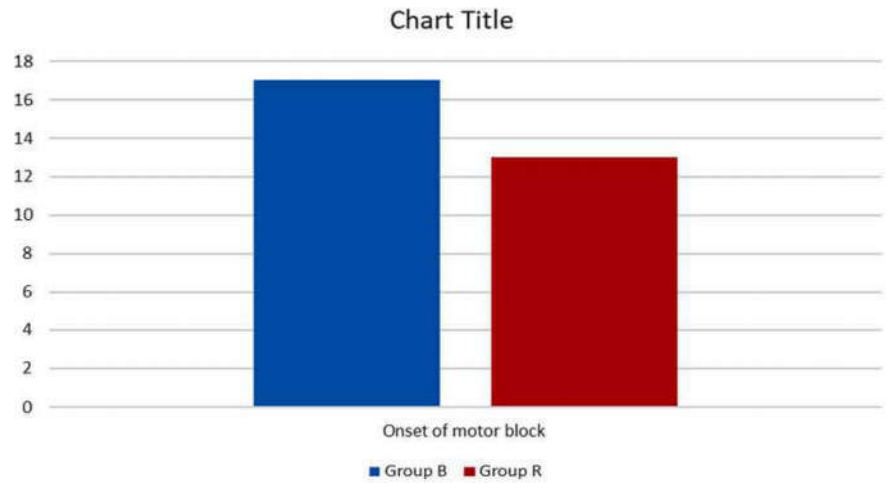

Fig. 2: Comparison of onset of motor block in minutes

Comparison of Motor block onset in minutes (Mean ± SD)

There was significant difference in onset of motor block between the group B (17.03±3.21) and group R (13±3.23). (p = 0.0001).

Duration of Sensory Block in two groups (min) (Mean ± SD)

There was no significant difference in duration of sensory block between the group B (444.5±21.47) and group R (434.67±29.969) by student t test (p = 0.149).

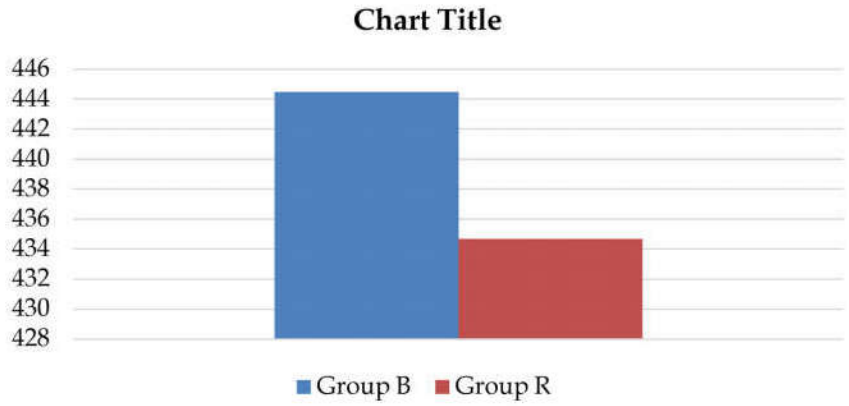

Fig. 3: Mean values of duration of sensory block in two groups

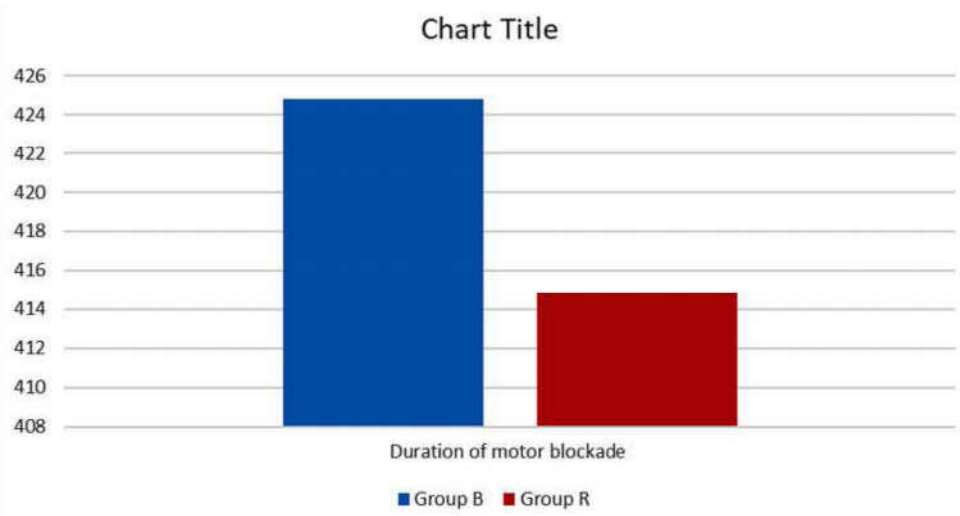

Fig. 4: Mean values of duration of motor block in two groups

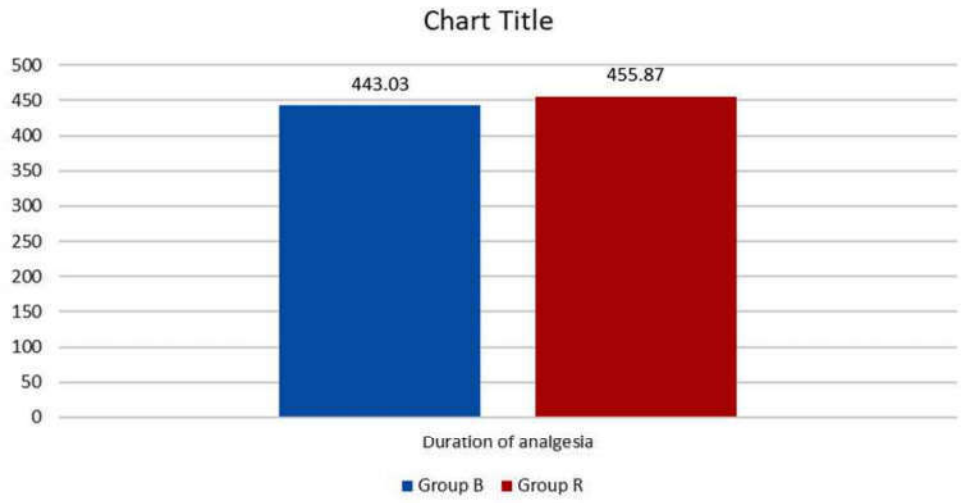

Fig. 5: Mean values of duration of Analgesia in two groups

Duration of Motor Block in two groups (min) (Mean ± SD)

There was no significant difference in duration of motor block between the group B (424.83±19.453) and group R (414.83±24.371). (p = 0.084).

Comparison of Duration of Analgesia in study groups

There was no significant difference in duration of Analgesia between the group B (455.87 ± 15.62) and group R (443.03 ± 33.54). (p = 0.06)

Discussion

Brachial plexus block has been emerged as a popular technique among the anesthesiologists for upper limb surgeries. This type of anesthesia avoids the untoward effects of general anesthesia like complications related to upper airway instrumentation. The research has also shown that this approach is very attractive approach and effective.

This study was taken up to evaluate the efficacy of Bupivacaine and Ropivacaine and the advantage in using ultrasound guidance to avoid complications and block failure. A randomized single blinded study was taken up

In a study by Sreeharsha Sirigeri comparing 0.5% Bupivacaine and 0.75% Ropivacaine in supraclavicular brachial plexus block by perivascular approach were randomly divided into Group B and Group R, which received 30ml of 0.5% Bupivacaine and 0.75% Ropivacaine respectively. The onset time of sensory block was faster in Group R compared to Group B having a mean value of 16.13±3.05 minutes and 17.70±2.35 minutes respectively. The onset time of motor block was faster in Group R compared to Group B having a mean value of 23.90±1.83 minutes and 25.43±2.22 minutes respectively. The duration of sensory and motor block was 480.3 and 472.8 in group R and 472.1 and 460.2 in group B. The duration of post-operative analgesia was 504.2 minutes in Group R and 499.6 minutes in Group B [5].

In this study the onset time for sensory and motor block in Bupivacaine (Group B) was 11.4 minutes and 17.03 minutes respectively and the onset time of sensory and motor block in Ropivacaine (Group R) was 9.53 and 13 respectively. The duration of sensory and motor block in Bupivacaine group was 444.5 minutes and 424.83 minutes respectively while in the Ropivacaine group it was 434.67 minutes and 414.83 minutes respectively. The onset of sensory and motor block was faster in Group R than in Group B which was significant.

In a study by Chandni M Soni et. al. the motor and sensory block by Ropivacaine and Bupivacaine in combination with lignocaine in supraclavicular block was compared in sixty patients scheduled for upper limb orthopedic surgeries who were randomly divided into two groups. Group R received Ropivacaine 0.75% 20 ml plus Xylocaine 2% 10 ml while Group B received Bupivacaine 0.5% 20 ml plus Xylocaine 2% 10 ml via supraclavicular route. Sensory onset of group R is nearly 6.6 minutes while in Group B it is 7.4 minutes, and motor onset in group R is 12.9 minutes while that in Group B is 11.5 minutes. There is no significant difference in intra-operative pulse, SBP and DBP. The duration of sensory block in Group R is nearly 9.13 hours while that in Group B is 9.81 hours, the duration of motor block in Group R is 8.9 hours while in Group B it is 9.93 hours and total duration of analgesia in Group R is 9.2 hours while that in Group B is 9.86 hours. Group Bupivacaine showed prolonged duration of sensory and motor block and prolonged duration of analgesia compared to Group Ropivacaine but the difference was statistically insignificant [6].

Whereas in this study onset time for sensory and motor block in Bupivacaine (Group B) was 11.4 minutes and 17.03 minutes respectively and the onset time of sensory and motor block in Ropivacaine (Group R) was 9.53 and 13 respectively. The duration of sensory and motor block in Bupivacaine group was 444.5 minutes and 424.83 minutes respectively while in the Ropivacaine group it was 434.67 minutes and 414.83 minutes respectively. The onset of sensory and motor block was faster in Group R than in Group B which was significant. There was no significant difference in duration of sensory and motor block between the group B and Group R and there is no significant difference in intraoperative pulse, SBP and DBP.

In another study by Hetal rathod et. al. the effects of 0.375% Bupivacaine and 0.375% Ropivacaine in supraclavicular brachial plexus block was compared in sixty patients scheduled for upper limb orthopedic surgeries who were randomly divided into Group B and Group R who received 0.375% Bupivacaine and 0.375% Ropivacaine respectively. The sensory and motor onset (mean-minutes) was 21.13 and 25.87 in group B and was 13.3 and 21.37 in group R respectively. The duration of sensory and motor block (mean- minutes) was 480.3 and 472.8 in group R, and 472.1 and 460.2 in group B The duration of post-operative analgesia was 504.2 minutes in Group R and 499.6 minutes in Group B. Group R provided statistically significant & rapid onset of sensory and motor blockade than Group B for upper limb surgeries.

There were no significant differences in duration of sensory and motor blockade [1].

In this study the onset time for sensory and motor block in Bupivacaine (Group B) was 11.4 minutes and 17.03 minutes respectively and the onset time of sensory and motor block in Ropivacaine (Group R) was 9.53 and 13 respectively. The duration of sensory and motor block in Bupivacaine group was 444.5 minutes and 424.83 minutes respectively while in the Ropivacaine group it was 434.67 minutes and 414.83 minutes respectively. The duration of post-operative analgesia was 443.03 minutes in Group R and 455.87 minutes in Group B .The onset of sensory and motor block was faster in Group R than in Group B which was significant.

In a study by Tarek atef tawfic 60 patients aged between 17 and 61 years with chronic renal failure (CRF) for arterio-venous fistula (AVF) creation were compared with 0.25% Ropivacaine (group I) and 0.25% Bupivacaine (group II) for supraclavicular block. Both groups were comparable as regards onset time of motor block as well as duration of sensory and motor block. However, the mean onset time of sensory block was more delayed in the Ropivacaine group. There was significantly higher incidence of complications in Bupivacaine group especially respiratory distress and Horner's syndrome. Therefore, these results suggest that Ropivacaine 0.25% is a better local anesthetic than Bupivacaine 0.25% for use in a supraclavicular approach for brachial plexus block in high risk patients with CRF [7].

In this study the onset time for sensory and motor block in Bupivacaine (Group B) was 11.4 minutes and 17.03 minutes respectively and the onset time of sensory and motor block in Ropivacaine (Group R) was 9.53 and 13 respectively. The duration of sensory and motor block in Bupivacaine group was 444.5 minutes and 424.83 minutes respectively while in the Ropivacaine group it was 434.67 minutes and 414.83 minutes respectively. The duration of post-operative analgesia was 443.03 minutes in Group R and 455.87 minutes in Group B .The onset of sensory and motor block was faster in Group R than in Group B which was significant. There were no complications in either of the groups because of the use of ultrasound.

Conclusion

Supraclavicular approach to the brachial plexus is an alternative to general anesthesia for surgeries around the elbow, forearm and hand. Complications including vascular puncture, local anesthetic toxicity, pneumothorax, and patient discomfort have made the technique undesirable. With the advent of ultrasound, all these complications are minimized and the drug can be deposited under direct vision. Ultrasound guidance with real-time needle visualization in relation to anatomic structures and target nerves makes regional anesthesia safer and more successful. With ultrasound guidance in experienced hands, brachial plexus blockade can lead to decreased block performance and onset time, increased success rate and decreased rate of complications [8].

Bupivacaine is a long acting local anesthetic with long duration of action with a number of side effects, including motor weakness, cardiovascular and central nervous system toxicity. Ropivacaine a similar long acting amide local anesthetic with better safety margin because of its structural properties and hence is associated with less CNS, CVS toxicity and local neurotoxicity. It also has the advantage of faster onset of sensory and motor blockade; longer duration of analgesia and anaesthesia [9].

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