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## Comparative study between bupivacaine- dexmedetomidine combination and bupivacaine (plain) in brachial plexus block using nerve stimulator

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### Abstract

**Introduction:** Brachial plexus block has evolved into a valuable and safe alternative to general anaesthesia for the upper limb surgeries. It is a great tool in the anaesthetic armamentarium for relief of pain preoperatively, perioperatively and post operatively. It is possible and desirable for patient to remain ambulatory. Adjuvants with local anaesthetics in brachial plexus block are being used to achieve quick, dense and prolonged block. Dexmedetomidine added to local anesthetics prolongs the duration of block and postoperative analgesia in brachial plexus block.

**Methods and Methodology:** It is a prospective, randomised, comparative study of 60 patients admitted in a tertiary hospital for upper limb surgery who were posted under regional anaesthesia during the period of October 2012 to December 2014. The patients taken in this study were allocated into two groups randomly. Group B (n=30) 20millilitres (ml) of 0.5% bupivacaine +1ml saline and group D (n=30) 20ml of 0.5% bupivacaine +1microgram (mcg)/kilogram (kg) dexmedetomidine was given.

**Results:** There were no clinical or statistically significant differences in the demographic profile of patients in either group. Onset of sensory block in radial, median and ulnar nerve distributions were significantly shorter in group B. Motor onset was also significantly shorter in group B. However rescue time was higher in group D. There were no adverse effects noted in both the groups. There was a significant percentage of GA conversion seen in case of group. B.

**Discussion:** Onset of sensory block was faster in Group B than in Group D, onset of motor block was faster in Group B than in Group D, and the difference was statistically significant. There was significant increase in duration of analgesia in Group D (456.12±97.99 min) as compared with Group B (289.67±62.50 min). The difference was statistically significant. No side-effects (nausea, vomiting, dry mouth) were reported during the first 24 h in the post-operative period in both the groups. From this study, we would like to suggest that dexmedetomidine can be safely used with local anaesthetic in peripheral nerve blocks; however, further trials to determine the exact dose and effect of neurotoxicity on the human nerve are required.

**Keywords:** Brachial plexus block, dexmedetomidine, bupivacaine, nerve stimulator

### Introduction

Brachial plexus block has evolved into a valuable and safe alternative to general anaesthesia for the upper limb surgeries. It is a great tool in the anaesthetic armamentarium for relief of pain preoperatively, perioperatively and post operatively, with reduced risk of post anaesthetic nausea, vomiting and other side effects of general anaesthesia such as atelectasis, hypotension, ileus, dehydration and deep vein thrombosis are reduced <sup>[1]</sup>.

In the new trend of day care surgeries, brachial plexus block seems to be a better alternative to general anaesthesia with minimal hospital stay and less financial burden on the patients. Brachial plexus block is used widely today to provide anaesthesia for upper extremity. There are four usual sites of approach. Interscalene, Supraclavicular, Infraclavicular and Axillary. The most complete limb block is provided by supraclavicular approach to brachial plexus. The shoulder is not affected by axillary and the ulnar aspect of the hand and forearm is missed by the interscalene. The merits of brachial plexus block are it is very much helpful in emergency cases where general anaesthesia is contraindicated. Most homogenous block is provided by the technique. There is a minimal possibility of missing peripheral or proximal nerve branches. Immediate post-operative analgesics can be avoided for pain relief due to prolonged duration of analgesia. Thus for upper extremity surgeries regional blockade at the

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brachial plexus provides effective and reliable anaesthesia and analgesia.

Adjuvants with local anaesthetics in brachial plexus block are being used to achieve quick, dense and prolonged block. One among these being dexmedetomidine, a selective  $\alpha_2$  adrenoceptor agonist, which has higher affinity to  $\alpha_2$  receptors compared to clonidine. Dexmedetomidine added to local anesthetics prolongs the duration of block and postoperative analgesia in brachial plexus block. Addition of dexmedetomidine in clinically relevant doses to bupivacaine results in a dose dependent increase in the duration of sensory block. Moreover, others have indicated an increased incidence of adverse effects like sedation, hypotension and bradycardia. Dexmedetomidine can also cause reduced pain by decreasing the systemic and local inflammatory stress response also, there is no reason for it to be ineffective, specifically in brachial plexus blocks. However their combination in supraclavicular brachial plexus block has been seldom tried till now, hence this study was undertaken after approval from the hospital ethical committee was attained for the study.

### Materials & Methodology

It is a prospective, randomised, comparative study .60 patients admitted in Yenepoya Medical College Hospital for upper limb surgery who were posted under regional anaesthesia during the period of October 2012 to December 2014.

The patients taken in this study were allocated into two groups randomly

In group B (n=30) 20millilitres (ml) of 0.5% bupivacaine +1ml saline and

In group D (n=30) 20ml of 0.5% bupivacaine +1microgram (mcg)/kilogram (kg) Dexmedetomidine was given.

**Inclusion Criteria:** Patients posted for upper limb surgery in the age group of 18-70 years with ASA (American society of Anaesthesiologists) grade 1, 2.

**Exclusion Criteria:** Patient refusal, emergency surgery, Any bleeding disorder or patient on anticoagulants, Neurological deficits involving brachial plexus, Patients with allergy to local anaesthetics, Local infection at the injection site, Patients on any sedatives or antipsychotics, Body mass index >35.

### Preoperative Preparation

After taking an informed consent, a thorough pre-anaesthetic evaluation was done for all the patients. Systemic examination was done including airway and the surface anatomy where the block was going to be given. All the patients were kept nil per oral overnight. All of them received Tab. lorazepam 2mg and Tab.ranitidine150 mg night before the surgery.

### Equipments

#### a) For the procedure

An autoclaved portable tray covered with sterile towels containing

1. Sponge holding forceps.
2. Two bowls for iodine and spirit.
3. Towels and towel clips.
4. Gauze pieces.

Other things taken for performing the block

1. Insulated needle-5 cm length.
2. Nerve Stimulator.
3. Bupivacaine 0.5%-20ml., DEXMEDITOMIDINE 1 AMPULE
4. Lignocaine 1%-2ml.
5. ECG leads.
6. 10 cm extension with 3-way stopcock
7. Syringes with needle-20ml, 2ml.
8. Hypodermic needle 5cm, 22G.

#### b) For emergency resuscitation

The anaesthesia machine, pipeline O<sub>2</sub> supply, emergency oxygen source, working laryngoscope with different blades, appropriate size endotracheal tubes and connectors, working suction apparatus with suction catheter, intravenous fluids, airways (oropharyngeal). Drugs and equipments for emergency resuscitation and for giving general anaesthesia were kept ready.

**Monitors:** Non-invasive blood pressure monitor on the opposite upper limb, pulse oximetry, ECG, monitoring of respiratory rate.

### Techniques

With head turned slightly to the opposite side patient was placed in supine position without a pillow. The arm was kept by the side of patient so that his fingers were in touch with his knee. Facing the foot of the table, the anaesthesiologist who was performing the block stood at the side of the patient to be blocked. Under aseptic conditions, the area was prepared and draped. 1cm above the midpoint of the clavicle, the subclavian artery pulsation was felt, the tip of the index finger was rested in the supraclavicular fossa directly over the arterial pulsations and the artery was retracted medially inwards and downward if possible.

**Needle Puncture:** Using a 2cc syringe with 24G needle an intradermal wheal was raised just above the palpating finger. A 5 cm 22G short bevel needle connected to a 10 cm extension with 20 ml syringe with 20ml 0.5% BUPIVACAINE +/- DEXMEDITOMIDINE was inserted through the skin wheal and advanced slowly Backwards (posteriorly), slightly Inward (Medially) and Downward (caudal) [BID] gradually towards first rib, so that the shaft of the needle and syringe were almost parallel to the patient's head. It was instructed to the patient to say "yes" when he/she was feeling a sensation of "tingle" or "electric shock" down the arm and tell verbally where he/she was feeling it. Paresthesia was sought in the digits of the hand or wrist. If paresthesia was elicited, then after negative aspiration for air and blood, 20ml Ropivacaine 0.5% was injected. If needle was touching the first rib and paresthesia was not obtained, then the needle was walked slowly posteriorly and towards vertebra to elicit paresthesia. If not the procedure was repeated. The nerve stimulator was used to assess the block

In both the groups, intercostobrachial nerve was blocked with 5 cc 0.25% bupivacaine for tourniquet pain.

### Efficacy Assessment

#### Assessment of sensory block

**1) Onset of sensory block:** Time interval between administration of local anaesthetic to complete analgesia of

forearm in relation to the distribution of each major nerves tested by pinprick over the forearm.

### Grading of sensory blockade

#### Grade

- 0 = Normal sensation
- 1 = Blunted sensation (analgesia)
- 2 = Absence of sensation

**2) Duration of sensory block:** It's the duration between times of onset of sensory block to the time when patient first complains of pain at the site of surgery.

### Assessment of motor block

- a) Onset of motor block:** Time interval between administrations of local anaesthetic to the time when finger movements are lost completely.
- b) Duration of motor blockade:** It's the duration between the time of loss of finger movements to the time the patient first regains the finger movements.

### Grading of motor blockade

#### Grade

- 0 - No blockade
- 1 - Loss of movements at elbow joint
- 2 - Loss of movements at wrist joint
- 3 - Loss of finger movements

**Successful block:** When analgesia and motor block was present in the areas supplied by all the four major nerves, we considered our block successful.

Failure was defined as the absence of sensory block in at least one neural distribution or inadequate motor block and the need for another anaesthetic technique to allow surgery

### Complications

- a) Related to procedure:** Haematoma formation, Vessel

puncture, Multiple puncture, Pneumothorax, Neuropraxia.

- b) Related to Local anaesthetic:** Circumoral numbness, intravascular injection, Convulsions

### Results

The data was analysed by SPSS version (Statistical Package for Social Sciences) software. Independent t-test was applied for demographic data, haemodynamic parameters, onset and duration of sensory and motor blockade and duration of analgesia. Fisher exact test was applied for assessment of quality of block. P-value was considered significant if  $<0.05$  and highly significant if  $<0.001$ .

60 patients posted for upper limb surgeries were assessed for suitability to enroll in the study and were randomly assigned to one of the two groups. There was no protocol deviation pre-operatively and intraoperatively, except for patients in either group who had to be given general anaesthesia for inadequate block.

The baseline haemodynamic parameters were comparable in both groups. Significantly lower pulse rate was observed at 60, 90 and 120 min, but not less than 60 beats/min, in Group D as compared with Group B ( $P<0.001$ ). Systolic and diastolic blood pressure were found to be significantly lower than baseline from 30 to 120 min in Group D as compared with Group B ( $P<0.001$ ). No treatment was required for this fall in blood pressure. The haemodynamic parameters were comparable at the end of 180 min.

There were no clinical or statistically significant differences in the demographic profile of patients in either group. Onset of sensory block in radial, median and ulnar nerve distributions were significantly shorter in group B. Motor onset was also significantly shorter in group B. However rescue time was higher in group D. There were no adverse effects noted in both the groups. There was a significant percentage of GA conversion seen in case of group. B.

**Table 1:** Time of onset of sensory and motor anaesthesia with rescue analgesia

	GROUP	N	Mean	Std. Deviation	t	df	P VALUE
Sensory onset time	GROUP B	28	14.82	3.056	-11.23	52	<0.001
	GROUP D	26	24.19	3.073			
Motor onset time	GROUP B	28	20.11	2.998	-15.93	42.996	<0.001
	GROUP D	26	36.85	4.514			
Rescue analgesia time	GROUP B	28	283.57	52.93	-9.628	52	<0.001
	GROUP D	26	443.65	68.754			

**Table 2:** B;lock failure

	Group B	Group D
NIL	28 (93.3%)	27 (90%)
GA conversion	2 (6.7%)	3 (10%)
Total	30 (100%)	30 (100%)

### Discussion

Onset of sensory block was faster in Group B than in Group D, onset of motor block was faster in Group B than in Group D, and the difference was statistically significant. The duration of motor block was  $292.67 \pm 59.13$  min in Group B as compared with  $472.24 \pm 90.06$  min in Group D. Again, duration of motor block was significantly longer in Group D.

There was significant increase in duration of analgesia in Group D ( $456.12 \pm 97.99$  min) as compared with Group B ( $289.67 \pm 62.50$  min). The difference was statistically

significant. No side-effects (nausea, vomiting, dry mouth) were reported during the first 24 h in the post-operative period in both the groups.

A study by Brumett *et al.* showed that dexmedetomidine enhances duration of bupivacaine anaesthesia and analgesia of sciatic nerve block in rats without any damage to the nerve. The histopathological evaluation of these nerve axons and myelin were normal in both control and dexmedetomidine + bupivacaine groups [7].

In another study, perineural dexmedetomidine added to ropivacaine for sciatic nerve block in rats prolonged the duration of analgesia by blocking the hyperpolarisation-activated cation. This effect was reversed by a hyperpolarisation-activated cation channel enhancer but not by an  $\alpha_2$  adrenoreceptor antagonist. This shows that the analgesic effect of peripheral perineural dexmedetomidine was caused by enhancement of the hyperpolarisation-

activated cation current, which prevents the nerve from returning from a hyperpolarized state to resting membrane potential for subsequent firing<sup>[9]</sup>.

Kousugi *et al.* in their study found that high concentrations of dexmedetomidine inhibit CAPs in frog sciatic nerves without  $\alpha_2$  adrenoceptor activation. Their result showed that dexmedetomidine reduced the peak amplitude of CAPs reversibly and in a concentration-dependent manner. This action was not antagonized by  $\alpha_2$  adrenoceptor antagonists (i.e., yohimbine and atipamezole); rather,  $\alpha_2$  antagonists reduced the CAP peak amplitude. Clonidine and oxymetazoline, two other  $\alpha_2$  agonists, also inhibit CAPs.

However all studies carried out so far to prove the peripheral action of  $\alpha_2$  agonists were animal studies. There are very few human studies, i.e. greater palatine and axillary brachial plexus nerve blocks have subsequently demonstrated that increased duration of sensory blockade can be achieved by adding dexmedetomidine to bupivacaine and levobupivacaine, respectively<sup>[13, 14]</sup>. Keeping these facts in mind, we decided to compare the action of dexmedetomidine with bupivacaine and bupivacaine alone in peripheral nerve blocks so that by increasing the duration of analgesia with a single shot block we can achieve a longer duration of post-operative analgesia without significant clinical side-effects and hence we can avoid continuous catheterization.

In our study, we compared the addition of dexmedetomidine (Group D 1  $\mu\text{g/kg}$ ) to bupivacaine in supraclavicular brachial plexus block. The result of our study shows that all patients in both groups were comparable with respect to demographic profile, duration of surgery and type of surgery. With these doses, we had stable haemodynamics in patients except significant lower pulse rate in Group D at 60, 90 and 120 min as compared with Group B, but not less than 60 beats/min.

Esmaoglu *et al.* added dexmedetomidine to levobupivacaine for axillary brachial plexus block and showed that it shortens the onset time of both sensory and motor block, prolongs the duration of block and the duration of post-operative analgesia<sup>[13]</sup>. This may be because peripheral  $\alpha_2$  agonist produces analgesia by reducing release of norepinephrine, leading to  $\alpha_2$  receptor-independent inhibitory effects on nerve fiber action potentials<sup>[12, 13]</sup>.

However, in our study, we found that onset of sensory block was a little faster with Group B as compared with Group D, but it was statistically significant, while onset of motor block was a little longer in Group D again significant statistically. The duration of analgesia in Group D was longer than in Group B, and it was statistically significant. The concern of prolongation of motor block. was minimal patient discomfort on movement in the post-operative period. None of the patients in Group D required sedation intraoperatively and they were comfortable throughout the surgery with arousable sedative effects. This can be explained on the basis that some amount of systemic absorption of drug could be present<sup>[4]</sup>. As  $\alpha_2$  agonists produce sedation by central action, they produce inhibition of substance P release in the nociceptive pathway at the level of the dorsal root neuron and by activation of  $\alpha_2$  adrenoreceptor in locus coeruleus.

From this study, we would like to suggest that dexmedetomidine can be safely used with local anaesthetic in peripheral nerve blocks; however, further trials to determine the exact dose and effect of neurotoxicity on the

human nerve are required.

## Conclusion

From our study it was concluded that 20ml of 0.5% bupivacaine +1microgram (mcg)/kilogram (kg) Dexmedetomidine significantly enhances the quality of supraclavicular brachial plexus block in upper limb surgeries by prolonged duration of sensory and motor block, enhancing post-operative analgesia. These benefits are not associated with any haemodynamic changes, sedation or other adverse effects. Dexmedetomidine added to bupivacaine is an attractive option for improving the quality and duration of supraclavicular brachial plexus block in upper limb surgeries.

Duration of analgesia was longer with Dexmedetomidine addition to bupivacaine. Incidence of multiple puncture and conversion to general anaesthesia was significantly less with use of Dexmedetomidine.

**Limitations** The major limitations of our study are that we did not use ultrasound-guided blocks because of unavailability at the time of our study; this could have helped us to lower dosages and volumes of local anaesthetic. We suggest that further studies to determine, further trials to determine the exact dose and effect of neurotoxicity and the cost-effectiveness of the drug are necessary.

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