Original Research Article

A comparative study of ropivacaine 0.5% and bupivacaine 0.5% in combination with fentanyl in supraclavicular brachial plexus block

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Abstract

Background: Regional anaesthesia now occupies an important position in anaesthesia now days and has undergone advancements both in techniques and drug availability. Regional anaesthesia techniques are an important assortment for anaesthesiologist because of their safety, low cost, advantage of early ambulation and prolonged postoperative pain relief. **Objectives:** To compare the time of onset and duration of sensory and motor blockade, duration of analgesia, hemodynamic parameters and complications of 0.5% Ropivacaine and 0.5% Bupivacaine used in combination with Fentanyl in brachial plexus block through supraclavicular route in upper limb surgeries. **Material and Methods:** A prospective randomized double-blind study was conducted in 60 patients of 18-65 years of either sex, ASA-grade I/II who underwent unilateral upper limb surgery; both elective and emergency, were randomly divided in to two groups of 30 each - Group BF in whom Bupivacaine 0.5% 29 cc with Fentanyl 50 µg 1 cc was used as local anaesthetic and Group RF who were given Ropivacaine 0.5% 29 cc with Fentanyl 50 µg 1 cc. Brachial plexus blockade was applied through supraclavicular approach Both the groups were compared for the time of onset and duration of sensory and motor blockade, duration of analgesia, hemodynamic parameters and complications due to the above mentioned drugs. **Results:** Onset time for Sensory and Motor blockade was shorter with ropivacaine. Duration of sensory block was significantly longer with ropivacaine but duration of motor block was statistically highly significantly longer with bupivacaine. Duration of post-operative analgesia was significantly longer with RF group and there was a significant difference in both groups in post-operative visual analogue scale (VAS) score. No statistically significant changes were observed in heart rate, respiratory rate, mean arterial pressure or oxygen saturation throughout the study. **Conclusion:** Ropivacaine along with fentanyl, have better profile in terms of rapid onset of sensory and motor block, prolonged duration of sensory block and post-operative analgesia.

Key Word: Ropivacaine, Bupivacaine, Supraclavicular, Brachial Plexus Block, Post-Operative Analgesia

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Received Date: 10/11/2018 Revised Date: 18/12/2018 Accepted Date: 04/01/2019
DOI: https://doi.org/10.26611/10159110

Access this article online

Quick Response Code:

Website: www.medpulse.in

Accessed Date: 11 January 2019

INTRODUCTION

Recently regional anaesthesia techniques have gained popularity and are an important assortment for anaesthesiologist because of its safety and low cost. This technique has advantages of early ambulation[1] and prolonged postoperative pain relief in addition to avoidance of unwanted effects of general anaesthetic drugs and pressure response of laryngoscopy and tracheal intubation.[2,3] Peripheral neural blockade is a part of compendious anaesthesia. Among these brachial plexus blocks the useful alternative to general anaesthesia for upper limb surgery owing to their high success rate and ability to provide prolonged postoperative pain relief.[4] It carries advantage of being

How to site this article: Prajapati J P, Modi T M. A comparative study of ropivacaine 0.5% and bupivacaine 0.5% in combination with fentanyl in supraclavicular brachial plexus block. *MedPulse International Journal of Anesthesiology*. January 2019; 9(1): 41-45. http://medpulse.in/Anesthsiology/index.php

safe, low cost of anaesthetic agents used, decrease operation theatre pollution, complete muscular relaxation maintaining stable haemodynamic parameters and the associated sympathetic block. The supraclavicular approach to brachial plexus blockade provides anaesthesia of the entire upper extremity in the most consistent, time efficient manner. It is performed at the trunk level where plexus is presented most compactly which is responsible for rapid onset and complete and reliable anaesthesia[5]. Bupivacaine, a long acting local anaesthetic drug, is the drug of choice for brachial plexus block, but carries risk of cardiac depression and central nervous system toxicity in large doses. Later a long acting local anaesthetic Ropivacaine was approved in 1996 with better safety profile compared to Bupivacaine. It has less cardiac depression and central nervous system toxicity when large volumes are used.[6] Coadministration of Fentanyl increases the duration of post-operative analgesia by potentiating the local anaesthetic action via central opioid receptor-mediated analgesia and acting directly on peripheral nervous system.[7] With this background, this study was carried out on 0.5% Ropivacaine and 0.5% Bupivacaine used in combination with Fentanyl in brachial plexus block through supraclavicular route in upper limb surgeries with the aims of comparing the time of onset and duration of sensory and motor blockade, duration of analgesia, hemodynamic parameters and complications due to the above mentioned drugs.

MATERIAL AND METHODS

After obtaining institutional ethical committee approval a randomized, prospective and double-blind comparative study was conducted in 60 patients of either sex, ASA-grade I/II and age group of 18-65 years in tertiary care teaching hospital, Ahmedabad. Patients who underwent unilateral upper limb surgery; both elective and emergency surgeries were recruited for the study. Patient having hypersensitivity to local anaesthetic drug, hemodynamic instability, local infection/inflammation, coagulopathy, neuropathies and unconscious patient were excluded. All the recruited patients underwent a pre anaesthetic checkup before surgery and all the routine and specific investigations were conducted. The patients were kept nil per oral for 6 hours before elective surgeries. On the day of surgery, prior to operation, written informed consent was taken and patients were explained about the procedure. Standard monitors like ECG, *Non-invasive Blood Pressure* (NIBP) and pulse oximeters were applied and patients' baseline parameters like pulse, blood pressure, respiratory rate, SPO_2 were recorded. Intravenous line was secured in all the patients and intravenous fluid started. Inj. Midazolam 2 mg i.v. slowly and inj. Ondansetron 4 mg i.v. was given as Pre-anaesthetic medication to all patients. The patients were randomly allocated to 2 groups- Group BF in whom Bupivacaine 0.5% 29 cc with Fentanyl 50 µg 1 cc was used as local anaesthetic and Group RF who were given Ropivacaine 0.5% 29 cc with Fentanyl 50 µg 1 cc. Brachial plexus blockade was applied through supraclavicular approach; classical technique (Kulenkampff's) was used. During the conduct of block and thereafter, the patient was observed vigilantly for any complications of the block and for the toxicity of the drugs injected. Patients were observed for any systemic side effects like bradycardia, hypotension, nausea, vomiting, pruritus etc during surgery. Onset of Sensory block was assessed every 2 min by a traumatic pin prick test in the areas innervated by radial, ulnar, and median nerves and compared with the same stimulation on contralateral hand. Sensory blockade was graded as Grade 0 if no loss of sensation to pinprick was observed, Grade 1 analgesia was considered if patient felt touch but no pain on pin prick and Grade 2 anaesthesia was considered if patient felt no touch sensation on pinprick Onset time was defined as time taken from drug injection to complete ablation of sensation (sensory score 2). Duration of sensory block was defined as time from onset of block to complete return of parasthesia (sensory score 0). Motor blockade was assessed by asking the patient to elevate the arm while keeping elbow straight (superior trunk) and at the hand by grip strength (middle and inferior trunk). Motor block was evaluated by three point scale which is graded as Grade 0 when patient feets no weakness, grade 1 when patient develops paresis (decreased movements with inability to perform activities against resistance) and grade 2 when patient develops paralysis. Onset time was defined as time taken from drug injection to complete motor block (motor grade score 2) and duration of motor blockade was defined as time taken from complete motor blockade to restoration of movements of forearm (grade 0). Hemodynamic parameters observed were intra-operative pulse, blood pressure, respiratory rate and SPO2 which were recorded at regular interval. All the parameters were observed at 5 minutes interval for 15 minute, then 15 minute interval for 30 minutes , then 30 minute interval for 60 minutes, then 1 hourly interval for 2 hour, then 2 hourly interval for 12 hours and then at 16 hour. Tourniquet inflation and deflation time and duration of surgery were noted. Intensity of post-operative pain was evaluated using VAS Score (visual analogue scale) with grade 0 (no pain) to 10 (worst pain). Pain score were noted post-operatively at 30 mins, 60 min and then 2 hourly till 16 hours. Time was

noted when patient regained VAS score of 4. Analgesia was considered satisfactory if the score was 3 or less. If VAS score was more than 4, analgesia was judged unsatisfactory and rescue analgesia was administrated in form of inj. Diclofenac sodium 2 mg/kg i.v. Evaluation was stopped and time for need of first analgesia was noted. Both groups were compared for duration of analgesia by calculating the duration of postoperative analgesia as time from onset of sensory blockade to time when patient's VAS score was > 4. Patients were observed for any complications like local haematoma / infection/ neuropathy, systemic neurotoxicity/ cardio toxicity/ pneumothorax etc. Data was statistically analysed by using unpaired student t- test. P value was calculated with the help of Graph pad software and p value < 0.05 was considered as significant.

RESULTS

After analysing the data it was found that both groups were comparable in respect to age, sex and weight as no statistically significant difference exist between both groups. (Table 1) Majority of patients had surgical procedures like K-wire, platting, nailing implant removal, external fixator and debridement in upper limb which was also comparable in between the groups. Duration of surgery in both the groups were comparable and there was no stastically significant difference. (Table 1) Minimum duration of surgery in Group RF was 30 minutes and in Group BF was 35 minutes. Maximum duration of surgery in Group RF was 150 minutes and in Group BF was 160 minutes. Onset time for Sensory and Motor blockade was shorter in RF group compared to BF with p value < 0.05 which was statistically significant. The mean onset time was 12.73 ± 2.60 min in group RF while it was 16.87 ± 2.80 min with group BF. The mean onset time was 16.93 ± 3.27 min in group RF while it was 19.30 ± 2.39 min with group BF. (Table 2) Duration of sensory block was longer in RF group as compared to BF group and it was highly statistically significant (P value <0.05. The mean duration of sensory block was 11.86 ± 2.16 hours in group RF while it was 9.93 ± 1.62 hours with group BF. Duration of motor block was longer in BF group as compared to RF group and it was highly statistically significant (p value < 0.05). The mean duration of motor block was 6.45 ±1.19 hours in group RF while it was 7.56 ±1.47 hours with group BF (Table 2) There was a significant difference in both groups in post-operative VAS score. (Figure 1) Duration of post-operative analgesia was significantly longer in group RF as compared to group BF and was statistically significant (P < 0.05). The mean duration of postoperative analgesia was 13.52 ± 1.71 hours in group RF while it was 11.77 ± 1.68 hours with group BF and the difference was statistically significant. (p < 0.05) In present study pulse rate, blood pressure both systolic and diastolic, SPO_2, Respiratory Rate remained stable without any significant fluctuation in both the study groups. No significant intra-operative and post-operative complications like pneumothorax, intra-arterial or intravascular placement of drug, nausea, vomiting, pruritus, neurotoxicity or cardiotoxicity were found in either group.

Table 1: Demographic comparison of both the study groups

Variables	Group RF (n=30) (Mean ± SD)	Group BF (n=30) (Mean ± SD)	P value
Age (in years)	38.83 ± 14.31	39.67 ± 14.44	>0.05
Weight (in kg)	61.00 ± 10.57	61.27 ± 8.41	>0.05
Sex Ratio (M : F)	22 : 08	23 : 07	-
Duration of Surgery (mins)	85.70 ± 35.37	84.60 ± 34.83	>0.05

Table 2: Characteristics of sensory and motor blocks in both the groups

	Onset Time (in minutes) (Mean ± SD)		Duration of block (in hr) (Mean ± SD)	
	Sensory Block	Motor Block	Sensory block	Motor block
Group RF (n=30)	12.73 ± 2.60	16.93 ± 3.27	6.45 ± 1.19	11.86 ± 2.16
Group BF (n=30)	16.87 ± 2.80	19.30 ± 2.39	7.56 ± 1.47	9.93 ± 1.62
P value	<0.0001*	0.0022*	0.0002*	0.0023*

*significant

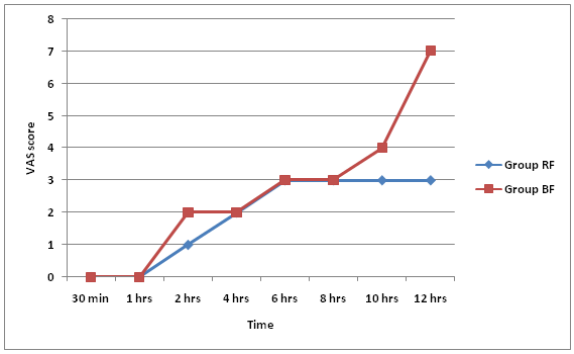

Figure 1: Post-operative visual analogue score (VAS) in both the groups

DISCUSSION

Regional anaesthesia has been increasing in popularity in recent years though general anaesthesia continues to be used for most of the surgical procedures as it provides improved satisfaction and cause less cognitive impairment and immunosuppression compared to general anesthesia (particularly in elderly patients).[8] Bupivacaine is frequently used as the local anaesthetic for brachial plexus anaesthesia because it offers the advantage of providing a long duration of action and a favourable ratio of sensory to motor neural block. However, with time, it was seen that racemic mixture of bupivacaine can cause cardiac and central nervous system toxicity in few patients.[9] This present study was conducted in 60 patients of varying age and sex belonging to ASA Risk I and II for upper limb surgery to evaluate the effect of Ropivacaine, a newer local anaesthetic agent and compared it to Bupivacaine in brachial plexus block. In present study, there were no statistically significant intergroup variations regarding age, body weight, gender, type of surgery and duration of surgery. Onset of sensory block and motor block was significantly rapid with RF group as compared to BF group. The reason for this difference could be due to the fact that pain impulses are transmitted through small myelinated A fibres and small unmyelinated C fibres and motor impulses are transmitted through large A fibres.[10] Blockade of nerve fibres depends on the physicochemical properties of the individual drugs like pKa, lipid solubility, etc.[11] The pKa of both the drugs are identical but as Bupivacaine is less lipid soluble, envisaging that it will block nerve fibres more slowly than Ropivacaine. There by equal volumes and concentrations of bupivacaine produces a slower sensory and motor block as compared with ropivacaine. Similar results were obtained in the studies by Casati *et al*, Tripathi *et al* and Raikwar *et al*.[12-14] In this study, duration of sensory block was significantly longer with RF group as compared to BF group but the duration of motor block was significantly shorter with RF group as compared to BF group which is in accordance to study by Tripathi *et al*[13]. Volume of drugs in this study was same as in our study but concentration of ropivacaine in this study was 0.75%. Ropivacaine is less likely to penetrate large myelinated motor fibres, resulting in a relatively reduced motor blockade. Ropivacaine has a greater degree of motor sensory differentiation. It has selective action on the pain-transmitting A β and C nerves rather than Aβ fibres, which are involved in motor function.[9] In one of the study by Raikwar *et al*[14] results differ than that found in our study and the duration of motor block and sensory block both were prolonged for Ropivacaine as compared to Bupivacaine with statistical significance. It may be due to volume of drug used in this study which was lower than our study. In another study it was found that there is no clinically important difference in times to onset and recovery of interscalene block for bupivacaine 0.5%, ropivacaine 0.5%, and ropivacaine 0.75% when injected in equal volumes.[15] In our study, duration of post-operative analgesia was significantly longer with Ropivacaine + fentanyl group as compared to Bupivacaine + fentanyl group which is same as study by Raikwar *et al*. and Casati *et al*.[12,14] In a study of comparing the effectiveness of 0.5% ropivacaine and 0.5% bupivacaine for brachial plexus block, by Hickey *et al* it was observed that duration of analgesia and anesthesia was prolonged but did not differ significantly between groups.[16] In study by Madhusudhana *et al*[17], addition of Opiates (50 mg tramadol in group 1 and 50 mcg fentanyl in group 2) with 0.75% Ropivacaine lead to increase post operative analgesia compared to plain o.75% Ropivacaine. In another study by Shirish *et al*[7] addition of fentanyl to local anaesthetic lead to increase success rate of sensory blockade and increase post-operative analgesia. Possible mechanisms of increase post-operative analgesia due to coadministration of fentanyl could be its direct action on the peripheral nervous system via central opioid receptor.[7] **No** statistically significant changes were observed in heart

rate, respiratory rate, mean arterial pressure or oxygen saturation throughout the study and which is in accordance to study by Modak *et al*.[18]

CONCLUSION

After accomplishing the present study, it can be concluded that Ropivacaine along with fentanyl, exhibits better profile of action with rapid onset of sensory and motor block, prolonged duration of sensory block and post-operative analgesia and can be proposed as a better alternative to Bupivacaine along with fentanyl for brachial plexus block in upper limb surgeries.

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Source of Support: None Declared
Conflict of Interest: None Declared