Comparison of Clonidine and Dexmedetomidine as an Adjuvant to 0.5% Ropivacaine in Supraclavicular Brachial Plexus Block: A Prospective, Randomized, Double-blind and Controlled Study

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ABSTRACT

Background: Brachial plexus blockade is the cornerstone of regional anesthesia practice. This study was done to compare clonidine and dexmedetomidine as an adjuvant to 0.5% ropivacaine in supraclavicular brachial plexus block (SCB).

Materials and methods: A prospective, randomized, double-blind study was done in 120 patients of American Society of Anaesthesiologist (ASA) grade I and II undergoing elective upper limb surgery under SCB. Patients were randomized into three groups. Group 1 (n = 40) received 30 ml of 0.5% ropivacaine, group 2 (n = 40) received 30 ml of 0.5% ropivacaine with 2 μg/kg clonidine, and group 3 (n = 40) received 30 ml of 0.5% ropivacaine with 1 μg/kg dexmedetomidine. Onset and recovery time of sensory and motor block, duration of analgesia and quality of block, hemodynamic variables, and level of sedation were studied in the three groups.

Results: Sensory and motor block onset times were shorter in group 3 than in group 1 and 2 (p < 0.0001). Sensory and motor block durations and duration of analgesia were longer in group 3 than in groups 1 and 2 (p < 0.0001). Blood pressure and heart rate were lower in group 3 as compared to groups 1 and 2 (p < 0.0001). The number of patients achieving grade IV quality of block was higher in group 3 as compared to the other groups.

Conclusion: Dexmedetomidine when added in SCB shortened the onset of sensory and motor block and enhances the duration of sensory and motor block and duration of analgesia without significant side effects.

Keywords: Clonidine, Dexmedetomidine, Ropivacaine, Supraclavicular brachial plexus block.

INTRODUCTION

Brachial plexus blockade is one of the approaches to sensorimotor regional neural blockade by which surgical anesthesia of the upper limb may be achieved. It is preferred in upper limb surgeries because it has certain advantages.1,2 It is safer in patients who are at high risk for general anesthesia, provides good postoperative analgesia and is economical.

The supraclavicular approach to brachial plexus block provides anesthesia of the entire upper extremity in the most consistent and time efficient manner. It has a high success rate and rapid onset of action. It provides more complete anesthesia of the plexus, particularly the axillary and musculocutaneous nerves, and does not require abduction of the arm to be performed.3,4 Peripheral nerve blocks have an increasingly important role in ambulatory anesthesia.5

Various studies have investigated several adjuvants like adrenaline, dextran 10%, potassium chloride, neostigmine, opioids, tramadol, dexamethasone, clonidine, bicarbonate and dexmedetomidine with the local anesthetics.6-11

Clonidine, a selective alpha 2 adrenergic agonist, has been used traditionally as an antihypertensive agent. Various studies have shown that clonidine can be used as an adjunct to local anesthetics in peripheral nerve blocks.12

In one study, author concluded that addition of 150 μg of clonidine to ropivacaine for axillary brachial plexus blockade prolongs motor and sensory block without an increase in the incidence of side effects.13

Dexmedetomidine was introduced two decades ago as a sedative and supplementation to sedation in the intensive care unit for intubated patients. Studies have shown that dexmedetomidine is more specific for α-2 adrenergic receptors than clonidine (ratio of α-2:α-1 activity, 1620:1 for dexmedetomidine, 220:1 for clonidine).14,15

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Swami et al compared the effects of clonidine (2 μg/ kg) and dexmedetomidine (1 μg/kg) added to 35 cc 0.5% bupivacaine in supravacular brachial plexus block. The aim of our study was to compare the effect of clonidine 2 ug/kg and dexmedetomidine 1 ug/kg added to ropivacaine 0.5% on the onset and duration of sensory and motor block, and total duration of analgesia, as primary outcome. Effect on hemodynamic variables, sedation score and the side effects, i.e. hypotension, bradycardia, headache, dryness of mouth, nausea and vomiting were also evaluated. This study was done to find a better additive in SCB along with 0.5% ropivacaine. We have used ropivacaine because it is less cardiotoxic than bupivacaine.

MATERIALS AND METHODS

This study was conducted in the Department of Anesthesiology, SMS Medical College, Jaipur. The approval for the study was taken from the institutional ethics committee. This prospective, randomized, double-blind study was done in 120 patients, of American Society of Anaesthesiologist (ASA) grade I and II, age 20 to 50 years, body weight 50 to 80 kg who underwent elective surgery in upper limb. All patients not willing to participate in the study, uncooperative patients, patients who were having local pathology at the site of injection or disability, history of convulsion, allergy to the drug used, bleeding disorder, severe neurological deficit, and patients in whom block was incomplete were excluded from the study.

Pre-anesthetic checkup (PAC) was done a day before the surgery that included complete history of patients including any known drug allergy, general and systemic examination and local examination of supravacular area. Pulse rate, blood pressure, respiratory rate and weight of the patient were noted. All routine investigations were done in all patients.

Informed consent was obtained for performance of block after complete explanation about the study protocol and the procedure. Visual analog scale (VAS) 0 to 10 was explained to the patient.

The patients were randomized into three groups each consisting of 40 patients by chit in box method. A total of 120 chits (40 per group) were made, each chit mentioning a particular study group. The patients were asked to pick up a chit from the box. Patients were allocated to the group mentioned on chit. Study drugs were prepared and administered to patients as per their respective allotted groups.

Group 1 (n = 40) received 30 ml of 0.5% ropivacaine, group 2 (n = 40) received 30 ml of 0.5% ropivacaine with 2 μg/kg clonidine, and group 3 (n = 40) received 30 ml of 0.5% ropivacaine with 1 μg/kg dexmedetomidine. All the solutions were diluted with isotonic normal saline to make a total volume of 32 ml.

Fasting status, consent and PAC were checked and intravenous access was secured. The patient was placed in the supine position, with the head turned away and the ipsilateral arm adducted. The interscalene groove and mid-point of the clavicle and subclavian artery were identified. After aseptic preparation of the area, at a point 1.5 to 2.0 cm posterior to midpoint of the clavicle, a skin wheal was raised with a local anesthetic (lignocaine 2% plain). Next, a 22 gauge, 50 millimeter ‘short beveled’ needle was passed through the same point in a caudal, slightly medial and posterior direction, until either a paresthesia was elicited or the first rib was encountered. If the first rib was encountered, the needle was moved over the first rib until a paresthesia was elicited either in the hand or arm. After eliciting paresthesia and negative aspiration of blood, medication was injected as per the respective group allotment.

After performance of nerve block patients were evaluated for onset of sensory block every 1 minute. The sensory block was assessed by pin prick with 25 gauge needle in C5-6 dermatome (Table 1). The onset time of the sensory block was taken as the time interval in minutes from the time of injection of the drug, till the sensory block started appearing, i.e. score > 1.

Motor block was assessed by using modified Bromage scale (Table 2).

The onset time of the motor block (OTMB), i.e. MBS score = 1, were recorded in all patients.

Heart rate, noninvasive blood pressure and SPO2 were measured every 5 minutes for first half an hour and thereafter every 15 minutes. Intraoperatively sedation was assessed by using a four point scale at 15 minutes interval. Postoperatively heart rate, noninvasive blood pressure, sensory block and motor power, sedation score were recorded at every 30 minutes interval. Visual analog scale score was assessed postoperatively at 6, 12 and 18 hours. Rescue analgesia was given at VAS score of 3. Tramadol injection 100 mg IV was given as rescue

<table>
<thead>
<tr>
<th>Table 1: Sensory block assessment</th>
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</thead>
<tbody>
<tr>
<td>Score</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Motor block assessment (modified Bromage scale)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>
analgesic. Total duration of analgesia was defined as the
time from injection of drug administration to patient’s
first request for rescue analgesic (i.e. at VAS 3).

The duration of motor block was defined as the
time of attainment of Bromage score 3 of block (onset)
until reversal to Bromage score 1. The incidence of
adverse effects, such as nausea, vomiting, headache,
bradycardia, respiratory depression, and hypotension
were recorded. Hypotension, defined as a decrease of
systolic blood pressure by more than 30% from baseline
or a fall below 90 mm Hg, was treated with incremental
IV doses of mephentermine 5 mg and IV fluid as required.
Bradyurcardia, defined as heart rate < 50 bpm, were treated
with IV atropine 0.3 to 0.6 mg. Patients were monitored
for 24 hours in postoperative period for adverse effects.

STATISTICS

A study power 80% and alpha level of 0.05 sample size
was calculated for 3 groups (40 patients in each group).
Aimed sample size was 120 patients.

Comparison between the three groups with respect
to demographic variables, intraoperative vitals HR, BP,
RR, SPO2, the onset and duration of sensory and motor
blocks were analyzed by using unpaired t-test. p-value
<0.05 was considered significant.

RESULTS

Mean age, body weight, ASA grading and duration of
surgery were similar in the three groups (Table 3).

The onset of sensory block was 12.2 ± 3.16 minutes in
group 1, 10.7 ± 4.05 minutes in group 2 and 4.9 ± 1.08 minutes
in group 3. It was found to be statistically significant
when we compared group 3 to groups 1 and 2 (p < 0.0001)
(Table 4).

The onset of motor block took 15.8 ± 3.29 minutes in
group 1, 12.1 ± 4.11 minutes in group 2, and 8.9 ± 1.41
minutes in group 3. It was statistically significant when
we compared group 3 to groups 1 and 2 and group 2 to
group 1 (p < 0.0001) (Table 4).

Duration of analgesia was 510.75 ± 45.31 minutes in
group 1, 713.25 ± 30.24 minutes in group 2 and 1014.25 ±
68.00 in group 3. It was statistically significant when
we compared group 3 to groups 1 and 2 and group 2 to
group 1 (p < 0.0001) (Table 4).

Duration of motor block was 460.5 ± 45.344 minutes in
group 1, 626.25 ± 33.42 minutes in group 2 and 769.25 ±
42.75 in group 3. It was statistically significant when
we compared group 3 to groups 1 and 2 and group 2 to
group 1 (p < 0.0001) (Table 4).

Duration of sensory block was 483.5 ± 47.09 minutes in
group 1, 675 ± 26.89 minutes in group 2 and 844 ± 40.56
minutes in group 3. It was statistically significant when
we compared groups 3 to groups 1 and 2 and group 2 to
group 1 (p < 0.0001) (Table 4).

Mean pain score in group 1 was 2.65 ± 0.48, in group 2
was 1.275 ± 0.45 and in group 3 was 0.25 ± 0.439. The mean
pain score in group 3 is significantly lower as compared
to groups 1 and 2.

In group 1, all 40 patients were awake and alert. In

group 2 (27/40) were awake and alert and 13 patients
were drowsy. In group 3(18/40) were awake and alert
and 22 patients were drowsy (Table 5).

There was no significant difference between groups
regarding the incidence of adverse effects (Table 6).

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### Table 3: Demographic profile

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group 1 (n = 40)</th>
<th>Group 2 (n = 40)</th>
<th>Group 3 (n = 40)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>34.2 ± 10.1</td>
<td>31.9 ± 12.9</td>
<td>25.8 ± 7.5</td>
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</tr>
<tr>
<td>Body weight (kgs)</td>
<td>56.8 ± 4.2</td>
<td>51.5 ± 7.7</td>
<td>56.4 ± 3.0</td>
<td>0.9</td>
</tr>
<tr>
<td>Duration of surgery (minute)</td>
<td>72.5 ± 14.8</td>
<td>71.2 ± 12.5</td>
<td>72.2 ± 16.7</td>
<td>2.0</td>
</tr>
<tr>
<td>ASA grade I/II</td>
<td>18/22</td>
<td>21/19</td>
<td>24/16</td>
<td>1.8</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>23/17</td>
<td>26/14</td>
<td>29/11</td>
<td>0.7</td>
</tr>
</tbody>
</table>

### Table 4: Onset of sensory and motor block, total duration of sensory and motor block, total duration of analgesia

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset of sensory block (minute)</td>
<td>12.2 ± 3.1</td>
<td>10.7 ± 4.0</td>
<td>4.9 ± 1.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Onset of motor block (minute)</td>
<td>15.8 ± 3.2</td>
<td>12.1 ± 4.1</td>
<td>8.9 ± 1.4</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Duration of analgesia (minute)</td>
<td>510.75 ± 45.31</td>
<td>713.25 ± 30.24</td>
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<tr>
<td>Duration of motor block (minute)</td>
<td>460.5 ± 45.344</td>
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<td>769.25 ± 42.75</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Duration of sensory block (minute)</td>
<td>483.5 ± 47.09</td>
<td>675 ± 26.89</td>
<td>844 ± 40.56</td>
<td>&lt;0.0001</td>
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</tbody>
</table>

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### Table 5: Duration of analgesia

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of analgesia (kgs)</td>
<td>72.5 ± 14.8</td>
<td>71.2 ± 12.5</td>
<td>72.2 ± 16.7</td>
<td>2.0</td>
</tr>
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</table>

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### Table 6: Incidence of adverse effects

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>p-value</th>
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<tbody>
<tr>
<td>Bradycardia</td>
<td>4/40</td>
<td>1/40</td>
<td>0/40</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Hypotension</td>
<td>3/40</td>
<td>2/40</td>
<td>1/40</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>4/40</td>
<td>1/40</td>
<td>0/40</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Hypotension</td>
<td>3/40</td>
<td>2/40</td>
<td>1/40</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

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### Table 7: Comparison of Clonidine and Dexmedetomidine as an Adjuvant to 0.5% Ropivacaine

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group 1</th>
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<th>Group 3</th>
<th>p-value</th>
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</thead>
<tbody>
<tr>
<td>Mean age (years)</td>
<td>34.2 ± 10.1</td>
<td>31.9 ± 12.9</td>
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<td>0.7</td>
</tr>
</tbody>
</table>
DISCUSSION

Brachial plexus block was achieved by classical supraclavicular approach and satisfactory surgical anesthesia was attained in all the cases for various types of upper limb surgeries.

A 2 mg/kg body weight of clonidine was added with ropivacaine in one group of patients based on works done by El Saied et al which concluded that addition of 150 mg of clonidine to ropivacaine for axillary brachial plexus blockade prolongs motor and sensory block without an increase in incidence of side effects.\textsuperscript{13}

In contrast, Culebras et al showed that clonidine (150 mg) added to 40 ml 0.5% bupivacaine did not prolong postoperative analgesia.\textsuperscript{16}

Casati evaluated the effects of clonidine 1 ug/kg added to ropivacaine and found longer onset time to establish block in clonidine group.\textsuperscript{17}

Bernard et al observed that small doses of clonidine 30 to 90 mg in combination with lidocaine administered in axillary block reduced sensory block onset time and significantly prolonged the duration of analgesia (p < 0.01). In this study higher doses of clonidine (300 mg) were associated with significant adverse effects.\textsuperscript{18}

Wolfgang et al studied the effect of clonidine as adjuvant for bupivacaine, mepivacaine and ropivacaine for axillary plexus block. Clonidine produced prolongation in bupivacaine and mepivacaine groups but did not produce additional block in ropivacaine group.\textsuperscript{19}

Aliya Esmaoglu et al have reported that 100 mg dose of dexmedetomidine when used as an adjuvant for ropivacaine in axillary block shortens the onset of sensory and motor block and prolongs duration of blockade without significant change in heart rate, blood pressure and sedation.\textsuperscript{20}

Swami et al compared the effects of clonidine (2 ug/kg) and dexmedetomidine (1 mg/kg) added to 35 cc 0.5% bupivacaine in supraclavicular brachial plexus block and found that dexmedetomidine enhanced the duration of sensory and motor block and also the duration of analgesia. In our study, we observed that both clonidine and dexmedetomidine have enhanced the duration of sensory and motor block and duration of analgesia.\textsuperscript{21}

Rachana Gandhi et al observed an 8 hours prolongation in duration of analgesia and motor block when 30 mg dexmedetomidine was added to bupivacaine.\textsuperscript{22}

In another study, Kenan kaykusuz et al observed a 3.5 hours prolongation of analgesia when dexmedetomidine 100 mg was added to levobupivacaine. In our study, we have found a significant prolongation of analgesia (5 hours) with dexmedetomidine compared to clonidine. This shows that the dose of dexmedetomidine of 1 mg/kg is appropriate for brachial plexus block and in fact superior to a higher dose of clonidine (2 mg/kg).\textsuperscript{23}

In our study in groups 1 and 2, no significant change in heart rate was seen in the intraoperative as well as postoperative period. However in group 3 statistically significant reductions in heart rate were observed. These results are consistent with the studies done by Adnan et al\textsuperscript{24} and Swami et al who found no change in heart rate with clonidine in axillary brachial block, and supraclavicular brachial plexus block respectively; and to the results of Aliya Esmaoglu et al and Swami et al who described significant bradycardia with dexmedetomidine.\textsuperscript{20,21}

Blood pressure (both systolic and diastolic) showed no difference in groups 1 and 2. The blood pressure values in group 3 showed significant reduction both intraoperatively and postoperatively as compared to baseline values but no active clinical intervention was required. These findings are in line with the works of El Saied et al who found no significant changes in blood pressure when 150 mg clonidine was added to ropivacaine. Aliya Esmaoglu et al and Swami et al have observed a decrease in the blood pressure and heart rate when dexmedetomidine was added to local anesthetic in brachial plexus block.

CONCLUSION

The upper limb surgeries performed under supraclavicular brachial plexus nerve block with 0.5% ropivacaine and dexmedetomidine (1 mg/kg) as an adjuvant result in early onset of sensory and motor blockade, prolongation of the duration of sensory and motor blockade and postoperative analgesia with better quality of block as compared to clonidine (2 mg/kg). The patient remained comfortable in postoperative period with considerable therapeutic benefit and without any potential adverse effects.
Comparison of Clonidine and Dexmedetomidine as an Adjuvant to 0.5% Ropivacaine

REFERENCES


