



EFFICACY OF DEXMEDETOMIDINE AND FENTANYL AS ADJUVANTS TO 0.75% ROPIVACAINE IN SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK- A COMPARATIVE STUDY

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ABSTRACT

Context: Supravlavicular Brachial Plexus block is popular in upper limb surgeries. Peripheral Nerve stimulation increases the success and accuracy with less complications. Local anaesthetic (LA) Ropivacaine has less cardio toxicity than Bupivacaine. Adjuvants are added to (LA) to increase quality and duration of blockade while reducing its toxicity.

Aim: To compare onset, duration of sensory and motor block by using 0.75% Ropivacaine with adjuvants Dexmedetomidine and Fentanyl in Supravlavicular block. Purpose of this study is to find duration of post-op analgesia and associated side effects.

Methods and Material: 60 patients of ASA grade 1,2,aged 18-65 years of either sex undergoing elective upper limb surgery, randomly divided into 2 groups of 30 each.

- Group RF: Inj. Ropivacaine 0.75% (24ml) + Inj. Fentanyl 50 mcg (1ml)

- Group RD: Inj. Ropivacaine 0.75% (24ml) + Inj. Dexmedetomidine 50 mcg (1ml)

Statistical analysis: Software package SPSS v20.0 used. Mann-Whitney U test was used to compare non parametric data.

Results: In group RF/RD in minutes respectively for Peak sensory block $9.9 \pm 4.2/13.3 \pm 4.9$ (p Value-0.002). Peak motor block $15.7 \pm 4.7/20.6 \pm 7.3$ (p Value-0.009). Total duration of sensory block $464.0 \pm 47.3/784.0 \pm 47.4$ (p Value < 0.001). Total duration of motor block $456.3 \pm 51.0/756.3 \pm 51.1$ (p Value < 0.001). Time required for post op rescue analgesia was longer in RD group.

Conclusion: Dexmedetomidine provides a longer duration of sensory and motor blockade and post-operative analgesia when compared to Fentanyl as an adjuvant to 0.75% Ropivacaine in Supravlavicular block.

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INTRODUCTION

The Brachial Plexus block often called the “Spinal anaesthesia of the upper extremity” providing analgesia and anaesthesia. Block is performed at distal origin of the divisions, where the brachial plexus is confined to its smallest surface area^[1]. The block performed with peripheral nerve stimulator or ultrasound technique has excellent results and minimal complications than blind technique^[2,3]. Ropivacaine is a newer local anaesthetic agent having less toxicity than Bupivacaine^[4] and lignocaine in terms of cardio toxicity and neurotoxicity. It is pure S enantiomer of S-1-Propyl-2,6-Pipecoloxylidide.

Additive when added to (LA), prolongs the action of block. An imidazoline selective α_2 adrenoreceptor agonist, Dexmedetomidine as an adjunct in peripheral nerve blocks has become a recent advance. Prolonged duration of motor block in supravlavicular block was demonstrated with addition of dexmedetomidine^[5]. Fentanyl is a synthetic opioid agonist, a Phenylpiperidine derivative. Opioids when added as adjuncts in peripheral nerve blocks are found beneficial^[6,7].

The present study was to compare the efficacy of sensory and motor onset of 0.75% Ropivacaine with Dexmedetomidine versus 0.75% Ropivacaine with Fentanyl. The duration and quality of sensory and motor blockade and post-operative analgesia was studied. Any associated complications or side effects were noted.

SUBJECTS AND METHODS

Sample size calculation: Study conducted by Soma C. Cham et al showed that mean(SD) of 'Total duration of sensory block (in min)' in Group 'RF' is 458.15(20.62) and in group 'RD' is 511.33(30.45) [ChamSC, Sangawar MA, Umesh L. et al. Comparison of the effects of Fentanyl and Dexmedetomidine in Supravlavicular Brachial Plexus block Achieved with Ropivacaine. Journal of Evolution of Medical and Dental Sciences July 2015; 4(54):9427-9436]. Entering this data in WINPEPI software and considering significance level at 1% and keeping the power at 95% the sample size comes to be 20 (10 in each group). However we have included more participants in our study and considered 60 to be the sample

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size(30 in each group) considering drop outs and to facilitate results interpretation.

After ethical committee clearance and written consent this prospective randomized double-blind comparative study was conducted on sixty patients of age 18-65 years of American society of Anaesthesiologist (ASA) grade I and II patients, undergoing elective upper limb surgeries under Brachial plexus block. Using computer-generated randomization, 60 patients were divided into 2 groups of 30 each.

Group RF: Injection Ropivacaine 0.75%(24ml) + Injection Fentanyl 50 mcg (1ml).

Group RD: Injection Ropivacaine 0.75%(24ml) + Injection Dexmedetomidine 50 mcg (1ml). Each group was given their respective drug according to double-blind method. Drug was prepared by anaesthesiologist who was not involved in administration of anaesthesia, patient care and data collection. Allocation concealment was achieved by double blind technique by which neither the patient nor the observer knew the drug which was administered. Double blind technique prevents bias in research results hence used. Preoperative evaluation of all the patients done day prior to surgery. Written informed consent was obtained. Premedication with Tablet. Alprazolam 0.25 mg at night and Tablet. Ranitidine 150 mg in the morning of surgery 2 hrs prior to surgery with a sip of water was given to all patients.

Exclusion criteria: Patients with severe cardiac, respiratory, renal disease, bleeding disorders, pregnancy, existing peripheral neuropathy of upper limb, infection at the site of block and hypersensitivity to study drugs were excluded from study.

Brachial plexus block by supraclavicular approach was given with a nerve stimulator. Sensory and motor blockade evaluation was done every 2 min until complete sensory and motor block or till 30 min, whichever was earlier.

- Time 0 -Completion of injection.
- Sensory blockade was assessed using the pin prick test.
- Modified Bromage Scale was used to assess motor block.

The failed blocks were excluded from the study.

Ringer lactate was administered as replacement and maintenance fluid. Heart rate, Respiratory rate, oxygen saturation, Blood pressures were noted at 5, 10, 20 and 30 minutes and then every 30 minutes till the end of surgery. Thereafter, every one hour in post-operative period. All patients were educated regarding the use of VAS (Visual Analogue Scale), in which 0 meant no pain and 10 meant worst pain.

VAS score:

0: no pain.

1-3: mild pain.

4-6: moderate pain.

7-10: severe pain.

Intraoperative and postoperative period side effects were noted.

Following recordings were made:

T0 - time of administration of drug

T1 – time of onset of sensory response

T2 – time of onset of motor response

T3 – time of peak sensory block

T4 – time of peak motor block

T5 – total duration of sensory block

T6 – total duration of motor block

T7 – time for rescue analgesia

Statistical Analysis: It was done using software package SPSS v20.0. Parametric scale data was compared using Student T-test. Non parametric data was compared using Mann Whitney U test. The p-value <0.05 was considered statistically significant.

OBSERVATION AND RESULTS

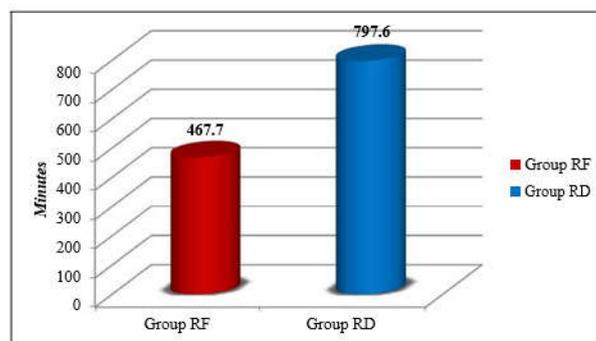
As we can see from Table 1, there was no significant difference between the two groups related to demographic data, ASA grading and duration of surgery (p-value > 0.05). As we can see from Table 2, subjects in group RF had significantly earlier onset of sensory and motor blockade as compared to group RD (p-value < 0.001). In group RF, majority of patients had peak sensory earlier than group RD (p-value 0.002), difference was statistically significant. In group RF peak motor blockade was significantly earlier as compared to group RD (p-value 0.009). Total duration of sensory and motor block in group RF was significantly less than group RD (p-value < 0.001). Time required for rescue analgesia was significantly prolonged in group RD as compared to group RF (p-value < 0.001)(Figure 1).

Table 1 Comparison of Demographic data and ASA grading

Parameter	Group RF (Mean +/- SD)	Group RD (Mean +/- SD)	p- value
Mean Age(years)	42.2 +/- 11.4	42.6 +/- 10.8	0.899
Gender (M : F)	21 : 9	22 : 8	1.000
Mean weight(kg)	62.1 +/- 8.7	60.7 +/- 6.6	0.499
ASA Grade I	23	25	
II	7	5	
Duration of Surgery	99.0 +/- 23.8	97.0 +/- 24.5	0.750

Table 2 Comparison of blockade between two groups

	Group RF	Group RD	Z score	p-value
T1- onset of sensory block (min)	3.3 +/- 0.7	5.1 +/- 0.8	-6.054	<0.001
T2- onset of motor block (min)	7.1 +/- 0.9	9.2 +/- 0.8	-6.239	<0.001
T3- Peak sensory block (min)	9.9 +/- 4.2	13.3 +/- 4.9	-3.083	0.002
T4- Peak motor block (min)	15.7 +/- 4.7	20.6 +/- 7.3	-2.610	0.009
T5- Total duration of sensory block (min)	464.0 +/- 47.3	784.0 +/- 47.4	-6.658	<0.001
T6- Total duration of motor block (min)	456.3 +/- 51.0	756.3 +/- 51.1	-6.657	<0.001
T7- Time required for rescue analgesia (min)	467.7 +/- 49.5	797.6 +/- 50.0	-6.657	<0.001



Graph of Comparison of time required for rescue analgesia (in minutes) between two groups.

Figure 1 Graph of Comparison of time required for rescue analgesia (in minutes) between two groups

There was no significant difference in pulse rate between two groups during pre-operative, operative or post-operative stage

(p-value > 0.005) (Figure 2). There was significant fall in systolic and diastolic blood pressure in group RD subjects. The fall started after 30 minutes of administration of the drug and was maximal 3 hours post-operatively. And it returned to normal 6-7 hours post-operatively (Figure3). There was no significant fall in SpO2 in the two groups.

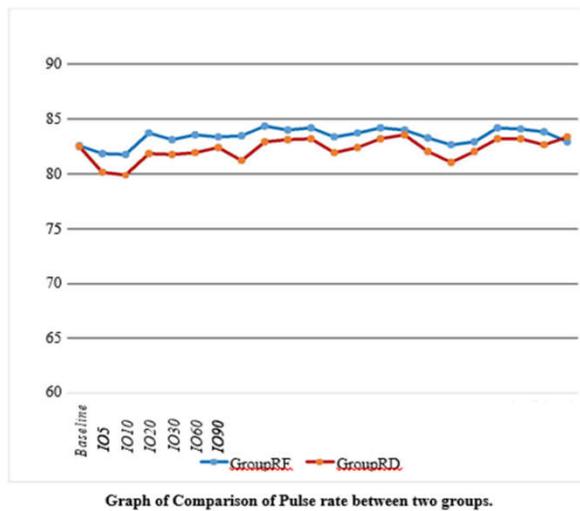


Figure 2 Graph of Comparison of pulse rate between two groups

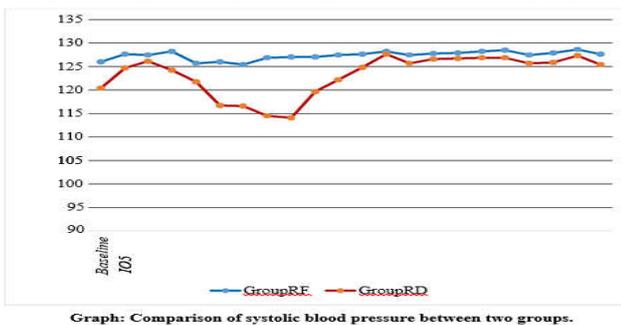


Figure 3 Graph of Comparison of systolic blood pressure between two groups

Incidence of side effects in both group

Incidence of side effects were minimum in both groups. In RF group 2 patients had nausea/vomiting and 1 patient had pruritis. While in RD group 3 patients had hypotension and bradycardia. Side effects seen in both groups were not statistically significant. (P-value >0.05). TD group shows only 3 patients with bradycardia and hypotension which is not statistically significant. Bradycardia and hypotension is dose dependent and may vary with individuals. Vagal tone patients may get bradycardia and hypotension with 1mcg/kg dose. Systemic absorption may cause these effects.

DISCUSSION

Supraclavicular block by peripheral nerve stimulator and ultra sound guided technique have excellent results than blind block. In this era with recent advances, Ropivacaine is widely used instead of Bupivacaine as analgesic effects are same with both drugs but Ropivacaine has less motor blockade and less cardiotoxicity which is advantageous. Local anaesthetics are combined with different adjuvants to fasten onset of action and prolong the duration of the block^[8,9].

An alpha 2 agonist, Dexmedetomidine is newer agent added to local anaesthetic drugs in peripheral nerve blocks. The objectives of addition of this agent to local anaesthetic drug

has been studied and has been found to significantly reduce onset time and prolong the duration of sensory block and analgesia^[10,11].

Norepinephrine release is inhibited by presynaptic activation of α_2 adrenoreceptors thus causing inhibition of sympathetic stimulation and pain signal is also terminated. Analgesia and sedation is produced by alpha2 adrenoreceptor agonist action by inhibition of release of substance p in nociceptive pathway at the level of dorsal root neuron and by activation of α_2 adrenoreceptors in locus coeruleus^[12]. Multifactorial mechanism of the analgesic actions of α_2 agonists has been thought not fully proved. Transmission of nociceptive signals in the CNS is modulated by spinal and supraspinal receptors. Peripheral α_2 adrenoreceptors may also mediate the antinociception^[13]. α_2 blockers by acting at any of these sites reduce nociceptive transmission, leading to analgesia. The activation of inwardly rectifying G1-protein-gated potassium channels resulting in membrane hyperpolarization and decreasing the firing rate of excitable cells in the CNS is considered to be a significant mechanism of the inhibitory neuronal action of α_2 -adrenoreceptor agonists^[14]. Reduction of calcium conductance into cells, thus inhibiting neurotransmitter release. Dexmedetomidine action in peripheral nerve block is mainly due to direct action on nerves, rather than due to central action of dexmedetomidine, as systemic circulation side effects would be seen due to systemic absorption.

Opioids have also been added to various local anaesthetics in brachial plexus blocks to prolong the duration of sensory and motor block and enhance post-operative analgesia. The more liposoluble opioids like Fentanyl and Buprenorphine are more effective^[15].

Ropivacaine has less motor effect than Bupivacaine, so to overcome that drawback, adjuvants fentanyl and dexmedetomidine were added to enhance quality, duration of sensory and motor blockade. Each group additive was used in dose of 1mcg/kg. Equivalent dose of each test drug as 1mcg/kg body weight and considering ideal body weight of 50 kgs, 50 mcg of either of test drug is added as adjuvant to Ropivacaine. In this study we aimed to compare the efficacy of Dexmedetomidine and Fentanyl added as adjuvants to 0.75% Ropivacaine in Supraclavicular Brachial plexus block in terms of onset and duration of sensory and motor block and duration of post-operative analgesia in both groups.

Onset of peak sensory block was earlier in group RF (9.9 +/- 4.2 minutes) compared to group RD (13.3 +/- 4.9 minutes) in our study. Comparison between two groups resulted in p-value 0.006, which was statistically significant.

Similar results were obtained by Soma C Cham, Medha A Sangawar, *et al*, who achieved a faster onset of sensory and motor block with Fentanyl compared to Dexmedetomidine added to 0.5% Ropivacaine in supraclavicular brachial plexus block^[16].

Onset of peak motor blockade was earlier in group RF (15.7 +/- 4.7 minutes) compared to group RD (20.6 +/- 7.3 minutes). Comparison between two groups resulted in a p-value of 0.003 which was statistically significant.

Total duration of sensory blockade was considerably lesser in group RF (464.0 +/- 47.3 minutes) compared to group RD

(784.0±47.4 minutes). The data between the two groups was compared and found to be highly significant (p-value<0.001). In a study conducted by Anjan Das, SaikatMajumdar, *et al.*^[5] 100 mcg of Dexmedetomidine added to 0.5% Ropivacaine in supraclavicular brachial plexus block, the time taken for peak onset motor block was 19.96 ± 1.28 minutes.

Madhusudhan *et al.*^[17] reported the total duration of sensory block as 372.0 ± 43.2 minutes in patients receiving Fentanyl added to 0.75% Ropivacaine.

Total duration of motor blockade was less in group RF (456.3 ± 51.0 minutes) which was significantly less than in group RD (756.3 ± 51.1 minutes). The duration of motor blockade in the two groups was analysed statistically and found to be highly significant (p-value < 0.001).

Anjan Das, SaikatMajumdar, *et al.*^[5] reported the duration of motor block as 624.2± 20.9 minutes when Dexmedetomidine 100 mcg was added to 0.5% Ropivacaine in supraclavicular block.

The result of our study demonstrated that the duration of postoperative analgesia in group RD (797.6 ± 50.0 minutes) was longer than group RF (467.7 ± 49.5 minutes). Statistically significant result was concluded and our results were same and comparable with results of Soma C Cham.

Soma C Cham *et al.*^[16] reported a mean of the time required for rescue analgesia as 596 ± 36.04 minutes in patients receiving Fentanyl as adjuvant and 648 ± 23.57 minutes in patients receiving Dexmedetomidine as adjuvant to 0.75% Ropivacaine in brachial plexus block.

Indira Gurajala, Anil Kumar, *et al.*^[18] reported a median time for rescue analgesia as 960 mins with 50 mcg of dexmedetomidine added to 0.5% Ropivacaine in supraclavicular block.

JigishaPrahlarai *et al.* conducted a study comparing 0.5% bupivacaine vs 0.5% ropivacaine in supraclavicular block, which concludes ropivacaine provided earlier onset of sensory block^[19]

Yoginee Satishrao Patki *et al.* had similar effects of addition of dexmedetomidine to Ropivacaine on time required for rescue analgesia (728.83 ± 10.23 minutes) as in our study^[20].

Dexmedetomidine as adjuvant when added to Ropivacaine in supraclavicular block prolongs significantly the time required for rescue analgesia. Vital parameters like Heart rate, oxygen saturation were not statistically significant intra and post operatively. No fall in saturation or respiratory depression was observed in any patient. Hypotension and bradycardia were noted in 3 patients in group RD. But incidence of side effects was not statistically significant.

CONCLUSION

In our study we found that combination of Fentanyl and Ropivacaine fastens the onset of sensory and motor block while combination of Dexmedetomidine and Ropivacaine prolongs the duration of sensory and motor block and decreases requirement of rescue analgesia.

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