

# A Comparative Study of Adjuvants (Dexmedetomidine Vs Dexamethasone) to Ropivacaine in Supraclavicular Brachial Plexus Block for Onset and Duration of Sensory Analgesia

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**Abstract:** ***Background:** Enhancing the duration of sensory and motor blockade of regional anaesthesia is often desirable for prolonged surgeries and also provides pain relief in the immediate postoperative period. We performed a prospective, randomised, study to evaluate the effect of Dexmedetomidine and Dexamethasone as adjuvants to Ropivacaine in supraclavicular approach of brachial plexus block. **Methods:** Sixty ASA physical status 1 and 2 patients undergoing elective hand, forearm and elbow surgeries under brachial plexus block were randomly divided to receive either 8 mg Dexamethasone (1ml) + 30 ml 0.75% Ropivacaine + 1ml distilled water or 50 mcg Dexmedetomidine (0.5ml) + 30 ml 0.75% Ropivacaine + 1.5 ml distilled water. The block was performed using a nerve stimulator. Onset and duration of sensory and motor blockade and total duration of analgesia were measured. Vitals were recorded at 3,5,10,15,30 and 45 minutes. **Results:** The onset of sensory block and onset of motor block both were found to be sooner with Dexmedetomidine than Dexamethasone. The duration of sensory block and motor blockade and duration of analgesia was longer with Dexmedetomidine than Dexamethasone. **Conclusion:** Both Dexmedetomidine and Dexamethasone enhanced the onset and duration of blockade but, the effect was found to be more pronounced with Dexmedetomidine.*

**Keywords:** Dexmedetomidine, Supraclavicular block, Dexamethasone, Ropivacaine, Brachial plexus Block

## 1. Introduction

Brachial plexus block is one of the most popular and widely employed regional nerve block technique for perioperative anesthesia and analgesia for surgery of the upper extremity. When approached at the level of trunks it gives a high success rate with minimal drug volume and a dense blockade given the compact arrangement of trunks at supraclavicular level.

The duration of sensory nerve blockade, and therefore analgesia with single shot regional anesthesia is relatively short lived.<sup>[1]</sup> Efforts to prolong brachial plexus block duration by increasing the local anesthetic dose are limited by their narrow therapeutic window.

Strategies to prolong brachial plexus block analgesia beyond the pharmacological duration of the local anesthetic include placing indwelling perineural catheters for prolonged infusion and co-administration of adjuvants like Epinephrine, Alpha 2 Agonists (Clonidine, Dexmedetomidine), Ketamine, Neostigmine, Morphine, Pethidine, Butorphenol, Tramadol, Buprenorphine, Midazolam, or the Corticosteroid Dexamethasone<sup>9</sup>.

0.5% Bupivacaine is the most commonly used drug for the procedure. Among the recent developments in regional anaesthesia, Ropivacaine is a newer longer acting local anesthetic belonging to aminoamides group of local anaesthetics like bupivacaine.

It is a pure S(-) enantiomer, unlike Bupivacaine, which is a racemate, developed to reduce potential toxicity and improve relative sensory and motor block profiles.

Dexmedetomidine, a newer  $\alpha_2$ -adrenoreceptor agonist is currently in focus for its sedative, anxiolytic, and analgesic properties. It results in a dose-dependent increase in the duration of sensory and motor block.

Dexamethasone, a long-acting glucocorticoid (t<sub>1/2</sub> >36 h) has potent anti-inflammatory and analgesic effects. It is proved to be beneficial in peripheral nerve blocks.

These drugs in various combinations with other adjuvants and local anesthetics were studied in the past few years, but very few studies have compared their efficacy in a single study with Ropivacaine against each other

## 2. Aims and Objectives

To compare the efficacy of Dexmedetomidine versus Dexamethasone as adjuvants to Ropivacaine in Supraclavicular brachial plexus block.

### Parameters Collected:

- Onset of sensory block measured from 3 minute to 45 minutes post injection of drug by Spirit swab method.
- Duration of sensory blockade
- Onset of motor block measured from 3 minute to 45 minutes post injection of drug by Bromage three pint score.
- Duration of motor blockade
- Duration of analgesia- measured upto 24 hrs post onset of block.

### 3. Materials and Methods

After approval from Institutional Ethics Committee and taking written, informed valid consent 60 patients were enrolled in the study.

This prospective study was conducted in 60 ASA 1 and ASA 2 patients posted for upper limb surgeries below shoulder joint under supraclavicular brachial plexus block in NRI Medical College and General Hospital.

#### 3.1 Study Design

The study was a controlled, randomised, double - blinded , prospective study.

#### Inclusion Criteria

- ASA 1 and ASA 2 patients
- Age group of 15-60 yrs of either sex
- Patients undergoing elective upper limb surgeries.

#### Exclusion Criteria

- ASA 3 and ASA 4 patients
- Infection at site of injection
- Peripheral neuropathy
- Presence of 1<sup>st</sup> 2<sup>nd</sup> and 3<sup>rd</sup> degree heart block
- Pregnant patients
- Presence of coagulopathies.
- Known allergy or hypersensitivity to local anaesthetic drugs.

Patients were randomly divided into two groups of 30 each:

- Group DM – patients received 30ml Ropivacaine(0.5%) with 0.5 ml (50 mcg) Dexmedetomidine and 1.5ml distilled water.
- Group DX – patients received 30ml Ropivacaine (0.5%) with 2 ml 8 mg Dexamethasone.

The total volume of drug injected into both the groups was constant.

In each patient thorough history was elicited. Patient was clinically examined in detail and investigated.

#### Monitoring:

Standard monitors were attached:

- Pluseoximetry on the non operating arm – for saturation (SpO<sub>2</sub> )
- ECG for heart rate and rhythm
- NIBP

An intravenous fluid was started before undertaking the procedure which continued throughout the length of surgery.

Vital parameters were recorded throughout the length of the procedure and oxygen at the rate of 4L/min was administered through oxygen mask.

- Two stainless sterile bowls one for each iodine and spirit
- Sterile gauzepieces , one sterile swab holding forceps and one sterile drape.

#### Technique of block:

The brachial plexus block was carried out after thorough explanation of the procedure and emphasizing the need for patient cooperation.

The procedure was carried out by a single experienced anaesthesiologist in all the patients of both the groups.

The classical approach to supraclavicular block using a single – injection, nerve stimulator technique was used in this study.

Position:

The patient was placed in the dorsal recumbent position without any pillow, arms at the sides and head turned to the opposite side to be blocked. Small pad was placed in the interscapular region.

- The patient was asked to lower his/her shoulder and flex the elbow, so that the forearm rests on the lap.
- The wrist was supinated such that the palm of the hand faced the patient's face. (This manoeuvre allowed for detection of any subtle finger movements produced by nerve stimulation.)

Under strict aseptic conditions, the part of the neck was cleaned and draped. The anaesthesiologist stood on the side to be blocked. The lateral border of the sternocleidomastoid (SCM ) muscle was identified and followed distally to the point where it meets the clavicle the point of needle entrance was about 1 inch (2.5 cm ) lateral to the insertion of the SCM in the clavicle<sup>[2]</sup> or one ‘thumb breadth’ lateral to the SCM. Palpation of the subclavian artery at this site confirms the landmark. The palpating index finger was placed at this site<sup>[2]</sup>.

Local infiltration of 1 ml of 2% lidocaine was given at the proposed puncture site.

We used an insulated needle to perform this technique<sup>[2]</sup>. The needle was connected to nerve locator by the electrodes and was properly grounded with the help of ECG lead. We started the stimulation with an intensity of 2.0 mA and a pulse width of 100 μs. Once the desired response was obtained – that is a muscle twitch of the fingers which is clearly visible - we started to decrease the current gradually to 0.4 mA. If we still obtained the desired response the drug solution of 32ml is injected after performing negative aspiration for blood before each incremental injection of 5ml.

If we did not get adequate response or if repositioning of the needle was necessary, the needle was withdrawn and the penetration angle was adjusted in the antero-posterior plane, either slightly more posterior or more anterior , but always parallel to the midline.

During the conduct of block, the patient was observed vigilantly for any complications of the block and for the toxicity of the drugs injected and thereafter monitored continuously.

4. Observations and Results

4.1 Demographic Data

Table 1

	DX	DM	P-Value
AGE(years)	35.87 +/- 10.6	35.1 +/- 8.6	> 0.05
WEIGHT(kgs)	77.03+/-7.08	76.47+/-6.33	>0.745

Table 2

		DX	DM	p-value
sensory	onset	15.2 +/- 1.52	10 +/- 1.43	< 0.001
	duration	10.4+/-1.21	12.78+/-1.61	< 0.001
motor	onset	17.37 +/- 2.01	13.13 +/- 1.38	<0.001
	duration	10.4+/-1.16	13.53+/-1.2	< 0.001
analgesia		697+/-44.6	892.7+/-43.76	<0.0001

4.2 Vital Signs

a) Heart Rate

The mean heart rate was comparable between both the groups at baseline, 3 min, 5 min, 10 min, 15 min, 30 min and 45 min. the p value was > 0.05 which was statistically not significant.

Table 3

Mean HR (bpm)	DX Group (n=30)		DM Group (n=30)		P-Value
	Mean	SD	Mean	SD	
Baseline	77.43	8.58	79.8	3.83	> 0.05
At 3 Min	77.9	8.49	79.26	3.87	>0.05
At 5 Min	77.83	7.73	78.13	3.27	>0.05
At 10 Min	77.43	7.75	78.8	3.38	>0.05
At 15 Min	78.06	7.31	76.66	3.57	>0.05
At 30 Min	78.26	7.5	75.93	3.46	>0.05
At 45 Min	78.56	8.24	75.6	2.89	>0.05

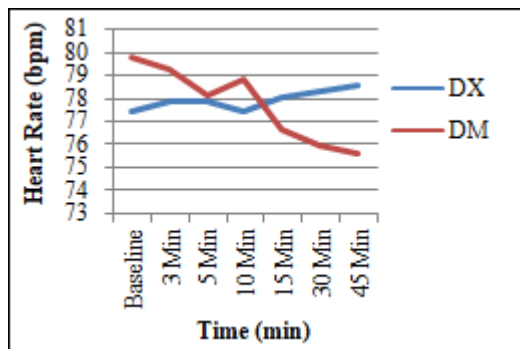


Figure 1

b) Mean Arterial Pressure

The mean arterial pressure was statistically significant (p value < 0.05 ) between both the groups before starting the procedure, at 3 min, 5 min, 15 min, 30 min and 45 min. It was comparable between both the groups at 10 min with p value was > 0.05 which was statistically not significant.

Table 4

Mean MAP	DX Group (n=30)		DM Group (n=30)		P-Value
	Mean	SD	Mean	SD	
Baseline	94.17	8.63	99.13	0.68	<0.05
At 3 Min	92.64	8.07	79.24	3.87	<0.05
At 5 Min	90.57	6.26	97.82	6.32	<0.05
At 10 Min	91.31	6.65	117.48	111.53	>0.05

At 15 Min	90.2	6.46	97.6	5.18	<0.01
At 30 Min	88.48	6.06	96.66	4.7	<0.01
At 45 Min	87.66	5.83	96.84	4.9	<0.01

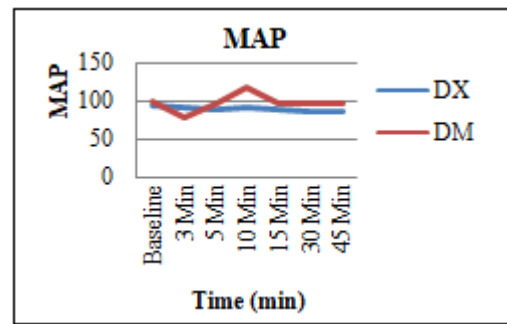


Figure 2

c) Adverse Effects

Dryness of mouth was seen in both the groups (DX-5 vs DM-6). This was statistically and clinically not significant. Sedation was seen in all the patients in group DM with Dexmedetomidine. (Ramsay sedation score – 2). This was statistically as well as clinically significant as it provided for a smoother experience for the patient with a p value <0.0012 by Fishers exact test.

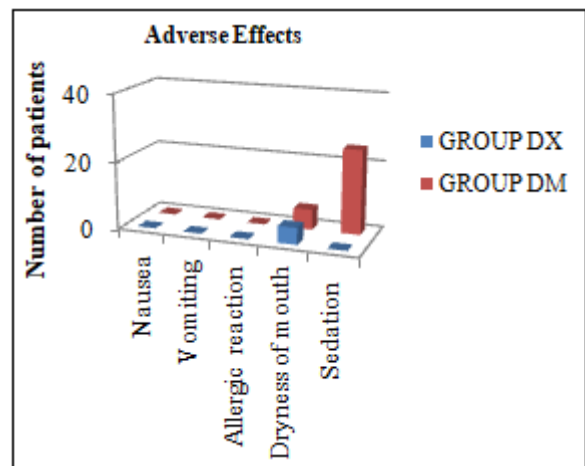


Figure 3

5. Discussion

Regional anaesthesia, especially peripheral nerve blocks have emerged to be an attractive and better alternative to general anaesthesia for various surgeries.

Of the various techniques of peripheral nerve blocks, Brachial plexus block is one of the most familiar and frequently performed block for upper limb surgeries.

It consists of injecting local anesthetic drugs in the fascial spaces surrounding the nerve plexus, thereby blocking the autonomic, sensory and motor fibres supplying the upper extremity<sup>[2]</sup>.

Advantages of the brachial plexus block when compared to general anaesthesia are:

- Early discharge which is suitable for outpatient procedures.
- Smooth transition from intraoperative to post operative pain control

- c) Increased blood flow to extremity
- d) Less incidence of nausea and vomiting
- e) Less drowsiness
- f) Avoidance of invasive ventilation techniques

Supraclavicular approach to block the nerves was selected in this study because it provides a rapid, dense and predictable anaesthesia of the entire upper extremity in the most consistent manner. It is more effective than other approaches – it is carried out at the ‘division’ level of the brachial plexus while the ‘trunks’ also can be blocked through the same approach by administering higher volumes of the drug<sup>[3],[4],[5]</sup>. Perhaps this is why there is often little or no sparing of peripheral nerves if an adequate ‘paraesthesia’ or stimulation is obtained.

The alleviation of pain and is one of the primary concerns for the anaesthesiologists. Any method of post operative pain relief must be safe, effective and feasible. Different drugs have been used as adjuvants to achieve quick, dense and prolonged block<sup>[6]</sup>. Adjuvants improve analgesia, reduce systemic side effects and reduce total dose of local anaesthetic required. Drugs like morphine, pethidine, clonidine, butorphenol, midazolam are commonly used along with local anesthetics for this purpose. Clonidine has been used as an adjuvant to local anesthetics since the 1980’s in various regional techniques to extend the duration of block.

In this scenario due to further advances in the post operative pain management various drug combinations have been tried and search for a potent adjuvant for local anaesthetic is still going on. In this context we have chosen Dexmedetomidine and dexamethasone since both of them are potent adjuvant drugs but the number of studies comparing them are very small.

Steroids block the nociceptive impulse transmission along the myelinated C fibres<sup>[7],[8]</sup>. They are very potent anti inflammatory and immunosuppressive agents. It is reported that perineural injection of steroids influences post – operative analgesia. The mechanism of how systemic administration of dexmedetomidine prolongs the duration of a nerve block is not fully determined<sup>[9]</sup>.

Although dexmedetomidine has central  $\alpha_2$ -mediated analgesic effects, an animal trial showed that the effect of dexmedetomidine was caused by blockade of the hyperpolarization-activated cation current peripherally and not by its central or peripheral  $\alpha_1$ - or  $\alpha_2$ -agonistic properties<sup>[10]</sup>.

We have conducted a controlled, randomized, double blinded, prospective study. 60 patients posted for upper limb surgeries below shoulder joint were given brachial plexus block by the supraclavicular approach using nerve stimulation technique. The patients were randomly divided into two groups. The Group DM received 30ml Ropivacaine (0.75%) with 0.5 ml (50 mcg) Dexmedetomidine and 1.5 ml distilled water. The Group DX received 30ml Ropivacaine (0.75%) with 2 ml 8 mg Dexamethasone. Volume of the local anaesthetic used in both the groups is constant. The principal investigator, who was blinded to the drugs

administered in the block assessed the onset and duration of the block.

The patients who were undergoing elective upper limb surgeries undergoing the following procedures were included in the study: Plating of lower end of humerus, Plating of both bones of forearm, Implant removal, Muscle or tendon repair.

In group DX 7 patients out of 30 (23.33%) underwent plating of lower end of humerus, 15 (50%) underwent plating of both bones of forearm, 5 (16.6%) underwent an older implant removal and 3 (10%) muscle / tendon repairs.

The local anaesthetic used in this study is Ropivacaine. Due to additional advantages like cardiac stability, less cardio toxicity than bupivacaine and pain relief with less motor blockade we chose Ropivacaine in our study<sup>11</sup>.

Dexamethasone as well as dexmedetomidine have been used as adjuvants to various local anaesthetics in different concentrations.

Very few have compared both the drugs to 0.75% ropivacaine in a single study in the supraclavicular approach of brachial block.

The onset of sensory block was determined by using spirit swab method. The time of onset of block is  $15.2 \pm 1.52$  minutes in group DX and  $10 \pm 1.43$  minutes in group DM. The time of onset is faster with dexmedetomidine than with dexamethasone.

This corresponds to the study done by Sampathi Shiva Krishna et.al. 8 mg of dexamethasone was administered with 28 ml of 0.5% Ropivacaine. The time of onset of sensory block was  $15.333 \pm 2.509$  minutes vs  $15.2 \pm 1.52$  minutes of the current study.

Vitals signs – Heart rate, Blood Pressure with mean arterial pressure were assessed.

Heart rate was assessed at baseline – before start of procedure, at 3 minutes, 5 minutes, 10 minutes, 15 minutes, 30 minutes and 45 minutes.

The results showed no significant change in heart rate between group DX and DM.

Mean arterial pressure was also measured at same intervals. The results showed a significant change in MAP at intervals of 3 minutes, 5 minutes, 15 minutes, 30 minutes and 45 minutes. This is clinically not relevant.

No clinical or statistically significant adverse events were seen with Dexamethasone.

Dexmedetomidine caused statistically significant sedation in group DM but it is not clinically significant.

From the above observations it is found in our study that both dexmedetomidine and dexamethasone have both



enhanced effects in all aspects of sensory blockade, motor blockade as well as analgesia.

The mechanism of analgesia produced by corticosteroids is not completely understood. The effect is suspected to be mediated by their anti-inflammatory or immune-suppressive effects<sup>[12],[13]</sup>. Corticosteroids cause skin vasoconstriction on topical application which is mediated by the occupancy of classical glucocorticoid receptors rather than by non-specific pharmacological mechanisms<sup>[12]</sup>. Corticosteroids might have local effects on the nerve; the dexamethasone effect may be related to this action. Many authors believe that the prolongation effect of dexamethasone is due to its local action and not a systemic one<sup>[14]</sup>. It was found that, steroids produce analgesia by:

- blocking transmission in nociceptive c-fibres
- suppressing ectopic neuronal discharge.

#### Limitations of the present study:

- Ultrasound guided block was not used in this study due to unavailability in our institution during the period of study.
- No control group was taken in this study for ropivacaine as a solo agent for block as the focus was to compare the adjuvants to each other with the same dose of local anaesthetic.
- Only fixed doses of the adjuvant drugs were compared. Different doses of drugs in the study were not compared each other.
- In this study the comparison was done by addition to ropivacaine only. Other local anaesthetics were not considered.
- Effects were compared only in the supraclavicular approach of the brachial plexus block. Other peripheral nerve blocks were not considered.
- From the available data and studies it can be concluded that Dexmedetomidine 50 micrograms and Dexamethasone 8mg both have an enhanced effect on the onset and duration of both sensory and motor blockade as well as analgesia. Our study cautiously concludes that among the two Dexmedetomidine is a better adjuvant to Ropivacaine than Dexamethasone in this particular dosage.

## 6. Conclusion

In conclusion addition of Dexamethasone (8mg) and Dexmedetomidine (50mcg) to 30 ml 0.75% Ropivacaine resulted in:

- Faster onset of sensory block with Dexmedetomidine
- Faster onset of motor block with Dexmedetomidine
- Prolonged duration of sensory block with Dexmedetomidine
- Prolonged duration of motor block with Dexmedetomidine
- Prolonged post-operative analgesia with Dexmedetomidine.

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