RESEARCH ARTICLE

A Comparative Study of Efficacy of Clonidine and Dexmedetomidine As An Adjuvant to Ropivacaine in Ultrasound Guided Supraclavicular Brachial Plexus Block Vis-À-Vis Onset of Surgical Anesthesia and Duration of Effect in Upper Limb Surgeries

Sandeep Dubey¹ | Rukhsana Najeeb² | Arshid Ahmad Sofi³

¹Senior Resident, Department of Anesthesiology GB Pant Hospital Delhi, India.
²Professor & Head of Department, Department of Anesthesiology & Critical Care, Govt. Medical College, Srinagar, India.
³Senior Resident, Department of Anesthesiology & Critical Care, Govt. Medical College, Srinagar, India.

Abstract

Background: Supraclavicular block is a safe, reliable and cost-effective technique of providing anesthesia for the upper limb surgeries. Objectives: To evaluate the effect of Clonidine and Dexmedetomidine as an adjuvant to Ropivacaine in ultrasound guided supraclavicular block in upper limb surgeries with respect to: Onset of sensory and motor block, Duration of sensory and motor block, Quality of block and Duration of post-operative analgesia.

Materials and methods: The purpose of present study was to compare the effect of addition of clonidine 1mcg/kg vs dexmedetomidine 1mcg/kg to 20ml of 0.5% ropivacaine in ultrasound guided supraclavicular brachial plexus block. A total of 90 patients of ASA I and II, aged 18-60 years, of either gender, undergoing upper limb surgery were allocated to three groups. Each group consisted of 30 patients. They received drugs as under: Group-A (dexmedetomidine group) received 20ml of 0.5% ropivacaine plus 1mcg/kg of dexmedetomidine. Group-B (clonidine group) received 20ml of 0.5% ropivacaine plus 1mcg/kg clonidine. Group-C (placebo group) received 20 ml of 0.5% ropivacaine plus 2 ml normal saline.

Results: Onset of sensory block was faster in Group-A as compared to Group-B and Group-C. The difference was statistically significant (p-value<0.05). Onset of motor block was faster in Group-A as compared to Group-B and Group C. The difference was statistically significant (p-value<0.05). Patients of Group-A had significantly longer duration of sensory and motor block when compared with Group-B and Group-C (p-value<0.05). Duration of post-operative analgesia was significantly longer in Group-A as compared to Group-B and Group-C (p-value<0.05). Quality of block was significantly better in Group-A as compared to Group-B and Group-C (p-value<0.05).

Conclusion: Dexmedetomidine prolongs the duration of sensory and motor block, duration of postoperative analgesia and improves the quality of block much more as compared to clonidine when used as an adjuvant to ropivacaine in ultrasound guided supraclavicular brachial plexus block.

Keywords: Nerve block, Dexmedetomidine, clonidine, sensory and motor block, supraclavicular brachial plexus block.
INTRODUCTION

Anesthesia has evolved into a specialty subject over decades with lot of improvements in the methods employed and drugs used to provide anesthesia with least complications. General anesthesia was one of the most common methods employed to provide anesthesia for upper limb surgeries. With the introduction of newer and safer local anesthetics and better advantages, regional anesthesia has taken over as the principle technique for upper limb surgeries. (1)

Many of the negative aspects of peripheral regional anesthesia stem from the fundamental fact that these procedures have traditionally been performed without the ability to visualize needle insertion, adjacent blood vessels, and the spread of local anesthetic. Over the past decade, ultrasound has gained popularity for peripheral nerve block because it allows the anesthesiologist to directly visualize the nerves of interest, the needle tip itself, and the spread of the local anesthetic in the desired location. In addition, the ultrasound image reliably depicts other structures such as blood vessels and lungs that have to be avoided. For these reasons, ultrasound guidance has increasingly become the standard technique for regional anesthesia. (2)

Brachial plexus blocks are regional anesthesia techniques that are employed as an alternative to general anesthesia for surgery of shoulder, arm, elbow, forearm, wrist and hand. These techniques involve the injection of local anesthetic in close proximity to the brachial plexus temporarily blocking the sensory and motor functions of the upper limb. (3)

First brachial plexus block was performed by William Halsted in 1889 using a surgical approach in the neck. Halsted applied cocaine to the brachial plexus. (4–6)

Upper limb surgeries below the shoulder joint are mostly performed under peripheral blocks such as the brachial plexus block. There are several techniques for blocking the nerves of the brachial plexus. These techniques are classified by the level at which the needle or catheter is inserted for injecting the local anesthetic i.e. interscalene block, supraclavicular block, infraclavicular block and axillary block from above downwards. (1, 3)

METHODS

This clinical study was conducted in the Postgraduate Department of Anesthesiology and Critical Care in Bone and Joint Hospital Barzulla, an associated hospital of Government Medical College, Srinagar. The observational study was done to compare the efficacy of dexmedetomidine and clonidine (α2 agonist drugs) as an adjuvant to ropivacaine in ultrasound guided supraclavicular brachial plexus block. The study was conducted after approval from the Institutional Ethical Committee and an informed written consent was obtained from all the patients for participation in this study.

Patients selected for surgery were among those already admitted in different units of the hospital. Preanesthetic evaluation was done at least 24 hours prior to surgery. A thorough history including history of previous anesthetic exposure, medications, personal habits, and allergy to any drugs was inquired about. General physical examination and cardiovascular system, respiratory system and central nervous system examination was performed. Airway assessment was also done to predict difficult intubation. All the routine investigations (CBC, BT, CT, BSR, KFT, LFT, electrolytes, chest radiograph, ECG, HBsAg, HCV, HIV) were asked for. In addition, all patients were weighed and height was measured.

An observational study was carried out on 90 American Society of Anesthesiologist (ASA) Grade I and II patients of either gender, aged 18–60 years, undergoing various bony orthopedic surgeries on the upper limb under supraclavicular brachial plexus block. The study was conducted in three groups of 30 patients each.

Supplementary information The online version of this article (10.15520/jmbas.v8i8.250) contains supplementary material, which is available to authorized users.

Corresponding Author: Arshid Ahmad Sofi
Arshid Ahmad Sofi
Email: arshidahmed2015@gmail.com
A Comparative Study of Efficacy of Clonidine and Dexmedetomidine As An Adjuvant to Ropivacaine in Ultrasound Guided Supraclavicular Brachial Plexus Block Vis-À-Vis Onset of Surgical Anaesthesia and Duration of Effect in Upper Limb Surgeries

Group A: Ropivacaine 0.5% (20 cc) + Dexmedetomidine 1mcg/kg
Group B: Ropivacaine 0.5% (20 cc) + clonidine 1mcg/kg
Group C: Ropivacaine 0.5% (20 cc) + 2ml normal saline

3 | TECHNIQUE

With the patient in proper position, the part was prepared and draped. The transducer was positioned in the transverse plane immediately superior to the clavicle at approx. its midpoint. The transducer was tilted caudally to obtain a cross sectional view of the subclavian artery. The brachial plexus was seen as a collection of hypoechoic oval structures lateral and superficial to the artery.

Using a 25G needle, 1-2 ml of local anesthetic was injected into the skin 1 cm lateral to the transducer to decrease the discomfort during needle insertion. The needle was never inserted deeper than 1 cm to avoid inadvertent puncture of and injection into the brachial plexus. The distribution of the local anesthetic was observed during administration by injecting small amounts of the local anesthetic as the needle advanced through tissue layers. The block needle was then inserted in plane towards the brachial plexus, in lateral to medial direction. When the injection displaced the brachial plexus away from the needle, an additional advancement of the needle 1-2 mm deeper was required to accomplish adequate spread of the local anesthetic. When injection of the local anesthetic did not appear to result in a spread in and around the brachial plexus, additional repositioning and injections was required.

4 | BLOCK ASSESSMENT

4.1 | SENSORY

Sensory block was assessed by the pin prick method. Assessment of sensory block was done at each minute after completion of drug injection in the dermatomal areas corresponding to median nerve, radial nerve, ulnar nerve and musculocutaneous nerve till complete sensory blockade was achieved. Sensory onset was considered when there was a dull sensation to pin prick along the distribution of any of the above-mentioned nerves.

Complete sensory block was considered when there was a complete loss of sensation to pin prick.

4.1.1 | SENSORY BLOCK GRADING

- Grade 0: Sharp pin felt
- Grade 1: Analgesia, dull sensation felt
- Grade 2: Anesthesia, no sensation felt.

Grade 1: was be considered as the onset of sensory block

4.2 | MOTOR BLOCK

Assessment of motor block was carried out at each minute till complete motor blockade after drug injection was achieved. Onset of motor blockade was considered when there was Grade 1 motor blockade. Peak motor block was considered when there was Grade 2 motor blockade. Motor block was determined according to a modified Bromage scale for upper extremities on a 3 pointscale. (7)

The block was considered incomplete when any of the segments supplied by median, radial, ulnar and musculocutaneous nerve did not have analgesia even after 30 min of drug injection. These patients were supplemented with intravenous fentanyl (1µg/kg) and midazolam (0.02mg/kg). When more than one nerve remained unaffected, it was considered a failed block. In this case, general anesthesia was given intra-operatively and patient was dropped from our study.

Patients were monitored for hemodynamic variables such as heart rate, blood pressure and oxygen saturation every 30 min after the block intra-operatively and every 60 min post operatively.

Sedation of patient will be assessed by the Ramsay Sedation Score. (8)

**Ramsay Sedation Score**

At the end of the procedure, quality of operative conditions was assessed according to the following
TABLE 1:
Grade 0: Normal motor function with full flexion and extension of elbow, wrist and fingers.

Grade 1: Decreased motor strength with ability to move the fingers only.

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

TABLE 2:
Score 1 Anxious or restless or both.

Score 2 Cooperative, orientated and tranquil.

Score 3 Responding to commands.

Score 4 Brisk response to stimulus.

Score 5 Sluggish response to stimulus.

Score 6 No response to stimulus

TABLE 3:
Grade 4: (Excellent) No complaint from patient

Grade 3: (Good) Minor complaint with no need for the supplemental analgesics

Grade 2: (Moderate) Complaint that required supplemental analgesia

Grade 1: (Unsuccessful) Patient will be given general anesthesia.

classic scale (9)

Assessment of blood loss was done and fluids were administered as per the loss. Duration of surgery was noted. The duration of sensory block was defined as the time interval between the end of local anesthetic administration and the complete resolution of anesthesia on all nerves. 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. Patients were assessed for duration of analgesia as per a numeric rating scale of 0 to 10. The numeric rating scale was recorded post-operatively every 2 hours till the score of 5. The rescue analgesia was given in the form of inj. diclofenac sodium (1.5 mg/kg) intramuscularly at the Numeric Rating Scale of 5 and the time of administration was noted. This gave us duration of post-operative analgesia.

All patients were observed for any side-effects like nausea, vomiting, dryness of mouth and complications like pneumothorax, haematoma, local anesthetic toxicity and post-block neuropathy in the intra- and postoperative periods.

Numeric Rating Pain Scale (10)

Perhaps one of the most commonly used pain scales in health care, the numerical rating scale offers the individual in pain to rate their pain score. It is designed to be used by those over the age of 9.
A Comparative Study of Efficacy of Clonidine and Dexmedetomidine As An Adjuvant to Ropivacaine in Ultrasound Guided Supraclavicular Brachial Plexus Block Vis-À-Vis Onset of Surgical Anaesthesia and Duration of Effect in Upper Limb Surgeries

FIGURE 1: A Pain Assessment Tool for the Person in Pain

numerical scale, the user has the option to verbally rate their scale from 0 to 10 or to place a mark on a line indicating their level of pain. 0 indicates the absence of pain, while 10 represents the most intense pain possible.

5 | STATISTICAL ANALYSIS

Data was entered in Microsoft Excel. Continuous variables were summarized as mean+SD or median and interquartile range, as appropriate. Categorical variables were summarized as percentages. Repeated measures ANOVA was used to compare continuous measurements across time within a group. Differences between a groups were analyzed using one way ANOVA for continuous measurements and a chi-square test for categorical variables. Non-parametric analysis for Likert-type variables was done using a Friedman test for within group differences and a Kurskall Wallace test for between groups. A p value of < 0.05 was considered as significant.

6 | RESULTS

The three groups were comparable with respect to age, sex, weight, height, ASA class and duration of surgery, as p-value was >0.05. No statistical difference (p-value > 0.05) existed among the three groups as regards to demographic profile among the study population. Table 4

Earlier onset of both sensory and motor block in dexmedetomidine group was noted followed by clonidine group followed by placebo group and statistical comparison showed a significant variation among the three groups (p-value <0.05). Table 5. The duration of motor and sensory blockade was also longer in group A as compared to other two groups The statistical comparison showed a highly significant variation between the three groups (p-value<0.001). Table 5

SD standard deviation, * Level of significance.

There was highly significant difference between the three groups in terms of duration of post-operative analgesia (p-value<0.001). Figure 2

FIGURE 2: Shows duration of post operative analgesia

In group A 25 (83.3%) of patients achieved grade-iv of block while 17 (56.7%) in group B achieved grade-iv quality of block and 9 in group C (p-value <0.05). There were a total 5 (16.7%) patients in group-A with grade-III block and 13 (43.3%) patients in group-B with grade-III block while 21(70%) patients in group C. The difference was highly statistically significant in our study. Figure 3

FIGURE 3: Shows quality of block among study groups.

7 | DISCUSSION

Regional anesthesia for upper extremity surgery has many advantages over traditional general anesthesia. Among these advantages are more effective postoperative analgesia, decreased requirements for

SD standard deviation, * Level of significance.
TABLE 4: Comparison of demographic profiles between the study groups

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>33.6±9.08</td>
<td>34.1±8.61</td>
<td>36.1±7.72</td>
<td>0.496</td>
</tr>
<tr>
<td>Sex Male/female</td>
<td>19/11</td>
<td>23/7</td>
<td>22/8</td>
<td>0.495</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>68.2±8.71</td>
<td>69.0±9.25</td>
<td>66.1±9.53</td>
<td>0.465</td>
</tr>
<tr>
<td>Height (cms)</td>
<td>165.8±5.72</td>
<td>167.9±5.36</td>
<td>168.5±5.59</td>
<td>0.164</td>
</tr>
<tr>
<td>ASAI/II</td>
<td>26/4</td>
<td>28/2</td>
<td>27/3</td>
<td>0.690</td>
</tr>
<tr>
<td>Duration of surgery</td>
<td>129.3±28.19</td>
<td>126.8±30.07</td>
<td>128.8±24.50</td>
<td>0.881</td>
</tr>
</tbody>
</table>

TABLE 5: Characteristics of Brachialplexus block between the study groups:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset of Sensory Block (Minutes)</td>
<td>10.4±2.03</td>
<td>13.7±2.12</td>
<td>17.7±1.95</td>
<td>&lt;0.05*</td>
</tr>
<tr>
<td>Onset of Motor Block (Minutes)</td>
<td>16.7±2.07</td>
<td>22.8±2.01</td>
<td>26.2±2.60</td>
<td>&lt;0.05*</td>
</tr>
<tr>
<td>Duration of sensory Block (Minutes)</td>
<td>702.7±58.86</td>
<td>345.9±29.66</td>
<td>236.4±33.90</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Duration of Motor Block (Minutes)</td>
<td>524.1±56.42</td>
<td>329.5±42.42</td>
<td>205.0±42.13</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

systemic opioids, and the potential complications associated with their use, and an ability to avoid instrumenting the airway. If performed by experienced operators it can provide successful surgical anesthesia in a high majority of cases (94.2-94.7%) with a very low complication rate. (11)

Brachial plexus block is one of the most commonly performed peripheral nerve blocks in day today practice. It can be used as the sole anesthetic technique or in combination with general anesthesia for intra-operative and postoperative analgesia. Brachial plexus roots are present between the scalenus anterior and medius muscles, where they combine to form the trunks. It is at this level supraclavicular blocks are performed. Trunks of the brachial plexus carry the entire sensory, motor and sympathetic innervations of the upper extremity in a very small surface area. As a result block is rapid in onset with predictable and dense anesthesia and high success rate. (12)

Heart rate and blood pressure remained stable at all times in most of the patients both intra-operatively and post-operatively in our study. Patients were monitored for hemodynamic variables for 24 hours after the placement of block. The heart rate was variable at each time interval and was lower in dexmedetomidine group, however, the difference was not statistically significant (p-value>0.05). In our study, two patients developed bradycardia (HR<60bpm) in the dexmedetomidine group and one patient in clonidine. It, however, responded to intravenous injection of atropine 0.5mg.

Regarding blood pressure (systolic and diastolic), both the groups were comparable. However it was observed that blood pressure remained on lower side in dexmedetomodine group, but the difference was statistically insignificant. There was one episode of hypotension in dexmedetomidine group.

Our results were similar to the Keshav Govind Rao et al (January-March). (13) They concluded that intra-operative and post-operative vitals did not show any significant variations in both groups i.e. dexmedetomidine as well as clonidine group and remained stable except one case of bradycardia and three cases of hypotension in dexmedetomidine group. All patients were cooperative, oriented and tranquil in both groups at all times of observation intra-operatively.

In our study time to the onset of sensory block was noted in all the three groups. In group A onset of sensory block was 10.4±2.03 minutes, in group B was 13.4±2.12 minutes, group C was 17.7±1.95 and the difference in the onset of sensory block in the three groups was statistically significant (p-value ANOVA <0.001).

Similar observations were found in the studies conducted by Kavitha Jinjal et al (2015). (14) They observed that addition of dexmedetomidine to local anesthetic solution hastened the onset of
sensory block as compared to clonidine, and the difference was statistically significant. The onset of sensory block in the above mentioned study was 13.7±2.12 minutes in clonidine group compared to 10.77±2.03 minutes in dexmedetomidine group. Harshavardhana HS (April 2014) (15) in their study comparing dexmedetomidine and clonidine as an adjuvant to local anaesthesia in supraclavicular block concluded that dexmedetomidine hastened the onset of sensory block as compared to clonidine. In their study, the onset of sensory block in clonidine group was 3.26±1.4 mins and in dexmedetomidine group was 2.59±2.2 minutes. The rapid onset of sensory block in their study was possibly due to higher volume of local anaesthetic solution used (30 ml) as compared to our study (20 ml).

The onset of motor block in our study was 16.7±2.07 mins in Group-A, 22.8±2.01 mins in Group-B and 26.8±2.6 mins in Group-C and the difference was statistically significant (p<0.05).

Similar observations were made by Kavitha Jinjal et al (2015). (14) They observed that addition of dexmedetomidine to local anaesthetic solution hastened the onset of motor block as compared to clonidine, and difference was statistically significant. The onset of motor block in their study was 15.7±1.7 mins in dexmedetomidine group as compared to 22.4±2 mins in clonidine group. Our results were similar to the above study.

Aliye Esmaoglu et al in (2010). (16) In their study added dexmedetomidine to levobupivacaine in axillary plexus block and found that dexmedetomidine shortens the onset of motor block. Onset of motor block in levobupivacaine plus dexmedetomidine group was 9.50±1.04 mins and in levobupivacaine only group was 11.10±1.24mins (p-value<0.05). Our results were similar to the above study.

The duration of sensory block in our study was 702.7±58.86 mins in Group A compared to 345±29.66 mins in Group-B and 236.4±33.90 in Group C (p-value<0.001) and the difference was statistically highly significant. Addition of dexmedetomidine to ropivacaine in supraclavicular brachial plexus block resulted in significant prolongation of sensory block as compared to clonidine in our study.

Our results are similar to the study conducted by Harshavardhan HS (April 2014). (15) In their study duration of sensory block in clonidine group was 212.90±24.8 min and in dexmedetomodine group was 399.5±61.7 min (p-value=0.001) and the difference was statistically highly significant.

The duration of motor blockade in our study was longer in dexmedetomodine group as compared to clonidine and placebo group. The duration of motor block was 524.1±56.42 mins in Group-A, 329.5±42.42 mins in Group-B and 205.0±42.13 mins in Group-C (p-value<0.001) and the difference was statistically highly significant.

Our results were comparable with study conducted by Dr. Jeby Mathew et al (October 2014). (17) They concluded that duration of motor block was prolonged by adding dexmedetomodine to bupivacaine as compared to clonidine with bupivacaine.

25 patients (83.3%) achieved grade-IV block in group A, 17 patients (56.7%) achieved grade-IV block in group B and 9 patients achieved grade-IV block in group C (p-value<0.05). 5 patients (16.7%) in group-A achieved grade-III block, 13 patients (43.3%) in group-B achieved grade-III block and 21 patients (70%) in group C achieved grade III block. The difference was statistically highly significant.

Our results were similar to study conducted by Sarita S Swami et al (2010). (18) They reported significantly better quality of block with dexmedetomodine as compared to clonidine. In their study 40% patients achieved grade-IV block in clonidine group and 80% in dexmedetomodine group.

We used numeric rating pain scale for assessment of post-operative analgesia. The numeric rating scale was recorded post-operatively every 2 hours. The rescue analgesia was given in the form of inj. diclofenac sodium (1.5 mg/kg) intramuscularly at the Numeric Rating Scale of 5 and the time of administration was noted. This gave us the duration of post-operative analgesia.

In our study there was statistically significant difference as regards to duration of analgesia between three groups with a mean of 741.9±62.23 mins in group A, 531.9±40.51 mins in group B
The duration of post-operative analgesia was significantly prolonged in patients who received dexmedetomidine as compared to clonidine group and placebo group.

Keshav Govind Rao et al (January-March 2014) (13) conducted a study to evaluate difference between clonidine and dexmedetomidine as adjuvants to bupivacaine in supraclavicular block, with regards to duration of analgesia. They observed that duration of analgesia was more in dexmedetomidine group as compared to clonidine group after supraclavicular block in their patients. The duration of analgesia in clonidine group was 289.67 ± 60.01 mins and in dexmedetomidine group was 732.40 ± 95.10 mins and the difference was statistically highly significant.

The result in our study was in agreement with Harshavardhan HS (April 2014) (15), who in their study concluded that addition of dexmedetomidine increases the duration of analgesia significantly more than clonidine when added to bupivacaine in brachial plexus block. The duration of analgesia observed in clonidine group was 227.88 ± 24.9 mins compared to 414.32 ± 14.2 mins in dexmedetomidine group and the difference was statistically significant. Similar results were found by Sarita S Swami et al (2012) (18), and Dr. Juby Mathew and et al (October 2014) (17), in their study. Rachana Gandhi and et al (2012) (19) in their study concluded that addition of dexmedetomidine to bupivacaine in supraclavicular brachial plexus block prolongs duration of analgesia. The duration of analgesia observed in control group was 194.8 ± 60.4 mins compared to 732.4 ± 95.1 mins in dexmedetomidine group and the difference was statistically significant.

REFERENCES


How to cite this article: Dubey S., Najeeb R., Sofi A.A. A Comparative Study of Efficacy of Clonidine and Dexmedetomidine As An Adjuvant to Ropivacaine in Ultrasound Guided Supraclavicular Brachial Plexus Block Vis-À-Vis Onset of Surgical Anaesthesia and Duration of Effect in Upper Limb Surgeries. Journal of Medical Biomedical and Applied Sciences. 2020;513–520. https://doi.org/10.15520/jmbas.v8i8.250