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Comparitive study of ropivacaine 0.5% versus ropivacaine 0.5% with fentanyl in supraclavicular brachial plexus block for upper limb surgery

[1]Dr Chandan Hessa, Junior Resident, RIMS, Ranchi

[2]Dr Ekramul Haque, Associate Professor, MD Anaesthesia, RIMS, Ranchi, Jharkhand

[3]Dr Amit Kumar, Senior Resident, MD Anaesthesia, RIMS, Ranchi, Jharkhand

[4]Dr Ashwini Ekka, Junior Resident, RIMS, Ranchi, Jharkhand

[5]Dr Prof Usha Suwalka, Head of Department, Department of Anaesthesia, RIMS, Ranchi, Jharkhand.

Corresponding Author: Dr Ekramul Haque, Associate Professor, MD Anaesthesia, RIMS, Ranchi, Jharkhand

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Abstract

Background: Supraclavicular brachial plexus block is the preferred anaesthetic technique of choice for surgeries of the upper limb. Over the past few decades several adjuvants have been added to enhance the effects of local anaesthetics in brachial plexus block. In this randomized controlled study we aim to assess the addition of fentanyl to ropivacaine in supraclavicular brachial plexus block in terms of duration of analgesia and onset time.

Methods: 60 patients aged 18-60 years scheduled for upper limb orthopaedic surgery were randomly divided into two groups of 30 patients each. Group R received 30 ml of 0.5% ropivacaine and Group RF received 30 ml of 0.5% ropivacaine with 50 microgram Fentanyl in supraclavicular brachial plexus block. Both the groups were assessed in terms of onset of block, duration of anaesthesia, post op analgesia, hemodynamic stability and complications if any.

Results: Demographic profile was comparable in both groups. The addition of fentanyl to ropivacaine 0.5% enhanced the onset of brachial plexus block and also increased the duration of anaesthesia and post op analgesia compared to ropivacaine 0.5% used alone.

Conclusion: The addition of fentanyl to ropivacaine 0.5% improved the blockade characteristics of supraclavicular brachial plexus block compared to ropivacaine 0.5% used alone.

Keywords: Supraclavicular brachial plexus block, Ropivacaine, Fentanyl

Introduction

The first brachial plexus block was performed over a century ago with cocaine by William halstead[1].

In the past decade many advances have been made in the field of regional anaesthesia with the advent of ultrasound and introduction of newer long acting local anaesthetics and adjuvants. They have improved the quality and duration of peripheral nerve blocks. In the post covid era, supraclavicular brachial plexus block

also known as the spinal of the upper limb has emerged as a preferred and reliable technique for upper limb surgeries because of the decreased risk of aerosolization of airway secretions associated with airway manipulation in general anaesthesia and it also provides good post op analgesia. Regional nerve blockade avoids the unwanted effects of anaesthetic drugs used during general anaesthesia and is beneficial for patients with various cardio-respiratory co-morbidities[2].

The ideal drug for brachial plexus block would be the one which has a faster onset of action, long duration of anaesthesia and with low toxicity profile. Bupivacaine has been the most commonly used local anaesthetic in brachial plexus block but it has the disadvantage of cardiac and central nervous system toxicity when used in high concentration or after accidental intravenous administration of the drug. Ropivacaine is a new long acting amide local anaesthetic with a better safety profile than bupivacaine. Ropivacaine, compared to bupivacaine blocks pain transmitting A delta and C fibers to a greater extent than A beta fibers which control motor function[3,4], leading to a lesser degree of motor blockade compared to bupivacaine but both have similar duration of sensory analgesia. Thus it is an ideal anaesthetic of choice for patients requiring early post-operative mobilization such as in day care surgeries. The practical difficulties faced for providing adequate post-operative analgesia are the requirement of high doses of drug and limited duration of action. Here comes the role of adjuvants like opioids(fentanyl, morphine), clonidine, vasoconstrictor agents etc have been used for regional nerve blocks to improve the block duration or quality or both[5]. We decided to evaluate the efficacy of Ropivacaine 0.5% due to its safety profile and added an adjuvant opioid Fentanyl 50 microgram to observe if it improved the blockade characteristics compared to Ropivacaine 0.5% used alone in supraclavicular brachial plexus block.

Aim: To determine the onset and duration of sensory and motor block, duration of analgesia, side effects and complications of 0.5% ropivacaine and 0.5% ropivacaine with fentanyl 50 microgram used in supraclavicular brachial plexus block.

Materials and methods

This prospective, randomized clinical trial was conducted on patients undergoing upper limb surgery. After obtaining approval from the institutional ethics committee, 60 ASA grade I and II patients aged between 18 to 60 years were included in the study only after obtaining a written informed consent. Patients who had not given consent and those with pulmonary, cardiac, renal, neurological or psychiatric disease and having allergy to any of the study drugs were excluded from the study.

Randomisation was done using sealed envelope technique and the patients were divided into two groups of 30 patients each. Group R was given 30ml of 0.5% ropivacaine and Group RF was given 30 ml of 0.5% ropivacaine with 50 microgram fentanyl.

Patients received tab alprazolam 0.5mg as overnight sedation and were kept nil per oral for 8 hours prior to surgery. In the operative room intravenous access was secured with 18 G cannula in all the patients and standard monitors were attached for monitoring oxygen saturation, heart rate, respiratory rate, noninvasive blood pressure and electrocardiography. Patients were pre medicated with InjGlycopyrrolate (0.2mg) iv, Inj Ranitidine (50mg) iv and Inj metoclopramide (10mg) iv.

For performing brachial block the patient was kept in supine position with the head tilted to the opposite side. After proper antiseptic precautions, subclavian artery was palpated at 1 cm above midpoint of clavicle just lateral to the lateral head of sternocleidomastoid muscle. An insulated 1.5 inch 25G insulated needles was introduced just lateral to the subclavian artery pulsation in backward, downward and medial direction toward the first rib. The nerve stimulator was attached to the stimulating needle and a initial current output of 1.5mA at 2 Hz frequency was delivered. After observing thecontraction of the muscle below the deltoid in the upper extremity, the current was decreased to 0.5mA while advancing the needle, until maximum contraction is elicited by minimum possible current. At this point the drugs were administered as per the allocated group after intermittent negative aspiration.

Assessment was done every 1 minute until onset of sensory and motor block. The sensory block was evaluated by Hollmen scale measured with pin prick test with a 3 point scale [Score 0: Sharp pain, Score 1: Touch sensation only, Score 2: No sensation] .Onset of sensory block was considered from the time of injection of drug to the time when sensory block was detected [score1]. The total duration of sensory block was considered from the time of complete block [score=2] to the time score was ≤1. The motor block was evaluated using Modified bromage scale [Score 0: Normal motor function with full flexion and extension of elbow, wrist and fingers, Score 1: Decreased motor strength with ability to move fingers only, Score 2: Complete motor block with inability to move fingers]. The onset of motor block was considered from the time of injection of the drug to the detection of motor block with score ≥1. The duration of motor block was taken as the time after attaining complete motor block (score=2) to the time to achieve score of 0 on modified bromage scale. The total duration of analgesia was defined as the time interval from the onset of block to the requirement of first rescue analgesia when the VAS score was ≥5. Inj Diclofenac sodium (1.5mg/kg) im was given as rescue analgesic. The block was considered incomplete if the patient complained of pain in any of the dermatome after 30 minutes of the block, such patients were given general anaesthesia and excluded from the study.

Inj Ondansetron was given to all patients before end of surgery. After the surgery all the patients were shifted to their respective wards and monitored for vitals, VAS for pain, regression of block and side effects such as nausea, vomiting, shivering, pruritis, pneumothorax, Horner's syndrome, recurrent laryngeal nerve palsy and respiratory depression.

The data was collected, compiled and checked. Data analysis and processing was done with the help of statistical software IBM SPSS (Statistical Package for Social Sciences) version-23. The test statistics used for analysis of data was student's t-test (For comparision of quantitative data-age, sex, weight) Chi square test (For Comparision of data present in categorical scale-outcome in both groups) .The results were presented in tables and figures. The results were considered significant if p value is <0.05 and considered as highly significant if p value is <0.001.

Results

There was statistically no significant difference between the two groups with respect to age, sex ratio, weight, height and ASA status. The onset of sensory and motor block was faster in the group receiving

fentanyl as adjuvant (Group RF).In our study we found that the onset time of sensory block in Group RF was 5.77±1.63 minutes and in Group R was 8.67± 1.66 minutes, which was statistically highly significant(p value<0.001).The motor block onset time was 8.27±1.57 minutes in Group RF and 12.23±1.736 minutes in Group R , which was statistically significant (p value <0.00001)

In our study the duration of sensory and motor block was longer in group RF, the mean time of duration of sensory block in Group RF was 474.3 ± 15.24 minutes and that of Group R was 410.3 ± 39.27 minutes which was statistically significant (p value <0.0001) and mean time of duration of motor blockade in Group RF was 436.67 ± 11.39 minutes and in Group R was 381.67 ± 39.04 minutes which was also highly significant (p value <0.0001)

The duration of analgesia in Group RF was 489±52.7 minutes and in Group R was 446±38.9 minutes , implying that addition of fentanyl 50 microgram to ropivacaine 0.5% increased the duration of analgesia as compared to ropivacaine 0.5% used alone and this increase in duration was statistically significant (p value <0.0001)

The blood pressure , heart rate, and oxygen saturation were noted for every 5 minutes until 15 minutes and every 15 min for 2 hours, they did not differ significantly throughout the procedure.

Discussion

In this study we found that addition of 50 microgram fentanyl to 0.5% ropivacaine led to an early onset of sensory and motor block and also prolonged the duration of sensory and motor blockade and quality of sensory and motor block was also better than ropivacaine group alone. Conversion from regional to general anaesthesia were nil in case of ropivacaine and fentanyl group ,however 5 patient converted to general anaesthesia in Ropivacaine group alone. During this Covid pandemic era this may be useful practice as chances of conversion from regional to general is minimum and hence less aerosolization. It also prolonged the duration of analgesia. Opioids exert their anti-nociceptive action at the central and/or spinal cord level . The exact mechanism of action of fentanyl given in brachial plexus block along with local anaesthetics is not known, however recent studies have begun to support the presence of peripheral opioid receptors .[6-9]So the possible mechanism maybe due to action of fentanyl in peripheral opioid receptors located on the primary afferent neurons. Another reason could be attributed to the action of fentanyl in the substantia gelatinosa after its centripetal axonal transport after perineural injection.[10]The advantage of peripheral administration of opioids along with local anaesthetics is it improves the quality of anaesthesia and avoids the centrally mediated side effects such as respiratory depression, pruritis, nausea and vomiting.

Soma C Cham et al 2015[11] conducted a prospective clinical trial in which 30 patients were given 30 ml of 0.5% ropivacaine and 30 patients were given 30 ml of 0.5% ropivacaine with 50 microgram fentanyl. They concluded that fentanyl added as an adjuvant to 0.5% ropivacaine in supraclavicular brachial plexus block led to earlier onset of sensory and motor block and increased the duration also and duration of post-operative analgesia when compared to 0.5% ropivacaine used alone.

Rajkhowa T et al 2016[12] in a similar study, with 66 patients with age group 18 to 65 years of ASA I and ASA II category and were divided into two groups.

Group R(Ropivacaine)received 30 ml of 0.5% ropivacaine and Group RF(Ropivacaine and fentanyl)received 0.5% ropivacaine plus 50 microgram fentanyl. They concluded that addition of fentanyl to ropivacaine used for brachial plexus block prolonged the duration of sensory and motor plexus block compared to ropivacaine used alone.

Munipalle et al 2017[13]conducted a randomised single blinded prospective study with 60 ASA I and II patients aged 20 to 60 years which were divided into two groups. Group A received 30 ml of 0.75% ropivacaine plus 5ml NS(Normal saline)and in Group B received 0.75% ropivacaine plus fentanyl 2 micrograms/kg in 5ml NS. They concluded that the addition of fentanyl to 0.75% ropivacaine produced quicker onset of action on supraclavicular brachial plexus block .

Studies by Geze et al[14], Madhusudan et al [15], Chavan SG et al [16] have also supported the observation that addition of fentanyl to local anaesthetic caused an increase in duration of sensory and motor block along with post-operative analgesia.

There was no significant change in hemodynamic parameters like blood pressure, heart rate and spo2 in both the groups after administration of the block. There were no side effects like nausea, vomiting, pruritis, drowsiness, perioral numbness, hypotension, bradycardia, arrhythmia or convulsions further cementing the safety profile of Ropivacaine.

Conclusion

In our study addition of fentanyl to 0.5% ropivacaine produced a quicker onset of action along with prolonged duration of action and post-operative analgesia. Aerosol generation is major concern in COVID era. It has been found in several studies that regional anaesthesia is preferred technique as far as aerosol generating procedure is concerned. Hence procedure and technique involving longer and early onset is perhaps going to help for infection containment.

Table 1: Demographic parameters in both groups

Demographic parameters	GroupR (n=30)	Group RF(n=30)
Age (years)	34 ± 11.49	30.43 ± 12.52
Weight (kg)	64.1 kg	63.13
Height (cms)	160.3±6.26	162.06±5.83
Sex (M:F)	25:5	24:6
ASA physical status I/II	22:8	24:6
Duration of surgery	92.5 ±21.2	101.6±20.94

Table 2: Characteristics of blockade in both groups

	Group R	Group RF	p Value
Onset of sensory block(min)	8.67± 1.668	5.77±1.633	<0.0001
Onset of motor block(min)	12.23± 1.736	8.27±1.574	<0.00001
Duration of sensory block(min)	410.33±39.127	474.33±15.241	< 0.0001
Duration of motor block(min)	381.67±39.048	436.67±11.397	<0.0001
Total duration of analgesia (min)	446.17±38.9	532±18.5	<0.0001

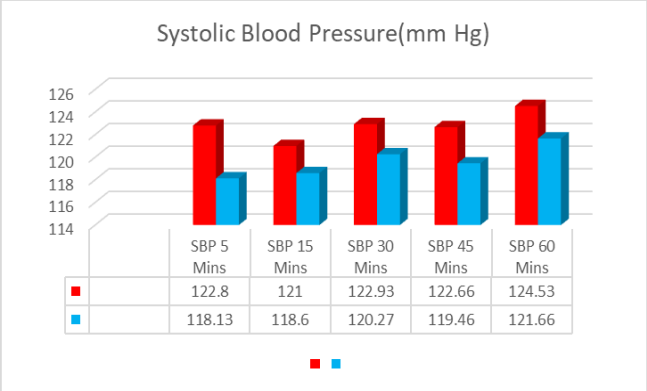

Fig 1: Peri operative Systolic BP monitoring (n=60)

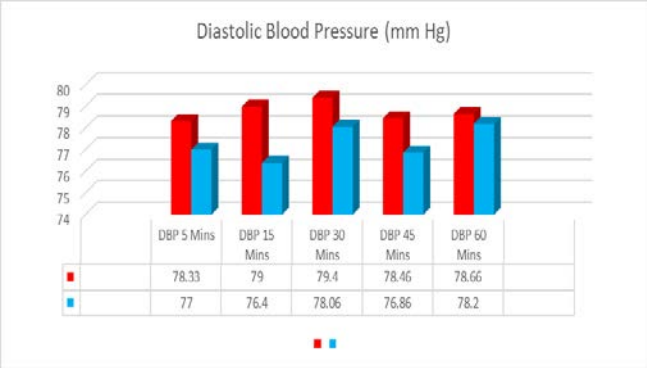

Fig 2: Peri operative diastolic BP monitoring (n=60)

Fig 3: Peri operative pulse rate monitoring (n=60)

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