

# COMPARISON OF EFFICACY OF DEXMEDETOMIDINE V/S FENTANYL AS AN ADJUVANT TO 0.5%ROPIVACAINE IN ULTRASOUND-GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK IN UPPER LIMB SURGERY: A RANDOMIZED, DOUBLE BLIND INTERVENTIONAL STUDY.

## Anaesthesiology

**Dr. Poonam Kalra** Senior Professor, SMS Medical College, Jaipur.

**Dr. Manish Choudhary\*** Junior Resident, SMS Medical College, Jaipur. \*Corresponding Author

**Dr. Mukesh kumar** Junior Resident, SMS Medical College, Jaipur.

## ABSTRACT

**Background and Objectives:** Supraclavicular brachial plexus block of the upper extremity provides several advantages over general anaesthesia, such as excellent pain control, decreased postoperative opioid administration, reduced side-effects and shortened stay in the post-anaesthesia care unit. Various adjuvants have been added to improve the quality of the block and prolong postoperative analgesia. The aim of this study is to compare the dexmedetomidine and fentanyl as an adjuvant to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block with respect to onset and duration of sensory and motor block and duration of analgesia. **Methods:** A total of 60 patients with ASA grade I/II scheduled for elective upper limb surgeries under supraclavicular brachial plexus block were randomly divided into two groups. Group A received 28 ml of 0.5% ropivacaine + dexmedetomidine 1µg/kg diluted in saline up to 2ml (Total volume = 30ml), and Group B received 28 ml of 0.5% ropivacaine + fentanyl 1µg/kg diluted in saline up to 2ml (Total volume = 30ml) for ultrasound-guided supraclavicular brachial plexus block. **Results:** The mean time of onset of sensory blockade was  $12.57 \pm 2.21$  minutes in group A and  $12.77 \pm 2.18$  minutes in group B. The mean time of onset of motor block for Group A was  $22.10 \pm 2.52$  minutes and for Group B was  $22.33 \pm 2.47$  minutes. There was a highly significant statistical difference in terms of the duration of sensory blockade, i.e.  $792.33 \pm 74.58$  minutes with dexmedetomidine group compared to  $586.83 \pm 85.31$  minutes with fentanyl group ( $p < 0.05$ ). The difference in duration of motor block was highly statistically significant with  $639.83 \pm 58.66$  minutes in Group A compared to  $445.67 \pm 51.44$  minutes in Group B. The mean time of first dose of rescue analgesia (duration of analgesia) in Group A was  $909.17 \pm 70.39$  minutes, while in Group B, it was  $692.50 \pm 73.54$  minutes. This difference was found to be statistically significant ( $p < 0.05$ ). **Conclusion:** Dexmedetomidine prolongs the duration of sensory and motor block and postoperative analgesia as compared to fentanyl when used as an adjuvant to ropivacaine in USG guided supraclavicular brachial plexus block.

## KEYWORDS

Ropivacaine, dexmedetomidine, fentanyl, supraclavicular brachial plexus block

## INTRODUCTION

supraclavicular brachial plexus block provides adequate muscular relaxation, good operative conditions and maintains stable perioperative haemodynamics for upper limb surgeries<sup>1</sup>. Ropivacaine, a long acting amide local anaesthetic agent, has an improved safety profile over bupivacaine with a reduced central nervous system and cardio toxic effects<sup>2,3</sup>. Fentanyl is a potent synthetic opioid analgesic with a strong agonistic action at the mu-opioid receptor, has been extensively studied as an adjuvant to local anaesthetic in peripheral nerve block<sup>4</sup>. Dexmedetomidine is a new highly selective  $\alpha$ -2 adrenoreceptor agonist and its selectivity to  $\alpha$ -2 adrenoreceptor is 8 times greater than clonidine<sup>5</sup>. Adjuvants were added to local anaesthetic solution in brachial plexus block to achieve quick dense and prolonged block with improved quality of anaesthesia<sup>6</sup>. In the present study, brachial plexus blocks were performed under ultrasound (USG) guidance for excellent anatomical images and optimal success rates of the block<sup>7,8</sup>.

## AIM

The aim of the present study was to compare the two adjuvants, dexmedetomidine and fentanyl, in terms of efficacy, duration of postoperative analgesia and any side effects.

## MATERIALS AND METHODS

This was a prospective, randomised clinical trial study. The Institutional Ethics Committee approved the study. Written informed consent was obtained from all of the patients. This study was conducted in the Department of Anaesthesia, SMS medical college and hospital, Jaipur. It included total of 60 patients divided into two groups ( $n=30$ ), of ASA grade I & II of either sex, aged 18-60 years, who underwent elective surgery of upper limb under supraclavicular brachial plexus block. Patients with local pathology at injection site, uncooperative patients, bleeding disorders, coagulopathies, severe neurologic deficit; severe renal, hepatic, respiratory or cardiac diseases; pregnancy and neuromuscular disorders were excluded from the study.

Preoperative assessment included detailed history, general physical examination, systemic examination, airway assessment and routine investigations. ECG and chest X-ray were also performed. All patients written informed consent and a preoperative fasting status of 8 h was

ensured. The block procedure and the Visual Analogue Scale (VAS) score were explained to the patient. Preoperative baseline vital parameters; heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and oxygen saturation of blood (SpO<sub>2</sub>) were recorded using a multipara monitor. An intravenous access was secured with an 18G cannula in the nonoperative upper limb in all the patients and infusion of Ringer's lactate was started as per the standard calculation of perioperative fluid replacement therapy. Patients were randomly divided into two groups of 30 patients by computer generated table. Group A patients received 28 ml of ropivacaine 0.5% with 2ml dexmedetomidine (1µg/kg diluted in saline) and Group B patients received 28 ml of ropivacaine 0.5% with 2ml fentanyl (1µg/kg diluted in saline) for supraclavicular brachial plexus block.

The patient was placed in supine position with a rolled sheet in the interscapular area. The head was turned to the opposite side and the ipsilateral arm placed by the side of the body. After painting the area with chlorhexidine (2%), it was covered with sterile hole towel. After aseptic preparation of the area, ultrasound-guided supraclavicular brachial plexus block was performed on the side to be operated.

After performance of block, patients were evaluated for onset of sensory block every minute till the block was established by pin prick test. The onset of sensory block was defined as the time from injection of local anaesthetic till the disappearance of pain by pinprick method. Motor blockade was checked every minute by asking the patient to move the arm, elbow and fingers. The onset of motor block was defined as the time from the injection of the local anaesthetic solution till motor paralysis equivalent to modified Bromage Score 3 was achieved. Intra operatively, heart rate, non-invasive blood pressure and SpO<sub>2</sub> was checked every 5 minutes for the first half hour and every 15 minutes thereafter. Post operatively, heart rate, non-invasive blood pressure, VAS and modified Bromage Score was checked at 0 min, 30 min, 1hr, 3hr, 6hr, 12hr, 24hr. Time of complete return of sensory blockade was noted. The duration of sensory block was defined as the time interval between the onset of sensory block (Grade 2) and complete resolution of anaesthesia (Grade 0), as determined by pin-prick. Time of complete return of motor blockade was noted. The duration of motor block was defined as the time between the onset of motor block (modified Bromage Score 3) to complete return of motor power (modified

Bromage Score 0). Rescue analgesic (Inj. Diclofenac 75 mg IV) was administered at a VAS score of  $\geq 4$  and the time was noted. The duration of analgesia was defined as the time between the end of local anaesthetic administration and the administration of rescue analgesic. All the patients were observed for any side effects, complications and changes in haemodynamic parameters in the intra and post-operative periods.

### SAMPLE SIZE AND STATISTICAL ANALYSIS

The sample size calculated was 30 patients undergoing upper limb surgeries in each group, with 80% power and 95% confidence, minimum difference intended to detect 193 minutes in the duration of motor block and SD of 32.9 minutes, as per the study conducted by Dharmarao PS et al. So, for the study purpose, total sample size was 60. Statistical analysis was performed with the SPSS (Statistical Package for the Social Science), version 21 for Windows statistical software package (SPSS inc., Chicago, IL, USA). Categorical data, that is, the number of male and female patients in each group, ASA physical status were presented as proportions. These data were compared in two groups and the difference in the proportion was inferred by Pearson's Chi-square test. Demographic data (age, weight), duration of surgery, VAS score, total duration of motor block and analgesia were expressed as mean  $\pm$  standard deviation. These data were compared in two groups and differences in means were inferred by unpaired t-test. For significance  $p < 0.05$  was considered as significant for both types of data.

### RESULTS

The 60 patients included in the study were comparable with respect to demographic variables, such as age, gender distribution, weight and ASA physical status. The mean age of patients in Group A was  $32.63 \pm 11.18$  years and in Group B was  $31.97 \pm 12.01$  years. The mean body weight of patients in Group A was  $62.57 \pm 5.61$  kgs and in Group B was  $62.80 \pm 6.04$  kgs. There was no statistically significant difference among the two groups ( $p > 0.05$ ). The difference in the sex ratio, duration of surgery and ASA physical status of patients in both groups were also statistically not significant. The mean onset time of sensory block in group A and group B was at  $12.57 \pm 2.21$  minutes and  $12.77 \pm 2.18$  minutes respectively while the mean onset time of motor block in group A was at  $22.10 \pm 2.52$  minutes and group B was at  $22.33 \pm 2.47$  minutes. This difference in the time of onset of sensory and motor block between the two groups was found to be statistically not significant ( $p > 0.05$ ). The duration of sensory block was  $792.33 \pm 74.58$  minutes in the dexmedetomidine group and  $586.83 \pm 70.14$  minutes in the fentanyl group. This difference was found to be statistically significant ( $p < 0.05$ ). The duration of motor block was  $639.83 \pm 58.66$  minutes in the dexmedetomidine group and  $445.67 \pm 51.44$  minutes in the fentanyl group. This difference was also found to be statistically significant ( $p < 0.05$ ). Sensory blockade lasted for a longer duration than motor blockade. In the dexmedetomidine group, the duration of analgesia was  $909.17 \pm 70.39$  minutes and in the fentanyl group it was  $692.50 \pm 73.54$  minutes. This difference was found to be statistically significant ( $p < 0.05$ ). Bradycardia was seen intraoperatively in 2 (6.67%) patients in Group A compared to none in Group B. Hypotension occurred in 1 (3.33%) patient of Group A compared to none in Group B which was managed by intravenous fluid. The difference was not statistically significant ( $p > 0.05$ ).

**Table 1: Demographic variables**

| Variable                  | Group A |       | Group B |       | P value |
|---------------------------|---------|-------|---------|-------|---------|
|                           | Mean    | SD    | Mean    | SD    |         |
| Age                       | 32.6    | 11.18 | 31.9    | 12.01 | 1.00    |
| Weight                    | 62.5    | 5.61  | 62.8    | 6.04  | 0.82    |
| Male                      | 23      | 76.6% | 24      | 80%   | 1.00    |
| Female                    | 7       | 23.3% | 6       | 20%   | 1.00    |
| ASA-1                     | 27      | 90%   | 28      | 93.3% | 1.00    |
| ASA-2                     | 3       | 10%   | 2       | 6.67% | 1.00    |
| Duration of surgery (min) | 70.50   | 14.76 | 69.13   | 13.49 | 0.709   |

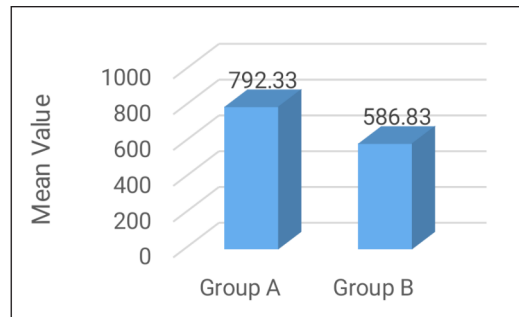
**Table 2: Baseline Clinical Variables**

| Variables    | Group A |       | Group B |      | P value |
|--------------|---------|-------|---------|------|---------|
|              | Mean    | SD    | Mean    | SD   |         |
| Heart Rate   | 82.33   | 10.59 | 82.67   | 9.11 | 0.896   |
| Systolic BP  | 122.40  | 8.78  | 120.93  | 8.55 | 0.328   |
| Diastolic BP | 80.57   | 4.07  | 79.50   | 4.80 | 0.357   |

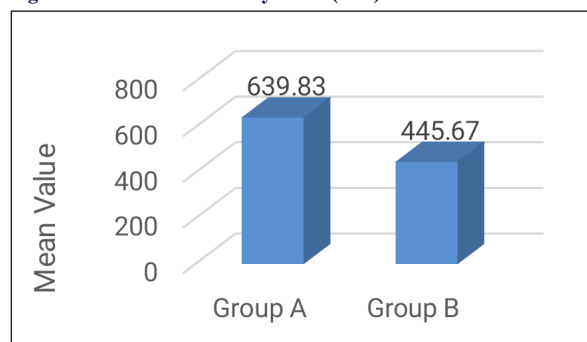
|                  |       |      |       |      |       |
|------------------|-------|------|-------|------|-------|
| MAP              | 94.50 | 5.38 | 93.00 | 5.83 | 0.304 |
| SpO <sub>2</sub> | 99.60 | 0.62 | 99.57 | 0.63 | 0.836 |

**Table 3: Onset and Duration of sensory and motor block (min)**

|                           | Group A |       | Group B |       | P value |
|---------------------------|---------|-------|---------|-------|---------|
|                           | Mean    | SD    | Mean    | SD    |         |
| Onset of sensory block    | 12.57   | 2.21  | 12.77   | 2.18  | 0.725   |
| Onset of motor block      | 22.10   | 2.52  | 22.33   | 2.47  | 0.718   |
| Duration of sensory block | 792.33  | 74.58 | 586.83  | 70.14 | < 0.001 |
| Duration of motor block   | 639.83  | 58.66 | 445.67  | 51.44 | < 0.001 |



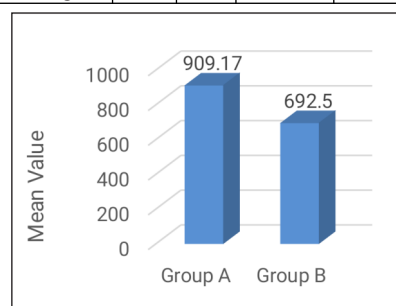
**Figure 1: Duration of Sensory Block (min)**



**Figure 2: Duration of Motor Block (min)**

**Table 4: Time of first dose of rescue analgesia or duration of analgesia (min)**

|                       | Group A |       | Group B |       | P value |
|-----------------------|---------|-------|---------|-------|---------|
|                       | Mean    | SD    | Mean    | SD    |         |
| Duration of analgesia | 909.17  | 70.39 | 692.50  | 73.54 | 0.001   |



**Figure 3: Duration of Analgesia**

### DISCUSSION

In the present study, we studied the intraoperative and postoperative anaesthetic effects of two adjuvants added to ropivacaine in a USG-guided supraclavicular brachial plexus block. Now-a-days, most of the upper limb surgeries are performed under regional anaesthesia. Ultrasound-Guided supraclavicular approach to the brachial plexus block is accurate and safe method used for upper limb surgeries. Side effects like intravascular injection, intraneural injection, pneumothorax, can be avoided with ultrasound-guided regional nerve blocks. Brachial plexus blocks provide postoperative analgesia of short duration, when local anaesthetic agents like bupivacaine or ropivacaine are used alone. To prolong the duration of analgesia of single shot blocks and minimise the use of systemic analgesics, various adjuvants have been added to local anaesthetics.

Ropivacaine<sup>10</sup>, an amide-linked long acting, pure S (–) enantiomer local anaesthetic, is less lipophilic than bupivacaine and hence a decreased potential for cardiotoxicity and central nervous system (CNS) toxicity. It has less penetration of large myelinated nerve fibres due to less lipophilicity, resulting in greater degree of motor sensory differentiation. In the present study, 30 mL of 0.5% ropivacaine was used. It was observed from previous studies that increasing the concentration of ropivacaine from 0.5% to 0.75% fails to improve the onset or duration of the block, and using 0.25% ropivacaine for subclavian perivascular brachial plexus block requires frequent analgesia and supplementation.

Dexmedetomidine<sup>11,12</sup> is a new highly selective  $\alpha$ -2 adrenoreceptor agonist and its selectivity to  $\alpha$ -2 adrenoreceptor is 8 times greater than clonidine. The activation of inwardly rectifying G1 protein-gated potassium channels, resulting in membrane hyperpolarisation and decrease in the excitability of the CNS cells and the reduction of calcium conductance into the cells, inhibiting neurotransmitter release, are the probable mechanisms of action of dexmedetomidine. In the present study, 1  $\mu$ g kg<sup>-1</sup> of dexmedetomidine was used together with 30 mL of 0.5% ropivacaine.

Fentanyl<sup>13</sup> is a potent synthetic opioid analgesic with strong agonistic action at  $\mu$  receptor. Fentanyl, when added to local anaesthesia in peripheral nerve blocks, potentiates the local anaesthesia action via central opioid receptor-mediated analgesia by the peripheral uptake of fentanyl to the systemic circulation. In the present study, 1  $\mu$ g kg<sup>-1</sup> of fentanyl was used together with 30 mL of 0.5% ropivacaine.

The faster onset of action of local anaesthetics, rapid establishment of both sensory and motor blockade, prolonged duration of analgesia and stable cardiovascular parameters makes these agents a very effective adjuvant in regional anaesthesia. The onset of sensory and motor blockade was similar in both the study groups, but the duration of postoperative analgesia was significantly prolonged with dexmedetomidine as adjuvant compared to fentanyl.

Marhofer et al<sup>14</sup> studied that addition of dexmedetomidine as adjuvant to ropivacaine in a USG-guided ulnar nerve block showed that the time for the onset of motor block is decreased without effect on time to the onset of sensory block. The duration of both sensory and motor block was prolonged. Soma C et al<sup>15</sup> studied 90 patients to evaluate the anaesthetic quality and length of analgesia with the addition of either fentanyl or dexmedetomidine to ropivacaine for supraclavicular brachial plexus block. It was found that the onset of the block is earlier, and the duration of action is prolonged in dexmedetomidine than fentanyl without increasing incidence of unwanted side effect. Dharmarao PS et al<sup>16</sup> studied 80 patients posted for elective elbow, forearm and hand surgeries to compared the onset and duration of sensory and motor blockade with the quality of perioperative analgesia and postoperative complications provided by dexmedetomidine and fentanyl as adjuvants to ropivacaine under ultrasound-guided supraclavicular brachial plexus block. It was found that the duration of sensory and motor block, and duration of analgesia is prolonged in dexmedetomidine group than fentanyl group. In the studies conducted by Indra G et al<sup>17</sup> and Hamed et al<sup>18</sup> it was observed that the duration of analgesia was significantly prolonged with dexmedetomidine as compared to fentanyl when administered as an adjuvant to local anaesthetics.

In our study, 2 patients out of 30 in dexmedetomidine group had bradycardia which was managed by awakening the patient, no drug therapy was required. 1 patient out of 30 in dexmedetomidine group had hypotension that was managed by intravenous fluid and no drug therapy was required. The difference was not statistically significant and clinically did not required any intervention. The remaining patients in both the groups had an uneventful course without any major complication.

The limitations of our study were the patients in the paediatric and geriatric age groups and patients with comorbid conditions were not included in this study.

## CONCLUSION

Dexmedetomidine prolongs the duration of sensory and motor block and postoperative analgesia as compared to fentanyl when used as an adjuvant to ropivacaine in ultrasound-guided supraclavicular brachial plexus block and is not associated with any major adverse events.

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