

## Comparison of clonidine and dexmedetomidine as adjuvants for ropivacaine in supraclavicular brachial plexus block

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**Background:** Addition of adjuvants to local anaesthetic in supraclavicular brachial plexus block helps in improving duration of block and analgesia. We compare clonidine and dexmedetomidine as adjuvants to ropivacaine in supraclavicular brachial plexus block.

**Method:** A total of 75 patients aged from 20 to 60 years belonging to ASA I-II scheduled for upper limb surgery were included and divided into three groups- Group I received 0.5% ropivacaine plus normal saline, Group II received 0.5% ropivacaine plus clonidine and Group III received 0.5% ropivacaine plus dexmedetomidine. The patients were compared for onset as well as duration of sensory and motor blockade, duration of analgesia and haemodynamic side effects.

**Results:** The mean duration of sensory and motor block as well as analgesia was found to be more (statistically highly significant  $p < 0.001$ ) in group III (dexmedetomidine group) having a much longer duration of sensory and motor block as well as analgesia compared to group I (plain ropivacaine) and group II (clonidine group).

**Conclusion:** Therefore, in present study it was found that addition of clonidine and dexmedetomidine to 0.5% ropivacaine are effective in supraclavicular brachial plexus block. However, dexmedetomidine is a better alternative to clonidine as adjuvant for 0.5% ropivacaine in to obtain early onset and prolong the duration of sensory and motor block and postoperative analgesia.

**Keywords:** Dexmedetomidine; clonidine; ropivacaine; supraclavicular brachial plexus block

### Introduction

Brachial plexus blockade is the cornerstone of regional anaesthesia practice of most anaesthesiologists. The supraclavicular approach is one of several techniques used to accomplish anaesthesia of the brachial plexus and is performed at the level of the brachial plexus trunks where almost entire sensory, motor and sympathetic nerve supply of the upper extremity is carried. Consequently, typical features of this block include its rapid onset, predictability and density.<sup>1</sup>

Long acting local anaesthetics have advantage of longer duration of block and prolonged postoperative analgesia to help reduce postoperative analgesic requirement. Ropivacaine, one of the newer long acting amide local anaesthetics, is the stereo isomer of bupivacaine and has been shown in to be less toxic than bupivacaine when injected intravenously.<sup>2</sup> The addition of an adjuvant to ropivacaine can further have the advantage of prolonging the duration of block and postoperative analgesia as well as decrease the dose of ropivacaine required.<sup>3</sup>

In this regard alfa-2 agonists, previously used as antihypertensive agents, have been utilized as adjuvants to local anaesthetics in nerve blocks. Clonidine, an imidazole, with selective partial agonist activity at alpha 2 adrenergic receptors, is being used to prolong the duration of analgesia when used in combination with local anaesthetic agents.<sup>4</sup> Dexmedetomidine, a highly selective alpha 2 adrenoreceptor agonist (1600 folds more selective for alpha 2 receptors) with sedative,

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sympatholytic and analgesic properties<sup>5</sup> have been found to be safe and effective in various neuraxial blocks and regional anaesthesia and has been shown to improve the quality of anaesthesia and reduce postoperative analgesia requirement.<sup>5,6</sup>

The present study was undertaken to compare the efficacy and safety of clonidine and dexmedetomidine as adjuvants for ropivacaine in supraclavicular brachial plexus block and to assess the sensory and motor blockade in terms of their onset and duration, duration of pain relief and side effects.

### Materials and methods

After approval by institutional ethical committee and obtaining written informed consent from patients, this prospective randomised study was done from April 2013 to March 2014. A total of 75 patients aged 20 to 65 years belonging to American Society of Anesthesiologists (ASA) physical status I-II, scheduled for upper limb surgeries were allocated into three groups randomly (randomization by computer generated random table method) with 25 patients in each group:

- Group I: Patients who received 29ml ropivacaine 0.5% plus 1ml saline.
- Group II: Patients who received 29ml ropivacaine 0.5% and 1ml clonidine (50mcg).
- Group III: Patients who received 29ml ropivacaine and 1ml dexmedetomidine (50 mcg).

Identical syringes were prepared by the anaesthesiologist not involved with the rest of the study. Patients with history of bleeding disorders and those receiving anticoagulants, pregnant females, ASA III or more were excluded from study.

On arrival at operating room monitors to record heart rate, blood pressure and oxygen saturation (SpO<sub>2</sub>) were established.

### Anaesthetic technique

The patients were made to lie supine on OT table, with head turned towards the opposite side.

The following landmarks were marked with the marker:

1. Clavicle from sternoclavicular joint to acromioclavicular joint.
2. Midpoint of clavicle.
3. One centimeter superior to the clavicular mid-point.

Neural localization was achieved using a nerve stimulator (Stimuplex, Braun, Germany) connected to a 22-gauge needle (Biometer, Melsungen, Germany). The position of the needle was judged adequate when an output current of 0.3 – 0.7mA elicited a distal motor response. After frequent negative aspirations, local anaesthesia solution (already prepared according to specific groups) was injected slowly into the brachial plexus sheath. All the patients were then assessed for onset of sensory and motor block and intraoperative haemodynamic variables.

Sensory block was assessed by pinprick method and compared with the same stimulation on contralateral arm.

- 0: Sharp pain
- 1: Touch sensation only
- 2: Not even touch sensation

Sensory score of 2 will be taken as the time of onset of sensory block

Motor block was assessed by Bromage scale on the three-point scale:

- 0: Normal motor function with full flexion and extension of elbow, wrist and fingers.
- 1: Decreased motor strength with ability to move fingers only
- 2: Complete motor block with inability to move fingers

Motor score of 2 was taken as the onset time of complete motor block.

### Data analysis

Statistical analysis was performed by the SPSS program for Windows, version 17.0. Continuous variables were presented as mean ± SD, and categorical variables as absolute numbers and percentages. Data was checked for normality before statistical analysis using Shaipro Wilk test. Normally distributed continuous variables were compared using ANOVA. If the F value was significant Bonferroni or Tamhane multiple comparison test was used to assess the differences between the individual groups. Categorical variables were analyzed using the chi-square test. For all statistical tests, a p-value less than 0.05 were taken to indicate a statistically significant difference.

**Results**

Patient characteristics in preoperative period are given in the Table 1. The three groups did not differ preoperatively with respect to mean age (Group I 44.72 ± 9.19 years, Group II 45.64 ± 8.91 years, Group III 46.44 ± 9.29 years), weight (Group I 65.96 ± 6.83Kg, Group II 64.76 ± 6.17 Kg, Group III 64.88 ± 6.70 Kg), systolic blood pressure (Group I 120.84 ± 10.85 mmHg, Group II 119.88 ± 9.88 mmHg, Group III 126.44 ± 10.50 mmHg), diastolic blood pressure (Group I 69.76 ± 6.63mmHg, Group II 69.00 ± 6.60 mmHg, Group III 71.08 ± 6.89 mmHg) with P value >0.05.

**Table 1:** Demographic data and preoperative parameters as mean±SD

Demographic data and baseline operative parameters	Group I	Group II	Group III	P value
	Control	Clonidine	Dexmedetomidine	
Age (years)	44.72 ± 9.19	45.64 ± 8.91	46.44 ± 9.29	0.801
Weight (kg)	65.96 ± 6.83	64.76 ± 6.17	64.88 ± 6.70	0.777
Male: Female percentage	76%	72%	72%	0.934
SBP (mmHg)	120.84 ± 10.85	119.88 ± 9.88	126.44 ± 10.50	0.062
DBP (mmHg)	69.76 ± 6.63	69.00 ± 6.60	71.08 ± 6.89	0.543
PR/min	71.76 ± 6.98	72.52 ± 6.75	72.32 ± 6.67	0.92
SBP=Systolic blood pressure, DBP=Diastolic blood pressure, PR=Pulse rate, SD=Standard deviation				

As shown in Table 2, it was observed that in group III there was faster onset of sensory and motor block compared to group II and group I (sensory block in Group I 13.04 ± 1.27min, Group II 13.72 ± 1.24 min, Group III 11.60 ± 1.08 min, motor block in Group I 16.92 ± 1.04min, Group II 17.16 ± 1.03 min, Group III 15.52 ± 1.05 min) with P value <0.05 .

**Table 2:** Onset of sensory and motor blockade

	Group I	Group II	Group III	P Value
	Mean ± Sd	Mean ± Sd	Mean ± Sd	
<i>Onset of sensory block (min)</i>	13.04 ± 1.27	13.72 ± 1.24	11.60 ± 1.08	0.006
<i>Onset of motor block (min)</i>	16.92 ± 1.04	17.16 ± 1.03	15.52 ± 1.05	<0.001

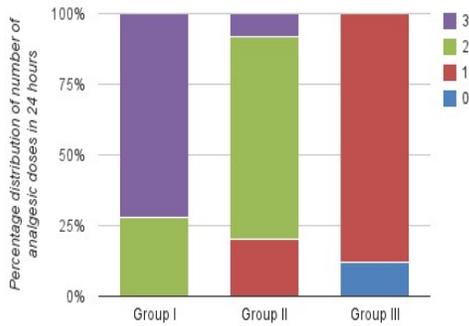
As shown in Table 3 the difference in three groups with respect to duration of sensory and motor block as well as duration of analgesia (measured till a visual analogue score of >3 was noted) was found to be statistically highly significant (p<0.001) with group II having a much longer duration of motor block compared to group I and group III having longest duration.

**Table 3:** Duration of sensory and motor blockade and duration of post-operative analgesia

	Group I	Group II	Group III	P Value
	Mean ± Sd	Mean ± Sd	Mean ± Sd	
<i>Duration of sensory block (min)</i>	359.20 ± 2.97	561.60 ± 33.13	728.40 ± 34.12	<0.001
<i>Duration of motor block (min)</i>	292.80 ± 18.38	488.80 ± 29.20	706.00 ± 25.50	<0.001
<i>Duration of analgesia (min)</i>	436.00 ± 19.79	623.20 ± 31.85	803.20 ± 42.00	<0.001

As shown in Figure 1, the rescue analgesia (used being injection diclofenac sodium 75mg intravenous in 100ml normal saline) used in group III was least as was significant decrease in 24-hour analgesic consumption in group III and group II compared to group I (statistically significant p value<0.001).

**Figure 1:** Number of doses of analgesics (diclofenac 75mg i.v.) in 24 hours



**Discussion**

Brachial plexus blockade is the cornerstone of regional anaesthesia practice of most anaesthesiologists. Brachial plexus block results in anaesthesia that is limited to a restricted portion of body, not disturbing the metabolism of rest of the body, early ambulation and early discharge of the patient. The usual indications for supraclavicular brachial plexus block are surgeries of hand and arm.

Nerve blocks with long acting local anaesthetics such as ropivacaine or bupivacaine are beneficial for improved postoperative pain therapy, but the duration of block is still not sufficient to avoid the postoperative use of opioids. Alternatively, perineural catheters can be used to prolong the duration of analgesia, however, in comparison with single-shot blocks, the insertion of peripheral nerve catheters is more time-consuming, costly, possibly more painful for the patient, has possible higher complication rates (e.g. infection, dislodgment), and needs more postoperative care. To improve the quality of block and prolong the duration of postoperative analgesia various adjuvants like epinephrine, clonidine, opioids, bicarbonate, neostigmine, verapamil, butorphenol have been added to local anaesthetics when used in brachial plexus block.<sup>7</sup> Adjuvants not only improve the quality of block but also improve the duration of analgesia which decreases the need for post-operative analgesics and continuous perineural catheters.

In this study it was observed that there was significant increase in mean duration of sensory and motor block in both group II and group III. This increase in duration was found to be

statistically highly significant with the addition of dexmedetomidine in comparison to clonidine and control group. This prolonged duration of sensory and motor blockade following the addition of clonidine and dexmedetomidine to local anaesthetics in peripheral nerve blocks has also been reported in earlier studies by Kenan Kaygusuz MD et al and Singelyn FJ et al.<sup>6,8</sup> Although in some studies addition of clonidine to local anaesthetics did not show any advantage of increasing duration of block as Erlacher W et al found that the addition of clonidine to ropivacaine 0.75% did not lead to any advantage of block of the brachial plexus when compared with pure ropivacaine 0.75%.<sup>9</sup> However, most of the studies report the advantages both in terms of quality and duration of block. Chakraborty S et al found that the addition of a small dose (30mcg) of clonidine to 0.5% bupivacaine significantly prolonged the duration of analgesia without producing any clinically important adverse reactions other than sedation.<sup>10</sup> The use of dexmedetomidine in group III resulted in faster onset of sensory and motor block. The mechanism of faster onset of block is mediated through blockade of the hyperpolarization-activated cation current (I<sub>h</sub> current), which is important to bring a peripheral nerve back to the resting potential.<sup>11</sup> The role of clonidine as adjuvant to ropivacaine in faster onset of sensory and motor block is controversial, with most of previous studies showing no effect on onset of block but use of dexmedetomidine with local anaesthetics have shortened the onset time of sensory and motor block.<sup>12,13</sup>

There was significant decrease in analgesic consumption in the postoperative period with the use of adjuvants dexmedetomidine and clonidine. There have been four proposed mechanisms for the this:- centrally mediated analgesia,  $\alpha_2$   $\beta$  adrenoceptor-mediated vasoconstrictive effects, attenuation of inflammatory response and direct action on peripheral nerve.<sup>14,15</sup> The prolongation of analgesia after neural blockade with use of alfa agonists resulted from increase in potassium conductance and blocking the conduction of C and A fibers.<sup>16</sup> Besides, clonidine also enhances lignocaine-induced inhibition of C-fiber compound action potential. Lipophilic nature of clonidine allows rapid absorption into cerebrospinal fluid and binding to adrenoceptor of spinal cord causing blockade at primary afferent terminals (both spinal as well as peripheral nerve endings).<sup>17</sup> Centrally alfa-2

agonists produce analgesia and sedation by inhibition of substance P release in the nociceptive pathway at the level of dorsal root neuron and by activation of alpha-2 adrenoceptors in locus coeruleus.<sup>18</sup>

There was no clinical or statistical change in respiratory rate or arterial saturation (SpO<sub>2</sub>) at all measured intervals in any of the three groups. Singh S et al and Kenan Kaygusuz MD et al also used on clonidine and dexmedetomidine as adjuvants to local anaesthetics in dose of 1mcg/kg body weight in which there was no significant difference in the ventilatory frequency or oxygen saturation.<sup>6,19</sup> Also the haemodynamic parameters (heart rate, mean blood pressure) recorded did show statistically insignificant difference in the three groups with clonidine and dexmedetomidine resulting lower hear rate and blood pressure however there was no need for pharmacological intervention. However, our haemodynamic data do not allow a conclusion regarding the safety in cardiovascular compromised patients. This was in accordance with the studies done by adding clonidine and dexmedetomidine added to bupivacaine, or levo-bupivacaine.<sup>20</sup>

Therefore, in our present study, we have found that addition of 50microgram dexmedetomidine to 0.5% ropivacaine in supraclavicular brachial plexus block decreased onset time of sensory and motor block and prolonged duration of postoperative analgesia and effect was significantly more than clonidine and control group.

### Conclusion

Therefore, in present study it was found that addition of clonidine and dexmedetomidine to 0.5% ropivacaine are effective in supraclavicular brachial plexus block. However, dexmedetomidine is a better alternative to clonidine to obtain early onset and prolonged duration of sensory and motor block and postoperative analgesia.

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