



Comparative Study between Fentanyl and Dexmedetomidine as Adjuvant to Ropivacaine in Brachial Plexus Block

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Abstract

Background: *Supraclavicular brachial plexus block is a frequently performed procedure to provide anesthesia and postoperative analgesia for upper limb surgeries. Bupivacaine is the most commonly used anesthetic, but ropivacaine has been successfully used as it is less cardiotoxic, less arrhythmogenic. Adjuvants to local anesthetics enhance the quality and duration of analgesia.*

Aim: *To compare the effects of fentanyl and dexmedetomidine as adjuvants to ropivacaine in brachial plexus block.*

Materials & Method: *After informed consent, sixty ASA I and II patients scheduled for upper limb surgeries under supraclavicular block randomly allocated into two groups of 30 each. GROUP D received 30ml of 0.5% ropivacaine with 20 µg dexmedetomidine and GROUP F received 30ml of 0.5% ropivacaine with 50µg fentanyl. Onset and duration of sensory and motor block, duration of analgesia were compared.*

Results: *Demographic variables were comparable between the two groups. The onset of sensory block in group F is 9.1 ± 1.84 min, and group D is 7.56 ± 1.81 min (<0.0019). The onset of motor block in group F is 15.6 ± 2.65 min and group D is 11.7 ± 2.28 min (<0.0001). Duration of sensory in group F and group D is 509.4 ± 45.43 min and 683.83 ± 96.96 min respectively (<0.0001). Duration of motor block in group F and group D is 457.6 ± 43.58 min and 618.7 ± 100.7 min respectively (<0.0001). Duration of analgesia in group F is 596.9 ± 59.5 min and group D is 770.66 ± 110.19 min (<0.0001). Significant difference observed in duration of sensory, motor block, and analgesia between the two groups.*

Conclusion: *Dexmedetomidine is better adjuvant to ropivacaine than fentanyl as it enhances the duration of block and analgesia without adverse hemodynamic consequences.*

Introduction

Peripheral nerve blocks have a prominent role in modern anesthesia practice as they provide ideal operative conditions and excellent postoperative analgesia without systemic side effects¹. Brachial plexus block is a useful alternative to general anesthesia for upper limb surgeries. Given first by Prof Halsted in 1984 and improved by Herschel kulenkampff and Winnie. It became the first

choice of anesthesia for upper limb surgeries as it minimally alters systemic physiology, a good choice for daycare and emergency surgery even in full stomach patients and, in patients where general anesthesia is undesirable². The use of ultrasound guidance increases the accuracy and safety of the block.

Bupivacaine, an amide group local anesthetic, is in use because of its high potency and prolonged

duration of action. One of the disadvantages is that it is cardiotoxic with inadvertent injection into the artery. Ropivacaine is an amide local anesthetic prepared as S enantiomer, and it is less cardiotoxic, less arrhythmogenic, and less toxic to the central nervous system than bupivacaine, and it also has intrinsic vasoconstrictor property³.

The major limitation of regional anesthesia is short duration of action and limited period of postoperative analgesia. So various adjuvants, i.e., Opioids, Midazolam, Neostigmine, Ketamine, have been tried to overcome these limitations and potentiate the efficacy of block⁴.

Dexmedetomidine, is a potent α_2 adrenoceptor agonist, is approximately eight-times more selective towards the α_2 adrenoceptor than clonidine. In various studies, dexmedetomidine has been reported to increase sensory and motor blockade also prolongs the duration of analgesia^{5,6}. In humans, dexmedetomidine has also shown to increase the duration of block and post-operative analgesia when used with local anesthetic in various regional blocks^{7,8}.

Opiates are known to have an analgesic effect at the central and spinal cord level. Opioids such as fentanyl have been used for regional nerve plexus blocks to improve the block duration and quality. The peripheral administration of opioids provides stronger and long-lasting analgesia without the central side effect.⁹

Abdallah et al¹⁰ examined various doses of dexmedetomidine (30 μ g, 100 μ g, 0.75 μ g/kg, 1 μ g/kg) as an adjunct for brachial plexus block and found that dexmedetomidine significantly prolonged the block, but observed reversible bradycardia as an adverse effect which may be due to high dose of dexmedetomidine used.

Hence, the current study was planned with minimizing the dose of dexmedetomidine (20 μ g), and the study was intended to compare the efficacy of fentanyl (50 μ g) and dexmedetomidine (20 μ g) as additives to 0.5% ropivacaine in supraclavicular brachial plexus block.

Aims and Objectives of the Study

To evaluate and compare the anesthetic and analgesic effect of fentanyl and dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block with respect to - time of onset and duration of sensory and motor block, duration of analgesia and complications.

Patients and Methods

The present study was conducted at the Department of Anesthesiology, King George Hospital, Visakhapatnam. Written and informed consent taken from all patients who participated in the study.

This study is a prospective, randomized, comparative study. 60 patients of American Society of Anesthesiologists (ASA) I and II physical status between the age of 18 and 60 years scheduled to undergo elective upper limb surgery were randomly assigned to two Groups F and D (n = 30 patients/group)

Patients aged between 18 to 60 years of both genders with ASA status 1 and 2 and those undergoing upper limb surgeries were included.

Exclusion criteria included ASA status III and above, local infection at the site of puncture, patients having neurologic deficit in the upper limb, patients with history of coagulation abnormality, patient with a known allergy to study drug, pregnant and lactating patients, patients with cardiopulmonary disorders and those without valid informed consent.

All the patients were assessed before surgery, and pre anesthetic evaluation was done. The patient was informed about the anesthesia procedure, drugs used, its effects, and side effects. Written and informed consent taken. Visual analogue scale explained to the patient. All the patients were given tab Alprazolam 0.5 mg the night before the surgery.

Intravenous access secured with 18 G cannula and infusion with Ringer Lactate started. All patients were given Inj. Ondansetron 4 mg iv, and Inj midazolam 1 mg iv 15 mins before the procedure.

All the necessary equipment and drugs needed for the administration of general anesthesia and resuscitation were kept ready. Patients were connected to noninvasive monitors like pulse oximetry, noninvasive blood pressure monitor, and five lead ECG. Baseline parameters recorded, i.e., pulse rate, systolic, and diastolic blood pressure, SPO₂.

Under strict aseptic conditions, supraclavicular brachial plexus block was performed with USG guidance (Sono Site) by in plane technique using 6-13 Hz probe. **Group F** received 30ml of Ropivacaine 0.5% + 1ml Fentanyl (50µg) and **Group D** received 30ml of Ropivacaine 0.5% + 1 ml Dexmedetomidine (20µg).

The following parameters were assessed:

Onset and duration of Sensory block

- Sensory block assessed by pinprick test using the blunt end of a 26-gauge needle every minute after administration of drug injection in the dermatomal areas corresponding to the median nerve, ulnar nerve, radial nerve, and musculocutaneous nerve till complete blockade.
- Sensory block assessed by a 3-point scale: 0 - normal sensation, 1 - Loss of sensation of pinprick (analgesia), 2 - Loss of sensation of touch (anesthesia).

Onset time – It is defined as the time interval between the end of total local anesthetic drug administration and complete sensory block (score 2).

Duration of the sensory block – It is defined as the time interval between the onset of block and resolution of anesthesia (score 0).

Onset and duration of motor block

- Motor blockade assessed by Modified Bromage Scale: 0 - Normal motor function, 1 - Ability to move only fingers, 2- Complete motor block with an inability to move elbow, wrist, and finger.

Motor block onset time- defined as the time interval between the end of total local anesthetic

administration and complete motor block (MBS score 2).

Duration of motor block- defined as the time interval from the onset to the recovery of complete motor function (MBS score 0).

Duration of analgesia or first request for analgesia

- The pain was assessed using a standard 10 cm Visual Analogue Scale (VAS). Time for the first request for postoperative analgesia (duration of analgesia) was noted. Intravenous inj. Tramadol 100mg with inj. Ondansetron 4mg was given as a rescue analgesic if the VAS score was higher than or equal to 4.

Hemodynamic Parameters: During the intraoperative period, patients were monitored for hemodynamic variables like heart rate, systolic pressure, diastolic pressure, and mean arterial pressures every 5 minutes during the first 15mins, then every 15 mins throughout the surgery and hourly thereafter.

Complication such as bradycardia (<50 bpm), hypotension(>20% of baseline), respiratory depression, pneumothorax, horners syndrome, nausea, vomiting were noted.

Statistical Analysis

Data entered in Microsoft MS Excel sheet and analysis was done using GRAPHPAD software on personal computer. Continuous data such as onset, duration expressed as mean and standard deviation and analyzed using student t-test. Categorical data expressed as proportions and analyzed using the chi-square test. A p-value of < 0.05 is considered to be statistically significant.

Results

There was no statistically significant difference observed between the two groups with respect to age, weight, sex ratio with p value >0.05 (Table 1). The mean onset time of sensory block in group F is 9.1±1.84 min and group D is 7.56±1.81 min. The mean onset time of motor block in group F is 15.6±2.65 min and group D is 11.7±2.28 min (Table 2). Statistically significant difference

present between the two groups as p value is <0.05 and onset of the sensory and motor block was faster in group D than group F. Mean duration of sensory block in group F is 509.4±45.43 min and group D is 683.83±96.96 min. Mean duration of motor block in group F is 457.6±43.58 min and group D is 618.7±100.7 min

(Table-3). Significantly longer duration of sensory and motor block was observed in Group D than Group F (p<0.0001). Significant increase in mean duration of analgesia in group D was noted (770.66±110.19 min) as compared to group F (596.9±59.5 min) and the difference is statistically significant (p value-<0.0001).

Table 1: Demographic characteristics

Demographic profile	Group F	Group D	P VALUE	
Sex(M:F)	17:13	19:11	0.792	NS
Mean Age(YR) (Mean±SD)	38.6±14.14	36.6±14.05	0.58	NS
MeanWeight(kg) (Mean ±SD)	54.7±9.35	58.4±8.2	0.108	NS

NS - non significant

Figure 1: Demographic characteristics

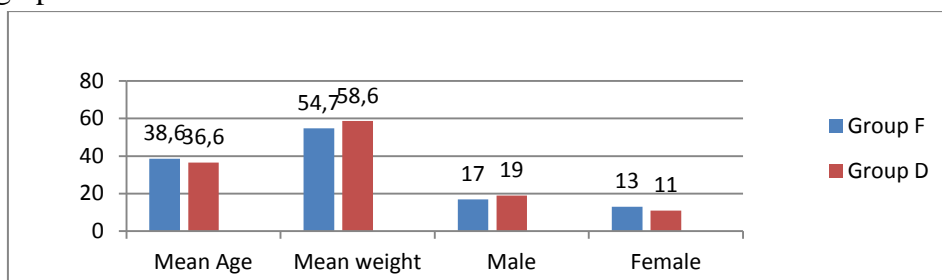


Table 2: Onset of sensory and motor block

	Group D(Min)	Group F(Min)	P VALUE
Onset of sensory block	7.56 ± 1.81	9.1 ± 1.84	<0.0019(S)
Onset of motor block	11.7 ± 2.28	15.6 ± 2.65	<0.0001(S)

S denotes significant

Figure 2: Onset of sensory and motor block

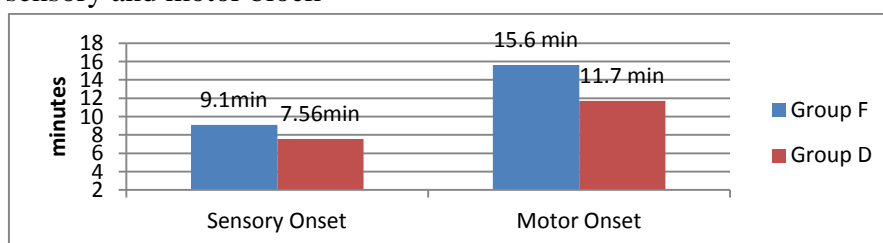
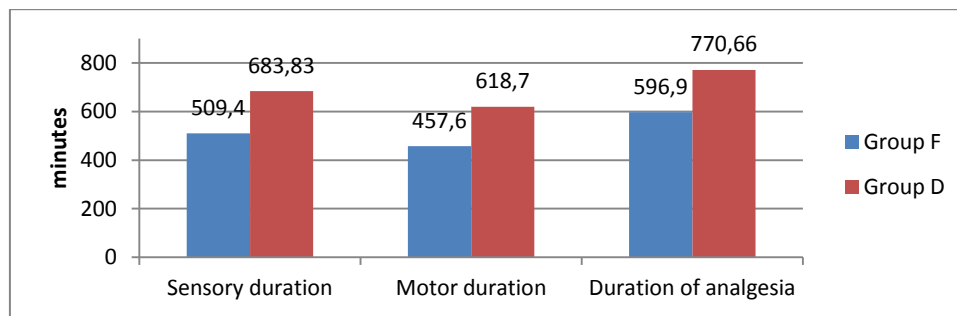


Table 3: Duration of block

	Group D(Min)	Group F(Min)	P VALUE
Duration of sensory block	683.83 ± 96.96	509.4 ± 45.43	<0.0001(S)
Duration of motor block	618.7 ± 100.7	457.6 ± 43.58	<0.0001(S)
Duration of analgesia	770.66 ± 110.19	596.9 ± 59.5	<0.0001(S)

Figure 3: Duration of block

Discussion

Brachial plexus block provides both intraoperative anesthesia and postoperative analgesia for upper limb surgeries. It has an advantage over general anesthesia like avoiding airway instrumentation, decreased incidence of nausea and vomiting, early mobilization, and extended postoperative analgesia¹¹. Of various approaches to brachial plexus, the supraclavicular route is preferred one as there will be rapid, dense, and predictable anesthesia of the entire upper limb¹². The accuracy of the block is increased with the use of ultrasound guidance, and the problems associated with the conventional technique like patient discomfort to paresthesia, injury to the nerve and surrounding structures avoided.

When local anaesthesia is used solely, they have a shorter duration of action. The duration of analgesia with local anesthesia alone can be prolonged with the use of indwelling catheters, but misplacement, migration and infection are the inherent problems with catheter placement^{13,14}. So adjuvants to local anaesthesia prolongs the duration of action without the need of an additional procedure and risks of catheter insertion¹⁵.

Dexmedetomidine is a centrally acting α_2 agonist mediating antinociception via peripheral α_2 adrenoceptors. Clonidine is another centrally acting α_2 agonist that is less selective and has been used as an adjuvant to local anesthesia¹⁶. The activation of inwardly rectifying G1 protein-gated potassium channels, resulting in membrane hyperpolarisation and decrease in the excitability of the CNS cells and the reduction of calcium conductance into the cells, inhibiting

neurotransmitter release, are the probable mechanisms of action of dexmedetomidine.

Fentanyl is a potent synthetic opioid analgesia with a strong agonistic action at the μ -opioid receptor with a rapid onset and short duration of action. Fentanyl, when added to local anesthesia in peripheral nerve blocks, potentiates the local anesthesia action via central opioid receptor-mediated analgesia by the peripheral uptake of fentanyl to the systemic circulation¹⁴.

In the present study, both the groups were standardized with respect to the volume of drug injected and supraclavicular block performed using the USG technique. Continuous hemodynamic monitoring was done throughout the procedure.

The demographic variables like age, weight, sex, were similar between the two groups with p-value is >0.05 , suggesting statistically insignificant.

Studies done by Geze et al.¹⁷, Madhusudan et al.¹⁸, Sindjelic et al.¹⁴, have observed an increase in duration of sensory and motor block with post-operative analgesia with addition of fentanyl as adjuvant. Nisikawa et al.¹⁹ found that addition of fentanyl to axillary blocks with lidocaine plus epinephrine increase the block duration by approximately 1 hr but delayed block onset in all branches. It was speculated that this delay in onset of action of fentanyl was caused by differences in pH of the injectates.

Marhofer et al.²⁰ observed prolongation of ulnar nerve block (UNB) of 60% with perineural dexmedetomidine when added to 0.75% ropivacaine, whereas systemic administration of 20 μ g dexmedetomidine resulted in a prolongation of only 10% UNB with 0.75% ropivacaine..

Agarwal et al²¹. compared the effects of adding dexmedetomidine to bupivacaine in supraclavicular brachial plexus block in 50 patients. They concluded that dexmedetomidine as an adjuvant to bupivacaine for supraclavicular brachial plexus block significantly shortens the onset time and prolongs the duration of motor and sensory block and duration of analgesia.

In the present study, the mean onset time of sensory and motor block in group D is earlier than group F (p value<0.001) suggesting that group D has faster onset of block. A significant prolongation in duration of sensory and motor block was observed in group D when compared to group F. Present study results also showed that the duration of analgesia is prolonged in group D than group F. These results were comparable to the studies done by P.S. Dharmarao et al.²², Mohamed et al.²³ where they observed that dexmedetomidine prolongs the duration of anesthesia and analgesia when compared to fentanyl.

Hemodynamic parameters were similar in all groups. No respiratory depression, fall in spo₂ was observed in both groups. Mean heart rate and blood pressure remained lower than baseline in both groups. In group D, significant difference in mean heart rate compared to baseline was found and also MAP was lower than baseline but a fall of >25% was not seen.

The limitation of the study is that the parameters may be influenced by many other factors, plasma levels of the drug are not measured and patients of all age groups were not recorded.

Conclusion

Dexmedetomidine is a better adjuvant to ropivacaine in supraclavicular brachial plexus block when compared to fentanyl as it prolongs the duration of sensory and motor block and analgesia without adverse hemodynamic consequences.

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