

# A Comparative Study of Ropivacaine with Dexamethasone and Ropivacaine with Dexmedetomidine in Ultrasound Guided Brachial Plexus Blockade for Adult Upper Limb Surgeries

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## ABSTRACT

### BACKGROUND

Blockade of brachial plexus at several locations from the roots to the terminal branches will allow for surgical anaesthesia of the upper extremity and shoulder. We have attempted to compare the efficacy of dexamethasone and dexmedetomidine when used as an adjunct to brachial plexus blockade when used as a sole anaesthetic for upper arm surgeries.

### METHODS

After obtaining ethical committee clearance, a prospective observational study was conducted in patients undergoing upper arm surgeries. Patients were compared in two groups; Group 1 received 18 mL Ropivacaine (0.5 %) and Dexamethasone 8 mg (2 mL); Group 2 received Ropivacaine (0.5 %) and 75 mcg Dexmedetomidine along with 1.25 mL isotonic sodium chloride.

### RESULTS

Mean time of onset of sensory blockade was  $12.1 \pm 1.1$  min in Group 1 and  $10.3 \pm 1.2$  min in Group 2. Mean Duration of Analgesia in Group 1 was  $1024.5 \pm 62.0$  min and in Group 2 was  $1394.3 \pm 189.6$  min. Mean Onset of Motor block in Group 1 was  $18.2 \pm 1.5$  min and in Group 2 was  $14.7 \pm 1.0$  min. Mean Duration of motor block in Group 1 was  $697.2 \pm 37.3$  min and in Group 2 was  $776.3 \pm 48.0$  min.

### CONCLUSIONS

Our study revealed that dexmedetomidine is a better alternative for decreasing the onset of motor block along with enhanced quality and duration of supraclavicular block.

### KEYWORDS

Interscalene, Dexamethasone, Dexmedetomidine

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## BACKGROUND

Both general anaesthesia (GA) and regional anaesthesia have been used successfully for upper limb surgeries.<sup>1</sup> The advantages of regional anaesthesia include, it is cheaper than GA, anaesthesia targeted at the operative site, reduced recovery time, excellent post-operative analgesia and decreased opioid use.<sup>2,3</sup> Brachial plexus blockade has enjoyed great popularity since it was first reported in 1884. Effective regional anaesthesia can be achieved by blocking the brachial plexus at interscalene, supraclavicular, infraclavicular and axillary levels. Now with the advent of ultrasound machine, interscalene block is easier to perform with fewer complications, reduced dose of local anaesthetics,<sup>4</sup> reduced consumption of rescue medication after surgery<sup>5</sup> and improved patient satisfaction.<sup>6</sup> Adjuvants or additives are often used with local anaesthetics for its synergistic effect by prolonging the duration of sensory & motor block and limiting the cumulative dose requirement of local anaesthetics. The armamentarium of local anaesthetic adjuvants have evolved over time from classical opioids to a wide array of drugs spanning several groups and varying mechanisms of action like epinephrine, clonidine, dexmedetomidine, buprenorphine, dexamethasone, sodium bicarbonate, tramadol and midazolam.<sup>7</sup> Many studies have been done comparing either dexmedetomidine or dexamethasone in combination with ropivacaine vs with ropivacaine alone but only few studies have compared the effects of these two drugs in interscalene block. Our present study aims to compare the efficacy of dexamethasone and dexmedetomidine when used as an adjunct to interscalene block under ultrasound guidance.

To compare the efficacy of ropivacaine with dexamethasone and ropivacaine with dexmedetomidine in interscalene brachial plexus blockade for adult upper limb surgeries at Govt. T.D. Medical College Hospital, Alappuzha in terms of onset of analgesia, onset of motor block, duration of analgesia and duration of motor block. We also wanted to study the haemodynamic stability during surgery after giving interscalene brachial plexus block and any adverse effects.

## METHODS

After getting approval from the Institutional Ethics Committee, we studied 40 patients in the age group of 18 - 55 yrs. and ASA status I and II undergoing elective upper limb surgeries from June 2017 to June 2018. A thorough preanaesthetic evaluation was done and informed consent was obtained from all the patients.

### Inclusion Criteria

Those who gave consent to take part in this study.

- Age group 18 to 55 yrs.
- Body weight 50 Kg - 90 Kg.
- American Society of Anaesthesiologists (ASA) physical status 1 and 2.

### Exclusion Criteria

- Pregnancy.
- Obesity (BMI > 30).
- Pre-existing neuropathy involving the surgical limb.
- Systemic use of corticosteroids for > / = 2 weeks within 6 months of surgery.
- Sinus bradycardia.

The primary objective of the study was comparison of duration of analgesia and secondary objective was comparison of onset of analgesia, onset and duration of motor block and adverse effects. Patients were kept nil per oral for 8 hrs. All patients were given T. Alprazolam 0.25 mg, T. Pantoprazole 40 mg and T. Ondansetron 4 mg on preoperative day at 10:00 pm and at 6 am on the day of surgery.

The blocks were given in a block room so that there would not be any delay in surgery. Upon arrival in block room, electrocardiogram, blood pressure monitor and pulse oximeter were connected and basal heart rate and blood pressure were monitored. Under local anaesthesia intravenous access with 18 G canula was obtained and intravenous fluid ringer lactate was started. IV Midazolam 0.02 mg / Kg was given to all patients.

The patients were placed in supine position with the head turned away from the side to be blocked and the arms kept along the side of the body. After skin and transducer preparation, a linear high frequency probe is placed firmly over the supraclavicular fossa in the coronal oblique plane to get the best possible transverse view of the subclavian artery and the brachial plexus. Nerves appear hypoechoic and are round or oval. Brachial plexus is located superficial to the pulsatile subclavian artery and superior to the first rib. The plexus is traced up the neck with the probe until the plexus trunks are visualized as hypoechoic structures between the anterior and medial scalene muscles. After cleaning the skin with an antiseptic solution, 1 to 3 mL of local anaesthetic is infiltrated subcutaneously, a 5 cm long stimulating needle is inserted on the outer (lateral) end of the ultrasound transducer. The needle is advanced along the long axis of the transducer in the same plane as the ultrasound beam. This way the needle shaft and tip can be identified in real time as the needle is advanced towards the target nerves. Local anaesthetic mixture either 18 mL 0.5 % ropivacaine with 8 mg dexamethasone (2 mL) or 18 mL 0.5 % ropivacaine with 75 mcg dexmedetomidine (taken in a 100 units insulin syringe and each 10 units corresponds to 10 µg) & 1.25 mL isotonic sodium chloride was injected in aliquots so as to cause hydro-dissection of the plane around plexus. After adequate sensory level was obtained, patients were shifted to operation theatre. If there was sparing of dermatomes in the region of surgery in any patient, the block were supplemented with midazolam (0.05 mg / Kg) and ketamine (0.5 mg / Kg). In patients with lesser degree of block general anaesthesia would be supplemented and these patients would be excluded from the study. After injection of the intended volume of local anaesthetic mixture, patients were evaluated at 2 min intervals for the

development of sensory and motor block. Sensory block was assessed by loss of sensation to pinprick over desired dermatomes of upper limb. Motor block was assessed by failure to abduct the shoulder.

Assessment of time of onset of analgesia, onset of motor block, duration of analgesia, duration of motor block and adverse effects were done. The efficacy of post-operative analgesia was assessed using a visual analogue scale (VAS); this score graded (0 - no pain; 100 - worst pain possible). VAS score was recorded at every 10 min for the first two hours and every 30 minutes till 11 hours and hourly thereafter break through pain of more than 50 was managed with Inj. Tramadol 50 mg IV and the time was noted; which was recorded as end point of analgesia. That was the end point of the study. The time period between the onsets of analgesia to the end point of analgesia is documented as duration of analgesia. Adverse effects like hypotension (> 20 % decrease relative to baseline) dysrhythmia, itching, seizure, sedation (Ramsay sedation score > 3) nausea and vomiting, Horner's syndrome if any were noted.

**RESULTS**

The baseline demographic characteristics of (age, sex, weight) of the two groups of patients were comparable (Table 1, 2). There was no significant difference in mean duration of surgery between two groups. (Table 2)

	Group 1 (Ropivacaine + Dexamethasone)		Group 2 (Ropivacaine + Dexmedetomidine)	
	Count	%	Count	%
< 30 years	4	20.0 %	6	30.0 %
31 to 40 years	5	25.0 %	6	30.0 %
Age 41 to 50 years	5	25.0 %	6	30.0 %
> 50 years	6	30.0 %	2	10.0 %

**Table 1. Age Distribution in the Two Groups**

	Group 1 (Ropivacaine + Dexamethasone)		Group 2 (Ropivacaine + Dexmedetomidine)	
	Count	%	Count	%
Sex Male	11	55.0 %	13	65.0 %
Female	9	45.0 %	7	35.0 %
Weight (Kg)	66		59	0.092
Duration of Surgery (min)	105		108	0.690

**Table 2. Comparison of Sex, Weight, & Duration of Surgery, between the Two Groups**

	Group 1 (Ropivacaine + Dexamethasone)		Group 2 (Ropivacaine + Dexmedetomidine)		P Value
	Mean	SD	Mean	SD	
Time of Onset of Sensory Blockade (min)	12.1	1.1	10.3	1.2	< 0.001*
Onset of Motor Block (min)	18.2	1.5	14.7	1.0	< 0.001*

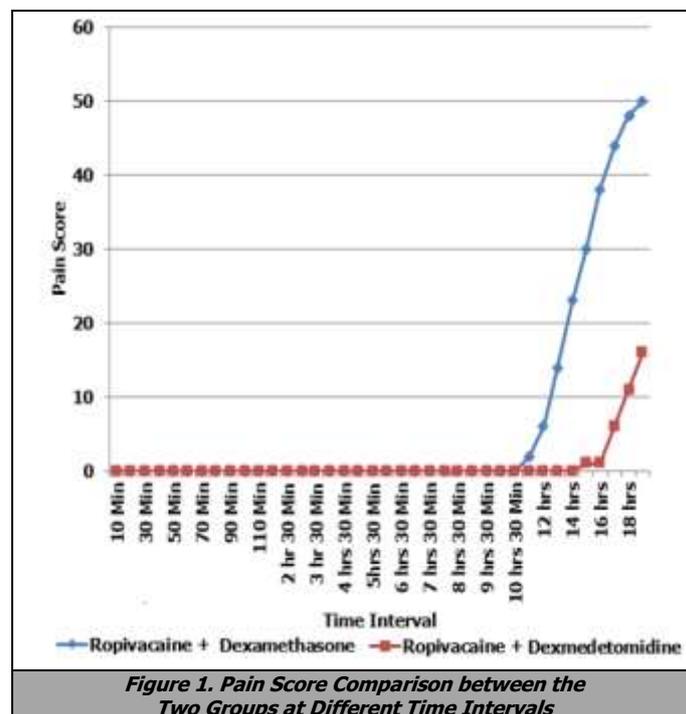
**Table 3. Comparison of Time of Onset of Sensory & Motor Block between the Two Groups**

The mean time of onset of sensory blockade was faster in dexmedetomidine group (10.3 ± 1.2 min) compared to

dexamethasone group (12.1 ± 1.1 min) p < 0.001 (Table 2). Dexmedetomidine group also had faster onset of motor block (14.7 ± 1.0 min) compared to dexamethasone group (18.2 ± 1.5 min) p < 0.001 (Table 3). Mean duration of analgesia was prolonged in dexmedetomidine group (1394.3 ± 189.6 min) compared to dexamethasone group (1024.5 ± 62.0 min); p < 0.001 (Table 4). Duration of motor block was also prolonged in dexmedetomidine group (776.3 ± 48.0 min) than in dexamethasone group (697.2 ± 37.3 min). P < 0.001 (Table 4).

	Group 1 (Ropivacaine + Dexamethasone)		Group 2 (Ropivacaine + Dexmedetomidine)		P Value
	Mean	SD	Mean	SD	
Duration of Analgesia (min)	1024.5	62.0	1394.3	189.6	< 0.001*
Duration of Motor Block (min)	697.2	37.3	776.3	48.0	< 0.001*

**Table 4. Comparison of Duration of Analgesia and Duration of Motor Block between the Two Groups**



**Figure 1. Pain Score Comparison between the Two Groups at Different Time Intervals**

There was significant difference in mean pain score between two groups from 12 hrs. to 18 hrs. Mean pain score at these intervals was significantly higher in Group 1 than in Group 2. (Figure 1)

In the study there was significant difference in mean pulse rate between two groups from 50 min to 19 hrs. At these intervals mean pulse rate was significantly lower in Group 2 than in Group 1. At other intervals there was no significant difference in mean pulse rate between two groups (Figure 2).

In the study there was no significant difference in mean SBP between two groups at all the intervals. (Figure 3).

Bradycardia and sedation were present in 10 % of patients in dexmedetomidine group whereas none of the patients in dexamethasone group had any complications.

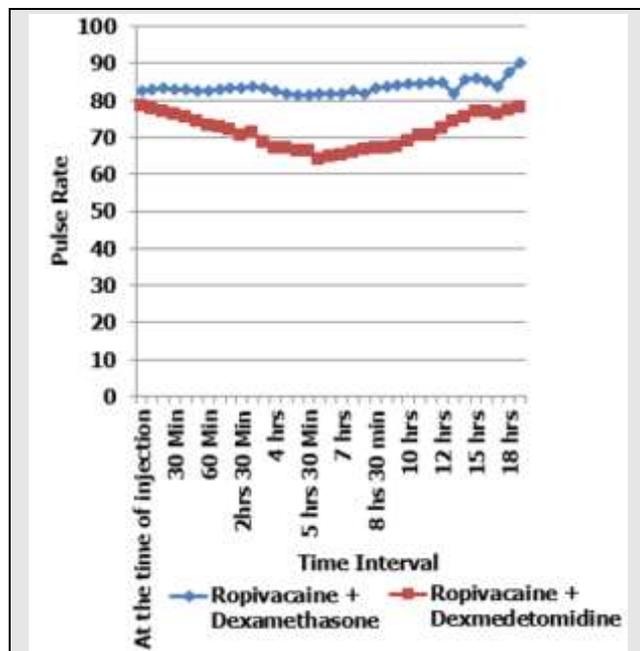


Figure 2. Pulse Rate Comparison between the Two Groups at Different Time Intervals

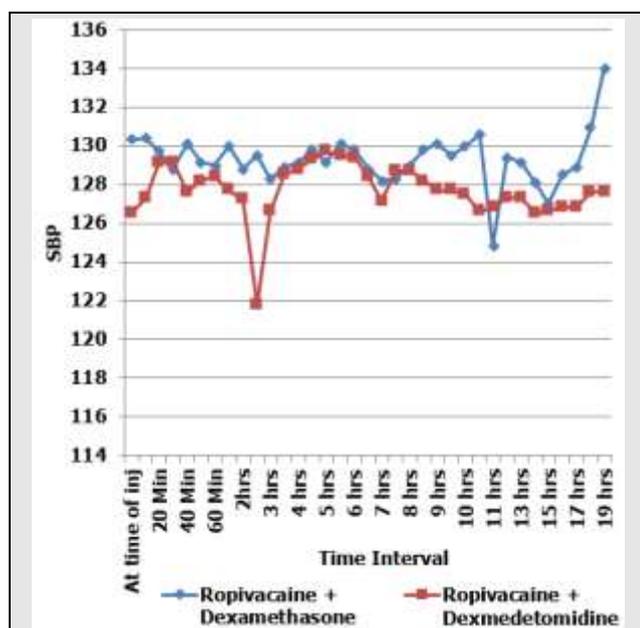


Figure 3. SBP Comparison between the Two Groups at Different Time Intervals

	Group 1 (Ropivacaine + Dexamethasone)		Group 2 (Ropivacaine + Dexmedetomidine)		P Value	
	Count	%	Count	%		
Bradycardia	Absent	20	100.0 %	18	90.0 %	0.147
	Present	0	0.0 %	2	10.0 %	
Sedation	Absent	20	100.0 %	18	90.0 %	0.147
	Present	0	0.0 %	2	10.0 %	

Table 5. Comparison of Complications between the Two Groups

**DISCUSSION**

Many studies have been using either dexamethasone or dexmedetomidine as adjuncts in brachial plexus block, but there is paucity of studies comparing these two drugs in terms of efficacy and safety when used in interscalene block.

Hence we conducted a prospective observational study to assess the effects of dexamethasone and dexmedetomidine on block profile and incidence of side effects.

In our study, the study groups were comparable in terms of ASA status, age, gender, and weight. Mean duration of surgery was also comparable between two groups. In consistence with several studies we found that both dexamethasone<sup>8,9,10</sup> and dexmedetomidine<sup>11,12,13,14</sup> are effective in prolonging duration of analgesia and motor block in peripheral nerve block and also both the drugs hasten the onset of sensory and motor block.

Armstrong KPJ & Cherry RA<sup>15</sup> demonstrated the use of a block room reduces the anaesthesia operation room time associated with brachial plexus analgesia. As we have used a block room for our cases, the operation room time was not affected.

Esmaoglu et al<sup>16</sup> reported prolongation of axillary brachial plexus block with 40 mL 0.5 % levobupivacaine & 100 mcg dexmedetomidine. As they observed bradycardia in 7 out of 30 patients in the study group, we decided to reduce the dose to 75 mcg. Srinivasa Rao Nallam et al<sup>17</sup> also found that 100 mcg dexmedetomidine hastens the onset and significantly prolongs the duration of action but with higher incidence of bradycardia and hypotension (44.9 %).

In our study the onset of sensory block in dexmedetomidine group was faster (10.3 ± 1.2 min) compared to dexamethasone (12.1 ± 1.1 min); the difference being statistically significant (p < 0.001). This is consistent with study done by Niranjana Kumar Verma and Ashutosh Ranjan<sup>18</sup> where they compared 50 mcg dexmedetomidine and 8 mg dexamethasone added to 30 mL ropivacaine (0.5 %) in supraclavicular brachial plexus block. However our study differed from the study done by Myeong Jong Lee et al.<sup>19</sup> who found that there was no significant difference in onset of analgesia and motor block between the groups. This may probably be because of the slightly higher dose of drugs (10 mg dexamethasone vs. 100 µg dexmedetomidine) used by them and also because they used both ultrasound and peripheral nerve stimulation which would have resulted in a more precise deposition of the drug.

In our study the onset of motor block was earlier in dexmedetomidine group (18.2 ± 1.5 min) compared to dexamethasone group (14.7 ± 1.0 min); the difference being statistically significant (p < 0.001). This is similar to study done by Mandeep Kaur et al<sup>20</sup> comparing dexamethasone and dexmedetomidine in supraclavicular brachial plexus block with 0.5 % bupivacaine. Niranjana Kumar Verma and Ashutosh Ranjan<sup>18</sup> also got similar results in terms of onset of motor block.

Duration of analgesia was prolonged in dexmedetomidine group (1394.3 ± 189.6 min) compared to dexamethasone group (1024.5 ± 62.0 min) the difference being statistically significant (p < 0.001). Mandeep Kaur et al<sup>20</sup> also got similar results in their study. But in our study, the duration of analgesia was more prolonged with dexmedetomidine probably because we have used 75 µg dexmedetomidine instead of 50 µg and we used ultrasound guidance which improved the deposition of the drug. A study by Bharti N et al<sup>21</sup> demonstrated prolonged post-operative

analgesia of 17 hours when dexmedetomidine was added to 0.75 % ropivacaine and 2 % lidocaine with adrenaline in supraclavicular brachial plexus block. This result was also similar to our results. In a meta-analysis done by Choi et al<sup>22</sup> dexamethasone prolonged the analgesic duration for long-acting LA from 730 to 1306 min. This was also in accordance with our results.

Duration of motor block was also prolonged with dexmedetomidine (776.3 ± 48.0 min) compared to dexamethasone group (697.2 ± 37.3 min), the difference was statistically significant ( $p < 0.001$ ). The duration of motor block of dexmedetomidine is similar to the study done by Mohamed Ahmed Hamed et al<sup>23</sup> who compared 1 µg / Kg of dexmedetomidine and 1 µg / Kg of fentanyl added to 0.5 % bupivacaine (1.5 mL / Kg).

In our study there was significant difference in mean pain score between two groups from 12 hrs to 18 hrs. Mean pain score at these intervals was significantly higher in Group 1 (dexamethasone) than in Group 2 (dexmedetomidine).

At these intervals mean pulse rate was significantly lower in dexmedetomidine group. There were no clinically significant changes to SpO<sub>2</sub> values or systolic BP values between two groups. This was in accordance with the study by Fritsch et al<sup>24</sup> who noted that dexmedetomidine lowered the heart rate but the blood pressure was stable. The haemodynamic profile of patients who received dexamethasone in a study conducted by Choi S et al was similar to the results obtained in our study.

Two patients in dexmedetomidine group had bradycardia with heart rate < 50 / min and were treated with IV atropine 0.6 mg. Two patients in dexmedetomidine group also had respiratory rate < 12 / min; but no interventions were required. These patients responded to verbal commands. The study by Myeong Jong Lee et al<sup>19</sup> also yielded similar results with regard to side effects. There was no incidence of clinically significant bradycardia or hypotension in the study conducted by Niranjana Kumar Verma and Ashutosh Ranjan<sup>18</sup> probably because the dose of dexmedetomidine that they used is lower (50 mcg).

Even though both dexamethasone and dexmedetomidine are very good adjuvants to brachial plexus block, dexmedetomidine is more effective because it shortens the onset of sensory block and also prolongs the duration of analgesia. But there was 10 % incidence of bradycardia and sedation with dexmedetomidine group.

## CONCLUSIONS

Both dexmedetomidine and dexamethasone are good as adjuvants in peripheral nerve blocks. But our study revealed that dexmedetomidine is a better alternative since it decreases the onset of block along with enhanced duration of interscalene block. There was increased incidence of bradycardia as well as sedation in those who received dexmedetomidine. Hence these patients have to be monitored more vigilantly, preferably in the high dependency areas postoperatively.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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