COMPARISON OF DEXMEDETOMIDINE AND CLONIDINE AS AN ADJUVANT TO LEVOBUPIVACAINE IN ULTRASOUND GUIDED AXILLARY BRACHIAL PLEXUS BLOCK: A RANDOMISED DOUBLE-BLIND PROSPECTIVE STUDY

Vinod Hosalli, Anilkumar Ganeshnavar, S Y Hulakund and Prakashappa D S

Abstract

Objectives:
Alpha-2-receptor agonist has been used as an additive to local anaesthetics for various regional anaesthetic techniques. We compared clonidine and dexmedetomidine as an adjuvant to local anaesthetic agent in ultrasound guided axillary brachial plexus block with respect to hemodynamic parameters, onset and duration of sensory, motor block and duration of analgesia.

Methods:
Ultrasound-guided axillary brachial plexus block was performed in 60 ASA I and II patients scheduled for elective upper limb surgeries under axillary brachial plexus block, were divided into two equal groups in a randomized, double blinded fashion. Group C received clonidine 1 μg/kg and Group D received dexmedetomidine 1μg/kg added to levobupivacaine 0.5% (36 cc). Hemodynamic parameters, onset and duration of sensory, motor block and duration of analgesia studied in both the groups.

Results:
There was no statistically significant difference in hemodynamic parameters, onset time of sensory and motor block in both the study groups. Duration of sensory block, motor block and post operative analgesia was significantly longer in dexmedetomidine group compared to clonidine group. In both the groups no side-effects (nausea, vomiting, dry mouth) were reported during the first 24 h in the post-operative period.

Conclusion:
Dexmedetomidine as an adjuvant to 0.5% levobupivacaine is more effective in prolonging the duration of sensory block, motor block and post operative analgesia compared to clonidine.

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Keywords: axillary brachial plexus block, clonidine, dexmedetomidine, levobupivacaine.

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INTRODUCTION

Brachial plexus blocks provide a useful alternative to general anaesthesia for upper limb surgeries. They achieve near ideal operating conditions by producing complete muscular relaxation, maintaining stable intraoperative hemodynamic condition and sympathetic block. Axillary brachial plexus block is one of the most popular techniques in upper limb surgeries, because of its ease, reliability and safety\(^1\).

The application of ultrasound technique for exact localization of nerves has revolutionized the regional anaesthesia field and is becoming increasingly popular as it increases success rates, shortens block onset time and reduces the number of needle insertions and complications.

Levobupivacaine, a local anaesthetic with higher toxic threshold, produces less cardiac effects, and a similar duration of action of analgesia compared to bupivacaine\(^2\).

Various adjuvants to local anesthetics were used to prolong analgesia with variable results and advantages\(^3\). Recently, \(\alpha_2\) agonist have been studied as adjuvants to local anesthetics in regional anaesthetic techniques for their efficacy to enhance the quality and duration of analgesia with fewer adverse effects. Clonidine, an \(\alpha_2\) adrenergic agonist has sedative, analgesic, perioperative sympatholytic with cardiovascular stabilizing effects and has been tried in combination with local anaesthetic drugs to enhance regional anesthesia.\(^4,5\)

The present study was aimed to test the hypothesis that dexmedetomidine produces faster onset of sensory, motor block and prolonged post operative analgesia when added as an adjuvant to levobupivacaine 0.5% in axillary brachial plexus block compared with clonidine.

METHODS

After ethical committee approval and written informed consent, a double-blind randomized prospective clinical study was carried out on 60 American Society of Anaesthesiologist (ASA) Grade I and II patients of either sex, aged 18–60 years, undergoing various bony orthopaedic surgeries on the upper limb under ultrasound guided axillary brachial plexus block. Patients with a history of pre-existing cardiac or pulmonary diseases, peripheral neuromuscular disease, bleeding or coagulation disorder, allergy to local anaesthetic amides, refusal to technique were excluded from the study. Any patients taking medications with psychotropic or adrenergic activities and patients receiving chronic analgesic therapy other than simple analgesics were also excluded from the study.

The study was conducted in two groups of 30 patients each. The patients were randomly assigned using “slips in a box technique” to one of the following groups:

- Group C: Levobupivacaine 0.5% (36 cc) + clonidine 1μg/kg
- Group D: Levobupivacaine 0.5% (36 cc) + dexmedetomidine 1 μg/kg.

The local anaesthetic solution was prepared by an anaesthetist not involved in the study.

On arrival in the operation room, baseline heart rate, blood pressure and oxygen saturation were recorded. An intravenous line was secured in the unaffected limb and Ringer’s lactate was started. The anesthetist performing the block was blinded to the treatment group. All observations were carried out by a single investigator who was also blinded to the treatment group.

The axillary brachial plexus block was performed using a transportable ultrasound system (Sonosite micromax; Sonosite Inc., Bothell,WA, USA) 6 -12 MHz linear high frequency ultrasound transducer to obtain the images of brachial plexus.

The patient was placed in the supine position with the head facing away from the site to be blocked. The arm is abducted to form an approximately 90° angle in the elbow joint. After thorough skin preparation, with the arm externally rotated, the biceps and coracobrachialis are easily identified laterally.
The landmark structure is the thick walled pulsatile axillary artery. The area around the artery was examined for location of the nerves. Typically the median nerve lies laterally, the ulnar nerve medially and the radial nerve lies posteriorly deep to the artery. The musculocutaneous nerve is located by searching within the hyperechoic borders of the flexor compartment.

The block was performed using local anesthetic mixture according to Group C or Group D with a 21G, 50-mm-long stimulating (Stimuplex, Braun, Germany) short bevelled echogenic needle for optimal control and visibility. Using ultrasound guidance the musculocutaneous nerve was first identified and anesthetized with 6 ml of the drug. The median, ulnar and radial nerves were individually anesthetized with 10 ml of local anaesthetic drug, after negative aspiration to avoid accidental intravascular needle puncture and spread of local anesthetic drug was observed in tissue planes.

Sensory blockade was tested using pin prick method along the distribution of the four nerves. Sensory block was graded as- Grade 0= sharp pin felt, Grade 1= analgesia, dull sensation , Grade 2= anaesthesia, no sensation. Assessment of sensory blockade was done in the dermatomal areas corresponding to median nerve, radial nerve, ulnar nerve and musculocutaneous nerve. Sensory onset is considered when there is dull sensation to pin prick (Grade 1) along the distribution of any of the above mentioned nerves. The duration of sensory block was defined as the time interval between the end of local anesthetic administration and the complete resolution of anaesthesia on all nerves. Motor blockade assessment was done using the modified Bromage scale for upper extremities on a three point scale.

Grade 0 = normal motor function with full extension of elbow, wrist and fingers. 
Grade 1= decrease motor strength with ability to move fingers and/or wrist only.
Grade 2= complete motor blockade with inability to move fingers.

Onset of motor blockade was considered when there is Grade 1 motor blockade. Peak motor block was considered when there is Grade 2 motor blockade. The duration of motor block was defined as the time interval between the end of local anesthetic administration and the recovery of complete motor function of the hand and forearm.

After LA injection, measurements of onset, duration of sensory and motor blockade and vital parameters (pulse, blood pressure, SPO2) was carried out every 5 min until 30 minutes. Postoperatively motor and sensory blockade and vitals of the patient was noted half hourly till the block completely wears off.

**Statistical Analysis**

Statistical analysis was done using SPSS software 11.0. All values are expressed as mean ± standard deviation. Chi-square test for proportions in qualitative data Student’s unpaired t-test for Quantitative data. P<0.05 was considered statistically significant.

**RESULTS**

A total of 60 adult consented patients scheduled for elective upper extremity surgery were comparable for their demographic data of age, sex, weight, ASA classification and type of surgeries [Table-1].

### Table 1: Demographic profile.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group C (n = 30)</th>
<th>Group D (n = 30)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>37.29 ± 16.651</td>
<td>37.90 ± 18.343</td>
<td>0.89 NS</td>
</tr>
<tr>
<td>SEX (M:F)</td>
<td>19:10</td>
<td>19:9</td>
<td></td>
</tr>
<tr>
<td>WEIGHT</td>
<td>62.93±6.38</td>
<td>60.91±5.44</td>
<td>0.06 NS</td>
</tr>
<tr>
<td>ASA STATUS I / II</td>
<td>24/4</td>
<td>27/2</td>
<td>0.15 NS</td>
</tr>
<tr>
<td>Type of surgeries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Radius ulna</td>
<td>16</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>
There was no significant difference in the baseline haemodynamic parameters in both groups. In Group D significantly lower pulse rate was observed at 60, 90 and 120 min, as compared with Group C, but not less than 60 beats/min (P<0.001) [Figure 1].

Figure 1: Comparison of pulse rate in both the groups

In Group D systolic and diastolic blood pressure were found to be significantly lower than baseline from 30 to 120 min as compared with Group C (P<0.001)[Figure-2].

Table-2: Sensory and motor blockade characteristics.

<table>
<thead>
<tr>
<th>Parameter/groups</th>
<th>Group C</th>
<th>Group D</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset of sensory block (min)</td>
<td>8.07 ± .651</td>
<td>8.14 ± 1.079</td>
<td>0.754</td>
</tr>
<tr>
<td>Onset of motor block (min)</td>
<td>14.62 ± 2.077</td>
<td>14.93 ± 1.844</td>
<td>0.557</td>
</tr>
<tr>
<td>Duration of sensory block (min)</td>
<td>233.00±48.42</td>
<td>423.17±80.01</td>
<td>0.001</td>
</tr>
<tr>
<td>Duration of motor block (min)</td>
<td>289.76±49.43</td>
<td>488.21±83.20</td>
<td>0.001</td>
</tr>
<tr>
<td>Duration of analgesia (min)</td>
<td>302.67±65.29</td>
<td>460.21±78.33</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Statistically significant longer duration of sensory block was observed in Group D (423.17±80.01min), as compared with Group C (233.00±48.42).

Duration of motor block was significantly longer in Group D (488.21±88.20min), compared to group C(289.76±49.43min).There was significant increase in duration of analgesia in Group D (460.21±78.33min) as compared with Group C (302.67±65.29). The difference was statistically significant [Table 2] (P=0.001).

In both the groups no side-effects (nausea, vomiting, dry mouth) were reported during the first 24 h in the post-operative period.

DISCUSSION

Ultrasound guided axillary brachial plexus block is a safe reliable anesthetic technique for upper limb surgery with less complication. It provides ideal surgical condition with stable hemodynamic, decreases vasospasm, edema, postoperative pain, and help early ambulation[16].

The real-time ultrasound guidance has been used to localize the peripheral nerve or plexus, accurate needle placement and
verification of local anaesthetic spread in the appropriate tissue planes\cite{9}, studies have shown faster onset times and longer duration of blocks when real-time ultrasound has aided the technique in comparison with other nerve localisation techniques\cite{10}. We compared dexmedetomidine and clonidine (\(\alpha_2\)-agonists) as an adjuvant to Levobupivacaine in axillary brachial plexus block, and found that there was a significantly increased duration of sensory and motor blockade in the dexmedetomidine group than in the clonidine group without any adverse effects.

Clonidine in neuraxial techniques affects mainly synaptic adrenergic receptors. Four mechanisms have been proposed, which have centrally mediated analgesia; \(\alpha_2\)-adrenoceptor mediated vasoconstrictive effects, attenuation of the response and direct action on the peripheral nerve\cite{11}.

Dexmedetomidine; a highly selective, \(\alpha_2\)-adrenergic agonist; has analgesic, sedative, anaesthetic sparing effects when used in systemic route\cite{12} and it is approximately eight-times more selective towards the \(\alpha_2\) adrenoceptor than clonidine. Animal studies have proven the combination of dexmedetomidine with ropivacaine to be safe and neuro-protective. The use of dexmedetomidine decreases inflammation around peripheral nerves, thereby decreasing the potential for peripheral nerve injury\cite{13}. In human beings, the beneficial effects of adding dexmedetomidine to local anesthetics during regional anesthesia and some peripheral nerve blockade procedures have proved to be efficacious for the surgical patients\cite{14}.

The results of our study corroborate with study conducted by Eismaoglou et al. Dexmedetomidine was added to levobupivacaine for axillary brachial plexus block and showed that it shortens the onset time of both sensory and motor block, prolongs the duration of block and the duration of post-operative analgesia\cite{13}. The results of our study corroborate with this study.

Swami et al. concluded that dexmedetomidine\((1 \text{ \(\mu\)}\text{g/kg})\) compared to clonidine\((1 \text{ \(\mu\)}\text{g/kg})\) when added to local anesthetic (35cc, bupivacaine 0.25\% ) in supraclavicular brachial plexus block enhanced the duration of sensory and motor block and also the duration of analgesia\cite{16}.

In another study by Zhang et al. reported prolonged sensory and motor blockade duration in patients who received dexmedetomidine (50 \(\mu\)g) in 40 ml of 0.33\% ropivacaine when compared to control group for axillary brachial plexus blockade\cite{17}. However, dexmedetomidine was also associated with an increased incidence of side effects such as bradycardia, hypertension, and hypotension.

A study conducted by Singelyn et al. reported that a minimum dose of clonidine (0.5 \(\mu\)g/kg) added to mepivacaine prolongs the duration of anaesthesia and analgesia after brachial plexus block and found no added advantage by exceeding the dose of clonidine to 1.5 \(\mu\)g/kg\cite{18}.

Popping et al. in their meta analysis of randomized trials observed that the prolongation of motor block was higher when clonidine was added to bupivacaine as compared with ropivacaine\cite{19}. All above studies correlated with our study findings. No patient in any of the groups exhibited significant side effects or hemodynamic variability in both groups during the perioperative period.

**CONCLUSION**

Dexmedetomidine as an adjuvant to 0.5\% levobupivacaine compared to clonidine for upper extremity surgeries under ultrasound guided axillary brachial plexus block has a definite advantage for enhancement of duration of sensory and motor blockade profile and post-operative analgesia without any hemodynamic variations and adverse events.

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