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Research Article

Comparative study of 0.5% ropivacaine and 0.5% bupivacaine for brachial plexus block by supraclavicular approach for upper limb surgeries

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ABSTRACT

Background: Present study was undertaken to evaluate the clinical efficacy of 0.5% ropivacaine for supraclavicular bronchial plexus block for upper limb surgeries and comparing it with 0.5% bupivacaine in terms of characteristics of supraclavicular blockade and side effects.
Methods: The design was a prospective double blind randomized study enrolling 60 patients of either sex, ASA I and II, were randomly allocated into two groups in which supraclavicular brachial plexus block was performed with nerve stimulator using 30 ml of ropivacaine 0.5% and bupivacaine 0.5% respectively. The onset and duration of sensory and motor block and possible adverse events were recorded.
Results: Ropivacaine had earlier onset of sensory and motor blockade compared to bupivacaine. The duration of sensory and motor blockade was longer in group of patients treated with ropivacaine than in bupivacaine group. No statistically significant difference was found in quality of blocks in both groups. There were no adverse effects observed in the study.
Conclusions: Ropivacaine 0.5% can be safely used as an alternative to bupivacaine 0.5% in supraclavicular bronchial plexus block.

Keywords: Ropivacaine, Bupivacaine, Supraclavicular brachial plexus block, Sensory and motor blockade

INTRODUCTION

Orthopedic and plastic reconstructive surgeries may turn out to be of prolonged duration, hence adequate sensory and motor blockade along with profound analgesia are the main requirements for such surgeries. With the introduction of newer and safer local anaesthetics and better advantages, regional anaesthesia has taken over as the principle technique for upper limb surgeries. Upper extremity regional anesthesia has been a mainstay of the anesthesiologist's armamentarium since hall first reported the use of cocaine to block the brachial plexus in 1884.[1] Various approaches to brachial plexus block have been described, but supraclavicular approach is the easiest and most consistent method for anesthesia and perioperative pain management in surgery below the shoulder joint. Supraclavicular block is performed where the brachial plexus is presented most compactly at the distal trunk/proximal division level. This compactness may explain the block's historical reputation for providing short latency and complete, reliable anesthesia for upper extremity surgery.[2] However it provides anesthesia of entire upper extremity in the most consistent and time efficient manner and also provides both intraoperative anesthesia and postoperative analgesia without any systemic side effects.[3]

The success rate of the block can be further enhanced by using electric nerve stimulator to identify the nerves and depositing the drug perineurally.[4] Variety of local anesthetics can be used to perform ideal and complete block. Among them, bupivacaine provides a longer duration of action, but at high doses it may lead to cardiotoxicity and neurotoxicity.[5] The cardiotoxicity may be life threatening as the dysrhythmias that are produced are resistant to all routinely used antiarrhythmics. Hence, there is a need for a drug which can have all the advantages of bupivacaine without its cadiotoxicity. Ropivacaine is a new amide local anaesthetic that has been shown in animal studies to be similar to bupivacaine in terms of onset and duration of brachial plexus block.[6] In human brachial plexus studies, ropivacaine 0.5% with or without epinephrine has been shown to provide effective sensory and motor block of prolonged duration.[7] The toxicity of ropivacaine has been reported to be less than that of bupivacaine.

The present research prompted us to study efficacy and safety of ropivacaine, the newer local anaesthetics, in brachial plexus block for upper limb surgeries and its comparison with the age old agent, bupivacaine.

METHODS

This prospective randomized double blind study included total 60 patients belonging to ASA grade I and II of either sex with the age between 18-60 years and weight between 40 to 80 kgs. Before starting the study ethical approval has been obtained by institutional ethics committee. A written informed consent was obtained from all the patients posted for upper limb orthopedic and plastic surgeries under brachial plexus block. Patients having own refusal for participation, patients with coexisting severe cardiovascular, respiratory or neurological disorders, contraindications of brachial plexus block like uncooperative and restless patients, some psychiatric patients, bleeding disorders, oral anticoagulant, anti-platelet agent, infection at the site of block placement, patients with past history of allergy to local anesthetics, pregnant women and lactating mothers were excluded from the study. Patients were randomly allocated into two groups of 30 patients each, receiving 30 ml of one of the two different drug solution; all solutions contain fresh epinephrine in a 1:400000 concentration as an intravascular marker. The local anaesthetic was provided in non-identified syringes, labelled with the patient's serial number, prepared by another anaesthesiologist, not related to this study. The randomization was done by doing the computerized chart and selecting one of them blindly. Group X received 0.5% ropivacaine and group Y received 0.5% bupivacaine. A detailed pre-anaesthetic evaluation was done day before surgery that included history and a thorough general and systemic examination and local examination of supraclavicular area. Routine relevant investigations were done in all the patients.

On operation table, standard ASA monitors were applied to the patient and baseline parameters like pulse rate, blood pressure, respiratory rate, SpO_2 were noted before giving supraclavicular block. The patient was placed in supine position, with the head turned about 30 degree to contra-lateral side. The interscalene groove, midpoint of the clavicle and subclavian artery was identified. 22 gauge, 50 mm- stimuplex needle with nerve simulator was directed just above and posterior to the subclavian pulse and directed caudally at a very flat angle against the skin. The needle was advanced till the desired EMR was observed (i.e. flexion and extension of finger). When contraction was still observed and palpated, the stimulator voltage was decreased to 0.5 mA then 30 ml of study drug was injected in 3 ml increments. If the rib was encountered without the paresthesia or blood was encountered, needle was withdrawn and a landmark as well as plane of the needle-insertion path was re-evaluated. Patients were evaluated every 3 minute to determine loss of shoulder abduction (deltoid sign as evidence of successive motor blockade). Sensory block was assessed by pinprick every 3 min in the C5-C6 determatomes. Motor blockade was assessed using Modified bromage scale. Failure to lose shoulder abduction after 30 min was considered to be block failure and hence general anaesthesia was given and patient was excluded from study. All episodes of local anaesthetic toxicity or hemodynamic changes requiring anesthesiologist intervention were recorded as adverse events. After evidence of successful motor and sensory block surgery was performed. In case of prolonged surgeries, general anaesthesia was administered as the effect of brachial plexus block seemed to be weaning off (patient complains of pain at the site of operation). Various parameters like HR, blood pressure, SpO_2, onset and duration of sensory and motor block, quality of block and complications if any were noted during and after the procedure every 3 min for the first 30 min and then every 10 min there after till the end of surgery.

Postoperatively patients were monitored every hourly for 12 hours, then after 12 hours patients were shifted to ward and they were asked to note the time of requirement of first rescue analgesic, complications in the form of neurotoxicity were assessed.

Statistical analysis

Demographic variables, duration of surgery, onset and duration of sensory and motor block and time interval for the first rescue analgesic were expressed as mean±SD. This data were compared in two groups and differences in means were inferred by unpaired't' test. A 'P' value <0.05 was considered statistically significant.

RESULTS

A total of 60 patients who underwent elective or emergency surgical procedure were enrolled for the study and were randomly allocated into 2 groups of 30 patients

each. In group X, (Ropivacaine) 80% patients were males and 20% patients were females. While in group Y (bupivacaine), 86.70% patients were males and 13.30% patients were females. The demographic profiles of the patients and mean duration of surgical procedures were comparable between two groups and difference was statistically not significant, (Table 1).

Table 1: Demographic data and duration of surgery.

Variables	Group X	Group Y	P-value
Age (years)	37.83±10.05	41.00±10.82	0.245
Weight (kg)	58.83±6.39	58.40±4.27	0.759
Duration of surgery (hours)	3.23±0.82	3.07±0.74	0.411

Observations regarding nerve blockade were made and compared between two groups. Onset of sensory blockade was significantly faster in group X than Group Y at C-5 and C-6 ($p < 0.05$). No statistically significant difference was found between two groups in regards to quality of sensory block, ($p > 0.05$). Motor block onset was seen faster in group X than in group Y and which was statistically significant. The maximum duration of sensory blockade was found for group X with mean of 9.03±1.38 hours whereas it was 7.18±1.08 hours for group Y. The duration of motor blockade was longer in group X (7.53±41.22 hours) as compared to group Y (6.62±1.01 hours), ($p < 0.05$). There was no statistically significant difference observed in quality of sensory and motor blockade in both groups. Table 2 shows the comparisons of characteristics of supraclavicular blockade and time of requirement of first rescue analgesic.

Table 2: Summary of results regarding characteristics of supraclavicular blockade.

Characteristics	Group X	Group Y	p-value
Onset of sensory block (min)	4.93±1.78	8.47±2.50	0.000
Onset of motor block (min)	10.63±2.92	17.80±3.71	0.000
Quality of sensory block	4.00±0.00	3.93±0.25	0.155
Duration of sensory block (hrs)	9.03±1.38	7.18±1.08	0.000
Duration of motor block (hrs)	7.53±41.22	6.62±1.01	0.002
Time interval for requirement of first rescue analgesic (hrs)	14.40±2.13	11.60±1.81	0.000

The time interval for requirement of first rescue analgesic was longer in group X than group Y. The number of patients requiring first dose of rescue analgesic were significantly more in group Y (37%) as compared to group X (3%) within 8-10 hours. Almost all the patients in group Y required rescue analgesia within 14 hours while in group X around only 55% patient's required rescue analgesia within 14 hours.

There was no statistically significant difference between two groups in terms of haemodynamic parameters at different time intervals till 12 hours of administration of brachial plexus block (Figure 1).

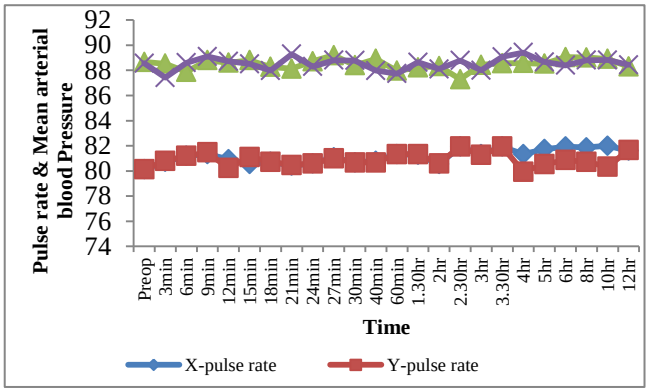

Figure 1: Showing heart rate (HR) and mean arterial pressure (MRP).

There was no evidence of any side effects or any signs of CNS toxicity, CVS toxicity or any allergic drug reaction.

DISCUSSION

In present study use of brachial plexus were preffered to block for the patients undergoing upper extremity surgeries. It is well accepted component of comprehensive anaesthesia care and of great value particularly in the patients who are poor risk for surgery and in emergency situations where patients are with full stomach and prone for aspiration. It provides excellent anaesthesia without loss of consciousness and protective airway reflexes. Anaesthesiologists opt for familiar approaches of brachial plexus anaesthesia such as interscalene, supraclavicular and axillary. However each has its own limitations and complications. But supraclavicular approach has been considered the most efficacious approach to brachial plexus block because in this approach we block the trunks of brachial plexus.[8] It is often called as spinal anaesthesia for upper extremity because of its ubiquitous application for upper extremity surgery characteristically associated with a rapid onset of anaesthesia, high success rate, complete and predictable anaesthesia for entire upper extremity. The patient's cooperation is very much essential for appreciating paresthesia to locate the nerve plexus. False appreciation of paresthesia may lead to failure of the technique. Use of nerve stimulator for nerve localization is simple and is also expected to help in accurate placement of the local

anaesthetic agents in close proximity to the nerve and reduces the rate of failure and complications too. Considering the above facts, we used classical approach technique of supraclavicular brachial plexus block with the aid of the nerve stimulator.

Many authors have studied different concentrations of ropivacaine that is 0.25%, 0.5%, 0.75% and 1% and compared them with 0.5% bupivacaine in different studies. It was found that 0.5% ropivacaine is safer and adequate for brachial plexus block. Different studies found that 0.5% ropivacaine was as equipotent as 0.5% bupivacaine in providing adequate brachial plexus block.[9-11] Klein N S et al and Bertini et al, in their studies of increasing concentration of ropivacaine from 0.5% to 0.75% failed to improve onset and duration of the interscalene brachial plexus block.[8,12] However Casati et al reported that ropivacaine was suitable and safe local anesthetic for brachial plexus block at a dose of 2.5-2.6 mg/kg without any adverse effects.[13] On the basis of literature review, the present study utilizes same concentration (0.5%) and volume (30 ml) of ropivacaine and bupivacaine. The drug was injected when the flexion and extension movements were seen at the fingers at a voltage upto 0.5 m A. Special care was taken while injecting the solution with repeated negative aspirations to prevent inadvertent intravenous injection. Using 30 ml of 0.5% ropivacaine with the average dose of 2.55 mg/kg, none of the patients developed any features of CNS or CVS toxicity in ropivacaine group; we can say that 0.5% ropivacaine can be used as a local anesthetic at a dose of 2.5mg/kg safely in supraclavicular brachial plexus block.

There was no significant difference between two groups with regards to the demographic profile (age, sex, weight) and duration of surgery. In our study onset of sensory block was defined as time elapsed from injection of drug to complete loss of cold perception of upper limb as elicited by using spirit soaked cotton or pinprick. Whereas onset of motor block was defined as time elapsed from injection of drug to complete motor block elicited by asking the patient to abduct the shoulder, flex the forearm and hand against gravity. The difference in the onset of sensory and motor blockade in both the groups was found to be statistically significant, ($p < 0.05$). Similar results were observed in a study conducted by Ana A et al.[14] Bertini et al reported that the mean peak time for the complete sensory and motor blockade was found to be shorter with different concentration of ropivacaine than bupivacaine.[12] Most of the other studies found no statistically significant difference in onset of sensory and motor blockade with 0.5% ropivacaine and 0.5% bupivacaine.[8-11,15-18] In the study duration of sensory blockade was defined as time elapsed between injection of the drug and return of the pin prick sensation. Longer duration of sensory block with ropivacaine than bupivacaine was found in supraclavicular block. Duration of motor blockade was defined as time between drug injections to complete return of motor power with movement of all upper limb joints. It was observed that ropivacaine when compared with bupivacaine shows longer duration of motor blockade with no difference in quality of motor blockade. The results regarding the motor blockade were agreement with various studies.[9,11,16,17] There was no significant statistical difference observed in quality of sensory and motor blockade in both groups. Similar results were found in the different studies.[11,12,16]

The time interval between administrations of supraclavicular block to the time of first rescue analgesic (VAS >3) was measured. Injection diclofenac 75 mg IV was given if the VAS >3. Difference of time interval was found to be statistically significant, suggesting that ropivacaine provides analgesia for longer duration than bupivacaine. The number of patients requiring first dose of rescue analgesic were significantly more in group Y (37%) as compared to group X (3%) within 8-10 hours. Almost all the patients in group Y (100%) required rescue analgesia within 14 hours while in group X around only 55% patients required rescue analgesic within 14 hours. No changes were observed in pulse rate, mean arterial pressure or oxygen saturation throughout the study and which was statistically not significant.

No adverse effects were noted in any of the patients in any group, no signs of CNS toxicity (like restlessness, anxiety, incoherent speech, lightheadedness, dizziness, blurred vision, tremors, drowsiness and convulsion) or CVS toxicity (hypotension, bradycardia, hypertension, tachycardia, vasovagal reaction, arrhythmias like extrasystoles, atrial fibrillation, ST segment changes and myocardial infarction), severe allergic reactions (rash, itching, difficulty breathing, tightness in the chest, swelling of the mouth, face, lips or tongue) nausea, vomiting, pneumothorax noted in any patient in any group. There was complete resolution of nerve block and no signs of any neurological dysfunctions noted upto 72 hours in any patients.

CONCLUSION

Ropivacaine at the concentration of 0.5% can be safely used as an alternative to bupivacaine as long acting local anesthetic in supraclavicular brachial plexus block. The study suggest that 0.5% ropivacaine because of its structural properties was associated with less CNS, CVS toxicity, local neurotoxicity, faster onset of sensory and motor blockade; longer duration of analgesia and anaesthesia with similar quality of block as 0.5% bupivacaine. It also has an added advantage of prolonging the requirement of first rescue analgesic in post operative period than bupivacaine.

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REFERENCES

1. Hall RJ. Hydrochlorate of cocaine. NY Med J. 1884;40:643-46.
2. Brown DL, Cahill DR, Bridenbaugh LD. Supraclavicular nerve block: anatomic analysis of a method to prevent pneumothorax. Anesth Analg. 1993;76:530-4.
3. Khanduri KC. Regi onal anaesthetic techniques for orthopaedic surgeries. Med J Armed Forces India. 2008;64:109.
4. Eeckelaert JP, Filliers E, Alleman JJ, Hanegreefs G. Supraclavicular brachial plexus block with the aid of a nerve stimulator. Acta Anaesthesiol Belg.1984;35:5-17.
5. Albright GA. Cardiac arrest following regional anesthesia with etidocaine or bupivacaine. Anesthesiology.1979;51:285-7.
6. Akerman B, Helberg IB, Trossvik C. Primary evaluation of the local anaesthetic properties of amino amide agent ropivacaine (LEA 103). Acta Anaesthesiol Scand. 1988;32:571-8.
7. Hickey R, Candido KD, Rammurthy S, Winnie AP, Blanchard J, Raza SM, et al. Brachial plexus block with a new local anaesthetic 0.5% ropivacaine. Can J Anaesth. 1990;37:732-8.
8. Klein SM, Greengrass RA, Steel SM. A comparison of 0.5% bupivacaine, 0.5% ropivacaine and 0.75% ropivacaine for interscelene brachial plexus block. Anesthesia Analgesia. 1998;87:1316-91.
9. Hickey R, Hoffman J, Ramaaurthy S, A comparison of ropivacaine 0.5% and bupivacaine 0.5% for brachial plexus block. Anesthesiology. 1991;74:639-42.
10. Vainionppa VA, Haavisto E, Huita TM. A clinical and pharamacokinetic comparison of ropivacaine and bupivacaine in axillary plexus block, Anesthesia Analgesia. 1995;81:534-8.
11. Meglade DP, Kalpokas MV, Mooney PH. A comparison of 0.5% ropivacaine and 0.5% bupivacaine for axillary brachial plexus anesthesia. Anesthesia Intensive Care. 1998;26:515-20.
12. Bertini L, Manuni S, Tanganello V. 0.75% and 0.5% ropivacaine axillary brachial plexus block; A clinical comparison with 0.5% bupivacaine, Regional Anesthesia Pain med 1999;24:514-8.
13. Casati A, Fanelli G, Aldegheri G, Barti M. Interscelene brachial plexus anesthesia with 0.5%, 0.75%, 1% ropivacaine: double blind comparison with 2% mepivacaine. Br J Anesthesia. 1999;83:872-5.
14. Ana A, Pena R, Guadalupe Z, Lemus, Beatriz V, Victoria G. Clinical comparison of bupivacaine and ropivacaine for neurostimulation-guided brachial plexus block by axillary approach; Mexicana De Anetesiologia. 2009;32(1):7-13.
15. Hickey R, Rowley CL, Winnie AP, S. A comparison of ropivacaine 0.25% and bupivacaine 0.25% for brachial plexus block. Anesthesia Analgesia. 1992;75:602-6.
16. Vaghadia H, Chan V, Ganpathy S. A multicentric trial of ropivacaine 7.5 mp/ml vs bupivacaine 5 mg/ml for supracavicular brachial plexus anesthesia. Anesthesia Canadian J Anesthesia. 1999;46(10):946-51.
17. Casati A, Fanelli G, Albertin A, Deni F. Interscelene brachial plexus anesthesia with either 0.5% ropivacaine or 0.5% bupivacaine. Minerva Anesthesiol. 2000;66(1):39-44.
18. Ahmet E, Halil U. A clinical comparison of equal concentration and volume of ropivacaine and bupivacaine interscelene brachial plexus anesthesia for shoulder surgery. Regional Anesthesia Pain Med. 2004;29(6):539-43.

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