



## Original Research Article

## Comparison of different concentration of dexmedetomidine added to ropivacaine in ultrasound guided supraclavicular block for orthopedic forearm surgery- A prospective, randomized, comparative clinical study

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## ARTICLE INFO

## Article history:

Received 03-05-2020

Accepted 26-05-2020

Available online 08-09-2020

## Keywords:

Brachial plexus block

Dexmedetomidine

Ropivacaine

Ultrasonography

## ABSTRACT

**Background and Aims:** There is no fix and ideal dose is known for dexmedetomidine as an adjuvant in brachial plexus block. So this study was performed to evaluate different doses of dexmedetomidine added to 0.5% ropivacaine, with the primary outcome of the duration of analgesia. Secondary outcomes included the effect on block characteristics, sedation, hemodynamics and adverse effects.

**Materials and Methods:** Totally 60 adult patients were randomly allocated to two equal groups (n = 30) using computer generated randomization. Patients in Group RD50 received 24 ml 0.5% ropivacaine + 50 µg of dexmedetomidine and Group RD100 received 24 ml 0.5% ropivacaine + 100 µg of dexmedetomidine in ultrasonography guided supraclavicular block.

The primary aim was the duration of analgesia and secondary aim were onset and duration of the sensorimotor blockade, hemodynamic variables, sedation score, and adverse effects

The data were interpreted with the help of t-test and Chi-square test.

**Results:** In group RD50, the onset of both sensory and motor block was 8.18 ± 1.49 min and 14.11 ± 2.09 min, respectively, while in group RD100 it was 8.23 ± 1.41 min and 14.06 ± 2.44 min, respectively. The duration of analgesia was similar in both groups (862.32 ± 45.51 vs. 864.43 ± 44.02 min; P >.05). The occurrence of bradycardia was observed significantly greater in RD100 group patients.

**Conclusion:** The addition of 100 µg dexmedetomidine to ropivacaine has similar effects on block characteristics and duration analgesia with a higher incidence of bradycardia as compare to 50 µg.

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## 1. Introduction

Brachial plexus block is a common anesthetic procedure for upper limb surgeries. Several approaches to the brachial plexus block have been reported but the supraclavicular approach is the simplest and the consistent method for anaesthesia and postoperative analgesia in surgery below the elbow joint.<sup>1</sup>

With the use of ultrasound various blocks like interscalene block, supra and infraclavicular and brachial plexus blocks are being more efficiently and frequently performed.<sup>2</sup> Many Cochrane based systematic reviews has supported the use of ultrasound to perform blocks and

their effectiveness in limb surgeries. These studies have concluded that there is a high level of data supporting ultrasound-guided regional blocks for better postoperative analgesia. These blocks are associated with better pain control, reduced incidence of complications and early recovery.<sup>3</sup>

In the brachial plexus block, multiple local anesthetics agents have been used. Bupivacaine is very potent and has prolonged duration of action as compared to other local anaesthetics so it is used commonly.<sup>4</sup> One of the disadvantages is that it is cardiotoxic, especially with inadvertent injection into the subclavian artery. Ropivacaine was developed with properties similar to bupivacaine, having lower lipid solubility and less cardiotoxicity.<sup>5</sup>

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Several adjuvants are used like clonidine, nalbuphine, dexamethasone, etc.<sup>6</sup> Dexmedetomidine is a highly selective  $\alpha_2$  agonist, and also used as an adjuvant to various local anesthetics. Various clinical trials conducted in both humans and animals have shown dexmedetomidine is safe to use as an adjuvant to local anesthetic in neuraxial and brachial plexus blocks.<sup>7–9</sup> Dexmedetomidine has been used in a dose ranging from 30 to 100  $\mu\text{g}$  in brachial plexus blocks.<sup>9,10</sup> There have been conflicting data regarding the safety of dexmedetomidine with higher dose. Nallam et al. in their study they found an increase in incidence of hypotension and bradycardia with a dose of 2  $\mu\text{g}/\text{kg}$ , whereas Das et al. concluded a dose of 100  $\mu\text{g}$  to be safe.<sup>9,11</sup>

Hence, we conducted following study for comparison of two doses of dexmedetomidine along with Ropivacaine and for finding an ideal dose of dexmedetomidine to be used as an adjuvant with improved supraclavicular block profile and decreased side effects.

The duration of analgesia was our primary outcome from this study while secondary outcomes included onset and duration of motor and sensory blocks, hemodynamic changes, sedation, and side effects.

## 2. Materials and Methods

After obtaining approval of the Ethical Committee of institute, 60 patients belonging to the American Society of Anesthesiologists (ASA) physical status I and II, aged about 18–60 years posted for orthopedic forearm/hand surgeries were selected for the study. This study was conducted for period of 1½ years between August 2016 and February 2018 in our tertiary care hospital setup.

Before surgery, all the participating patients were explained in details, about the role of this study in their local language and written informed consent was obtained. All patients were also familiarized with the use of a visual analog scale (VAS) pain score for the assessment of perioperative pain.

Patients with known history of hypersensitivity to drugs used in this study, any degree of heart block, renal and hepatic dysfunction, uncontrolled diabetes mellitus and hypertension, pregnant and lactating women, alcoholism and substance abuse; mental disorders, neuromuscular illness, bleeding disorders, patient denial, inadequate anesthesia requiring general anesthesia or when additional opioid or sedation required were excluded from participation in this study.

In all, sixty patients were allocated randomly in two groups ( $n = 30$  in each group) using computer-generated randomization software.

Patients in Group RD50 received 24 ml 0.5% ropivacaine + 50  $\mu\text{g}$  of dexmedetomidine diluted to 1ml with saline and Group RD100 received 24 ml 0.5% ropivacaine + 1 ml (100  $\mu\text{g}$ ) of dexmedetomidine in ultrasound guided supraclavicular block.

Pre anaesthetic check-up was done for all patients included in this study day before surgery. All the basic lab investigation was done like complete blood count, renal function test, S. bilirubin, basic serology, electrocardiogram and chest x-ray. All patients received antacid (ranitidine) and antiemetic (ondansetron) 45 min before surgery.

The patients were shifted to the operation theatre and multipara monitors such as noninvasive blood pressure, peripheral oxygen saturation (SPO<sub>2</sub>), and electrocardiogram were connected. A 20-gauge intravenous (IV) cannula was inserted in the nonoperative arm and 80 ml/hr hartmann's solution was started.

Position: Supine with head turned to the opposite side.

Procedure: Under all aseptic and antiseptic precautions, a supraclavicular brachial plexus block was given under ultrasonography (USG) guidance. The needle was aimed to reach the corner pocket between the rib-1 and subclavian artery and drug mixture was injected in aliquots of 5 ml after proper negative aspiration. The spread of injected drugs was observed in real-time to confirm a satisfactory spread around the brachial plexus.

Baseline values of hemodynamic parameters like heart rate (HR), mean arterial pressure (MAP), and SPO<sub>2</sub> were assessed for all the patients at baseline and after every 15 min till completion of surgical procedure.

Effect of the block was assessed every 2 minutes till 30 minutes after injection. After surgery block was assessed hourly for first 6 hours, thereafter 2 hourly until the effect of the block is weared of Sensory block was assessed by pin prick method using 24G hypodermic needle on 3-point scale: Grade-0: Normal sensation (Sharp pain felt), Grade-1 : Blunted sensation (Dull sensation or slight heaviness), Grade-2 : No pain perception (State of anaesthesia).<sup>12</sup>

Assessment of sensory block was done along the distribution of median nerve, radial nerve, ulnar nerve and musculo-cutaneous nerve at following sites.

1. Radial nerve (Lateral side of dorsum of hand).
2. Median nerve (Thenar eminence).
3. Ulnar nerve (Little finger).
4. Musculocutaneous nerve (Lateral border of forearm over the site of radial artery).

Modified Bromage scale was used to assess motor block, for upper limb using following grades.<sup>11</sup>

Grade – 0: Normal muscle tone with full flexion and extension of elbow, wrist and fingers.

Grade – 1: Decreased motor strength (with weak grip) i.e Paresis.

Grade – 2: Complete motor block with inability to move the fingers.

Sensory blockade onset was confirmed by loss of sensation to pinprick or by a score of 1. The onset of motor blockade was calculated as the time interval between the end of injection and complete immobilization of wrist or

score of 1. Analgesia duration was taken as time interval between the onset of sensory block and the first dose of rescue-analgesia given to the patient. A complete block was considered as a block with a grade 2 score. Patients with score of 0, 1 were considered having an incomplete block and were excluded from the study.

Post-operative pain assessment was done using VAS for every 2 hours till the block last. Postoperative heart rate (HR), systolic (SBP), diastolic (DBP) and mean blood pressure (MAP) and SpO<sub>2</sub> were recorded on hourly basis till 6hrs, every 2 hourly till the effect of block or 12 hours whichever is earlier. Rescue analgesia was provided with inj. diclofenac sodium 75mg intramuscularly when VAS >4cm. The number of patients given diclofenac during the first 24 hours of the postoperative period was noted.

The incidence of side effects (bradycardia, hypotension, and sedation) was noted. Sedation scoring was used (4 point sedation score): (0-awake, 1- drowsy, 2- sleeping but arousable on verbal command, 3 - sleeping and arousable only on tactile stimulation). Bradycardia was considered when HR decreased by 20% from baseline value or an absolute HR <50 beats per minute; which was managed by 0.6mg IV bolus dose of atropine. Hypotension was defined as a fall in blood pressure by 20% from baseline or an absolute MAP <60mmHg; which was managed by IV fluids (200ml of Ringer lactate) or bolus dose of mephentermine(3mg IV).

### 2.1. Statistical analysis

Data was analyzed using Graphpad (prism 8) and Microsoft excel 2010. Quantitative data was interpreted as mean  $\pm$  standard deviation, and qualitative data was interpreted as number and percentages. “t-test” was used for quantitative data. Chi-square test was used as test of significance to find the association for qualitative data. P value <0.05 was considered significance.

## 3. Results

65 patients posted for upper limb surgeries were selected for this study. 3 patients refused to participate and 2 patients had to be excluded due to incomplete blockade. We analyzed a total of sixty patients.

Both the groups were similar concerning age, weight, sex ratio, ASA physical status and the duration of surgery [Table 1]. Baseline haemodynamic parameters between the two groups were comparable (P > 0.05).

Table 2 presents the analgesia and blockade in two groups. The mean time for onset and duration of sensory and motor blockade was comparable in both the groups. Intraoperative and postoperative vital parameters like Heart rate, Mean arterial pressure (MAP) were similar in both groups. The occurrence of bradycardia (2 vs 11), hypotension (3 vs. 5) and sedation (5 vs 7) were more

in Group RD100 out of which bradycardia in Group RD100 is statistically significant (p <.05). [Table 3]. Other side-effects like nausea, vomiting, dryness of mouth, and complications like pneumothorax, hematoma, systemic local anaesthetic toxicity, and post block neuropathy in the intra and postoperative periods were not observed in any of the subjects.

Table 3 shows that a total number of doses of diclofenac sodium required for VAS>4 (rescue analgesia) in both the groups in 24 h were also comparable (P >.05).

## 4. Discussion

Our study shows that no dose-dependent increase in the duration of analgesia and sensory or motor blockade in the groups is observed. A higher dose was associated with effects such as bradycardia. Hence, according to us, a dose of 50  $\mu$ g seems to have a good balance between stable hemodynamics and satisfactory analgesia.

Dexmedetomidine is an  $\alpha$ 2 agonist with a higher selectivity for  $\alpha$ 2 receptors than  $\alpha$ 1. It has analgesic, sedative and sympatholytic effects that suppress many of the cardiovascular effects seen during the perioperative time period.<sup>11</sup>

In the brachial plexus block, multiple local anesthetics agents have been used. Bupivacaine is very potent and has prolonged duration of action as compared to other local anaesthetics so it is used commonly.<sup>4</sup> One of the disadvantages is that it is cardiotoxic, especially with inadvertent injection into the subclavian artery. Ropivacaine was developed with properties similar to bupivacaine, having lower lipid solubility and less cardiotoxicity.<sup>5</sup>

Dexmedetomidine has been used frequently in regional nerve blocks, still its mechanism of action is poorly understood. According to Marhofer et al., local mechanisms like decrease in norepinephrine release, inhibition of action potential etc are responsible for the prolongation of the regional nerve block.<sup>13</sup>

Question is to find the optimum dose of dexmedetomidine due to its clinical effects like sedation, bradycardia and hypotension. Many doses ranging from 30-100  $\mu$ g dexmedetomidine have been used perineurally in brachial plexus blocks. Comparison of 50mg and 100 mg of dexmedetomidine is done as these doses are commonly used in human studies.

Kaygusuz et al. studied the effects of supplementing dexmedetomidine 1  $\mu$ g/kg to levo-bupivacaine in the brachial plexus block. They discovered that adding dexmedetomidine reduces the onset time and increases the total duration of sensorimotor block and analgesia.<sup>12</sup>

Kathuria et al. supplemented dexmedetomidine as an additive to ropivacaine in supraclavicular block. They studied that the addition of dexmedetomidine 50 mg to 30 ml ropivacaine 0.5% in ultrasound-guided supraclavicular block resulted in a rapid onset and increased duration of

**Table 1:** Demographic data( mean  $\pm$  sd)

Variables	Group RD50	Group RD100	P Value
Age(yrs)	40.9 $\pm$ 10.946	41.86667 $\pm$ 10.477	0.7272
Sex(m/f)	15/15	13/17	0.7961
Weight (kg)	63.6 $\pm$ 8.31	65.97 $\pm$ 7.52	0.2515
Asa status (i/ii)	14/16	13/17	1.000
Duration of surgery (min)	95.83 $\pm$ 19.48	96.77 $\pm$ 18.57	0.849

**Table 2:** Block characteristics (MEAN  $\pm$  SD)

Variables (min)	Group RD50	Group RD100	P Value
Sensory onset	8.18 $\pm$ 1.49	8.23 $\pm$ 1.41	0.8943
Sensory duration	757.8 $\pm$ 33.54	762.83 $\pm$ 28.78	0.5355
Motor onset	14.11 $\pm$ 2.09	14.06 $\pm$ 2.44	0.9324
Motor duration	701.03 $\pm$ 34	704.97 $\pm$ 33.72	0.6539
Duration of analgesia	862.23 $\pm$ 45.51	864.43 $\pm$ 44.02	0.8498

**Table 3:** Comparison of incidence of side effects in two group

Side effects	Group RD50	Group RD 100	P Value
Sedation score $\geq$ 3	5	7	0.416
Bradycardia $50 \leq$ bpm	2	11	0.0047
Hypotension $\leq$ 60 map	3	5	0.447

**Table 4:** No. of patients needed rescue analgesia in 24 hrs

No. of patients	Group RD50	Group RD100	P Value
	12	8	0.2732

block and pain relief.<sup>14</sup>

Esmaoglu et al. summarized that dexmedetomidine (100  $\mu$ g) when added to 40 ml of 0.5% levobupivacaine increased duration of axillary block.<sup>15</sup> They showed that dexmedetomidine prolonged the duration of the sensorimotor block and postoperative pain relief.

All of the above studies used a single dose and did not compare the different doses of dexmedetomidine.

Lately in a study done by Nallam et al. concluded that increasing the dose of dexmedetomidine increases total duration of analgesia and the incidence of bradycardia and hypotension.<sup>11</sup> In our study, we did not find an increase in analgesia duration. This could be due to the accurate deposition of the drug using realtime ultrasound, irrespective of the dose used. The increase in adverse effects could be due to the systemic absorption of a greater amount of drug leading to its central mediated action. Dexmedetomidine acts centrally by stimulating  $\alpha_2$  inhibitory neurons in the medullary vasomotor center of the brainstem causing a reduction in sympathetic outflow. In a study done by Esmaoglu et al., both HR and MAP decreased over time.<sup>15</sup>

## 5. Limitations of our Study

As the facility is not available in our institution, we could not measure the relationship between dose and plasma concentration of ropivacaine and dexmedetomidine in our

study.

## 6. Conclusion

Dexmedetomidine (100 mg vs 50 mg) when supplemented as an adjuvant to ropivacaine in supraclavicular block were similar in terms of onset and duration of sensory-motor block, and the duration of postoperative analgesia, and showed no extra advantage. On the contrary 100mg dexmedetomidine produces a increased incidence of bradycardia, which requires proper monitoring and correction.

## 7. Source of Funding

Nil.

## 8. Conflicts of Interest

Nil.

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**Cite this article:** Chauhan AP, Jain A, Pandya J. Comparison of different concentration of dexmedetomidine added to ropivacaine in ultrasound guided supraclavicular block for orthopedic forearm surgery- A prospective, randomized, comparative clinical study. *Indian J Clin Anaesth* 2020;7(3):380-384.