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A COMPARATIVE STUDY BETWEEN DEXMEDETOMIDINE VERSUS DEXAMETHASONE AS ADJUVANT TO 0.5% ROPIVACAINE IN ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

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ABSTRACT **Introduction:** Brachial plexus block has evolved into a highly effective substitute for general anaesthesia in upper limb surgeries. This approach minimizes the body's stress response reduction in need for multiple anaesthetic medications. Dexmedetomidine, an alpha-adrenergic agonist when given along with local anaesthetic in nerve block, facilitates better anaesthesia and analgesia. It has analgesic, sedative and good cardiovascular stabilizing properties. Present study compares efficacy and safety of combination of ropivacaine with dexmedetomidine and ropivacaine with dexamethasone in USG guided supraclavicular brachial plexus block. **Material And Methods:** Prospective, randomized, double-blinded clinical study was conducted for 2 years in the tertiary care hospital. In present study, study group received 20 mL Ropivacaine (0.5%) + Dexmedetomidine (1 mcg/kg) diluted to a total of 1mL. Comparison group have received 20 mL Ropivacaine (0.5%) + Dexamethasone (4 mg). Outcome was compared. **Results And Observation:** Study group had a faster onset of motor block (13.81±1.99 min) when compared to comparison group (16.32± 1.80 min). The mean duration of sensory block was prolonged in study group (825.2±68 min) than comparison group (630.96±83.81 min). The mean ttime duration of motor block was prolonged in study group (766.5± 99.9min) when compared to comparison group (590.96± 78.2min). These results were statistically significant. **Conclusion:** Present study concludes that using 1mcg/kg Dexmedetomidine as an adjuvant is superior to 4mg Dexamethasone in enhancing the onset and duration of sensory and motor blocks, as well as the analgesic profile of 20ml 0.5% Ropivacaine in Ultrasound Guided Supraclavicular Brachial Plexus Blocks. The dexmedetomidine group exhibited quicker onset of sensory and motor block, as well as prolonged durations of sensory block, motor block, and analgesia.

KEYWORDS : Brachial plexus block, Dexmedetomidine, Dexamethasone, Ropivacaine

INTRODUCTION:

Upper limb surgeries often require efficient anaesthesia to ensure both effective pain management and patient safety. One promising approach to achieving these goals is the use of brachial plexus block. This approach minimizes the body's stress response along with reduction in the need for multiple anaesthetic medications. It provides intraoperative pain relief and extends its benefits to postoperative pain management. This achievement is done by administering a local anaesthetic in combination with adjuvant, facilitating both sensory and motor blockade. The supraclavicular nerve block presents a viable option in place of general anaesthesia for upper limb surgery. This approach eliminates the complexities associated with general anaesthetic drugs and the potential complications of upper airway intubation. It provides thorough muscle relaxation, maintains stable intraoperative hemodynamic, and betters postoperative pain relief [1].

Real-time ultrasonographic visualization of peripheral nerves, needle placement, and local anaesthetic spread has significantly improvised analgesic benefits of regional anaesthesia [2]. The amount of local anaesthetic required for effective nerve block can be minimized by directly monitoring its distribution. Ropivacaine is considered superior to Bupivacaine, as it provides more differential blockade and is safer to cardiovascular and central nervous systems. The decreased systemic toxicity is better when there are potential chances to use higher concentration of local anaesthetics in peripheral nerve blocks.

Furthermore, addition of adjuvant including dexmedetomidine, dexamethasone, clonidine, buprenorphine, magnesium and midazolam to local anaesthesia are known to provide added benefits to regional anaesthesia [3]. Of these, Dexamethasone and Dexmedetomidine are two widely used adjuvant to local anaesthetics, which can effectively prolong duration of postop analgesia and influence the sensory and motor blockade. Both dexamethasone and dexmedetomidine have the ability to diminish local inflammation and extend the duration of nerve block by inducing vasoconstriction, thereby preserving the local anaesthetic's concentration at the site. Different researches have shown that on adding these additives, anaesthetic and analgesic requirement are reduced substantially along with maintenance of hemodynamic stability. Steroids have good anti-inflammatory and analgesic properties. When steroid like Dexamethasone is used as an adjuvant to local anaesthetic in peripheral nerve block, this can influence the postop analgesia. Dexamethasone microspheres was found to prolong block duration in human studies [4]. Dexmedetomidine, an alpha-adrenergic agonist when given along with local anaesthetic in nerve block, facilitates better anaesthesia and analgesia. It has analgesic, sedative and good cardiovascular stabilizing properties

This study aims to compare the effectiveness of dexmedetomidine versus dexamethasone as adjuvants to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus blocks. By evaluating key outcomes such as the onset and duration of sensory and motor blockade, postoperative analgesia, and the incidence of side effects, this research seeks to determine which adjuvant provides superior results in terms of analgesic efficacy and safety. The findings from this study could guide clinical practice in optimizing anaesthesia protocols for upper limb surgeries, ultimately improving patient outcomes and minimizing the need for systemic analgesics.

OBJECTIVES:

To compare efficacy and safety of combination of ropivacaine with dexmedetomidine and ropivacaine with dexamethasone in USG guided supraclavicular brachial plexus block.

MATERIALS AND METHODS:

The prospective, randomized, double-blinded clinical study was conducted in Department of Anaesthesia, MGM Medical College Hospital, which is a tertiary care hospital, in Chh. Sambhajinagar. Study was registered to clinical trial registry of India with CTRI number: CTRI/2021/11/038117. Study Period was 2 years from date of approval from regulatory authority. Sample Size was calculated as per WHO guide written by Lwanga SK, Lameshow S. titled Sample size determination in health studies. For the present study, the required sample size for each group was minimum 31 patients, and therefore, a total of 66 patients were included in the study.

Inclusion criteria were patients of ASA physical grade I–II; patients aged between 20–65 years of both sexes; patients weighing between

45–70 kg; patients scheduled for elective or emergency upper limb surgeries involving the arm, forearm, or hand; and patients who provided written informed consent to participate in the study. Exclusion Criteria consists of history of infection at the site of the block; history of coagulopathies; known hypersensitivity to local anaesthetics or any study drug; presence of 1st, 2nd, or 3rd-degree heart block; pregnant women; and patients with pre-existing peripheral neuropathy.

The data was collected using a pretested semi-structured questionnaire and was cleaned, coded and entered in MS Office 365 Excel.

METHODOLOGY:

Patients scheduled for upper limb surgeries were selected and randomized into two groups using the sealed envelope method. Study group (Group RD) received 20 mL of 0.5% ropivacaine with 1 mcg/kg of dexmedetomidine, while Comparison Group (Group RX) received 20 mL of 0.5% ropivacaine with 4 mg of dexamethasone. The allocation sequence was generated using random number tables. Written informed consent was obtained from all patients. At the pre-anaesthetic checkup, patients were educated about the Visual Analogue Scale (VAS) for pain assessment. Patients were kept Nil by Mouth (NBM) for 6 hours prior to the procedure. Monitoring included pulse, oxygen saturation (O2), and mean arterial pressure (MAP). Oxygen supplementation was administered via a Venti mask, and IV access was established.

The supraclavicular block was performed under aseptic precautions using a SONOSITE ultrasound machine with a high-frequency 6-13 Hz linear probe. Patients were positioned supine with their head turned 45 degrees contralaterally. The ultrasound transducer was placed in the supraclavicular fossa in a coronal oblique plane to visualize the brachial plexus in a transverse section. A 25G needle was used to inject 2 mL of local anaesthetic (lignocaine) as a skin wheal, followed by needle insertion in an in-plane technique from lateral to medial towards the brachial plexus.

- **Group RD**: 20 mL of 0.5% ropivacaine with 1 mcg/kg dexmedetomidine was administered.
- **Group RX**: 20 mL of 0.5% ropivacaine with 4 mg dexamethasone was administered.

The onset of sensory and motor blockade was assessed every 5 minutes until complete sensory and motor block was achieved or for 20 minutes, whichever came earlier. Sensory block was assessed using the cold swab method, and motor block was assessed using the Bromage scale. Sensory block assessment was done using a 3-point cold test scale, where-
0: No sensory block (cold sensation felt)
1: Analgesia (unable to feel cold, but can feel touch)
2: Anaesthesia (no sensation of touch or cold)
Motor block assessment was done using the Bromage scale, where-
0: No motor blockade (normal motor function)
1: Paresis (reduced motor strength)
2: Paralysis (complete loss of motor strength)

Any failure to achieve a complete block led to conversion to general anaesthesia, and the patient was excluded from the study. Intraoperative vital signs (pulse rate, O2 saturation, and MAP) were recorded every 10 minutes during the surgery, and postoperatively every 2 hours for 24 hours.

Postoperatively, sensory and motor block regression were assessed every 2 hours for the first 10 hours and then every 4 hours for the next 14 hours postoperatively. The duration was defined as the time from the end of local anaesthesia administration to the complete resolution of sensory block (anaesthetic sensory block score 0) in all nerve territories. The duration was defined as the time from the end of local anaesthetic administration to the return of complete motor function (anaesthetic motor block score 0) of the hand and forearm.

Postoperative pain was assessed using the 10-point VAS at regular intervals; every 30 minutes for the first 2 hours, then every 4 hours for the next 24 hours If the VAS score was > 4, tramadol (1 mg/kg) was administered slowly via IV, with ondansetron (4 mg) given to prevent nausea. If pain persisted after 30 minutes, an additional dose of tramadol (50 mg) was given. If pain remained uncontrolled, paracetamol (20 mg/kg, maximum 4 g over 24 hours) was administered IV. The time from local anaesthetic administration to the first rescue analgesic dose was recorded as the duration of analgesia.

Statistical Analysis:

Data were analysed using IBM-SPSS software version 25. Age, weight, onset, duration of sensory and motor block and duration of surgery were studied using an independent student t test. Intraoperative and postoperative hemodynamic data were assessed using repeated measure Analysis of variance (ANOVA) followed by an independent student t-test. The sex ratio, ASA grade, and quality of anaesthesia were compared using the Chi-square test. Nonparametric data like VAS were presented as median and interquartile range (IQR). Pain score was assessed using the Mann-Whitney U-test for pairwise comparison. All tests were checked for 95% confidence intervals. Appropriate graphical representation was done.

OBSERVATIONS AND RESULTS:

Considering demographic profile, both the groups were statistically comparable in relation to age distribution (p= 0.888).

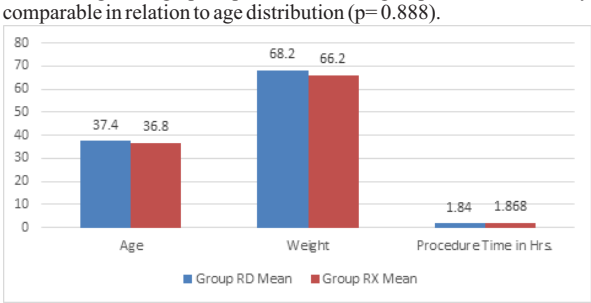

Fig 1: Demographic Profile

While doing procedure, both the groups were statistically comparable in relation to procedure time taken for surgery (p= 0.914). Group RD (9.94±1.73 min) had a faster onset of sensory block when compared to group RX (12.39± 2.25 min).

Group RD (13.81±1.99 min) had a faster onset of motor block when compared to group RX (16.32± 1.80min) (P <0.0001). The mean duration of sensory block was prolonged in Group RD (825.2±68 min) than Group RX (630.96±83.81 min) (P < 0.0001).

The mean duration of motor block was prolonged in group RD (766.5± 99.9min) when compared to group RX (590.96± 78.2min) (p<0.0001). The duration of analgesia was more prolonged in group RD (1097.7±90.1 min) when compared to group RX (725.8±84.6 min) (p <0.0001).

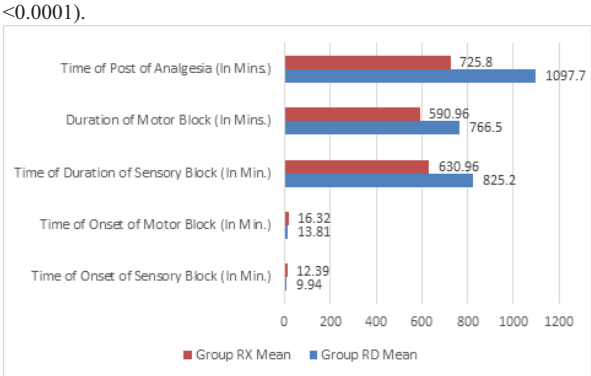

Fig 2: Comparison of Time of Onset of Sensory Block (In Min.)

There was statistically significant difference in median sensory block at 0 minute, 5 minutes, 640 minutes, 1120 minutes between the two groups (p < 0.05).

There was statistically significant difference in motor block at 10 minutes, 15-minute, 160 minute, 400 minutes, 640 minute, 880 minutes between the two groups (p < 0.05) (Table 1).

There was no statistically significant difference in the heart rate between the two groups at various time intervals (p > 0.05).

There was no statistically significant difference in the mean arterial pulse between the two groups at various time intervals (p > 0.05) (Table 2)

Table 1: Comparison Of Median Sensory Block And Motor Block At Different Time Interval At Different Time Interval

	Sensory Block			Motor Block		
	Group RD [N=31] Median (IQR)	Group RX [N=31] Median (IQR)	p-value	Group RD [N=31] Median (IQR)	Group RX [N=31] Median (IQR)	p-value
0 min	00 (00-00)	00 (00-00)	0.00001	P0 (00-00)	00(00-00)	1.000
5 min	00 (01-1.5)	00 (00-00)	0.00001	00 (00-01)	00(00-00)	0.141
10 min	01 (02-1.5)	00(01-01)	1.000	01 (02-02)	01(01-02)	0.043
15 min	02(02-02)	01(02-02)	1.000	03 (03-03)	02(02-03)	0.00001
20 min	02(02-02)	02(02-02)	1.000	03 (03-03)	03 (03-03)	1.000
40 min	02(02-02)	02(02-02)	1.000	03 (03-03)	03 (03-03)	1.000
60 min	02(02-02)	02(02-02)	1.000	03 (03-03)	03 (03-03)	1.000
80 min	02(02-02)	02(02-02)	1.000	03 (03-03)	03 (03-03)	1.000
100 min	02(02-02)	02(02-02)	1.000	03 (03-03)	03 (03-03)	1.000
120 min	02(02-02)	02(02-02)	1.000	03 (03-03)	03 (03-03)	1.000
140 min	02(02-02)	02(02-02)	1.000	03 (03-03)	03 (03-03)	1.000
160min	02(02-02)	02(02-02)	1.000	03 (03-03)	02(03-03)	0.001
400 min	02(02-02)	02(02-02)	1.000	02(03-03)	01(02-02)	0.00001
640 min	02(02-02)	01(01-02)	0.00001	01(02-02)	00(01-01)	0.00001
880 min	01(01-01)	00(00-01)	0.00001	00(01-01)	00(00-00)	0.00001
1120min	00(00-00)	00(00-00)	0.317	00(00-00)	00(00-00)	0.317
1360min	00(00-00)	00(00-00)	1.000	00(00-00)	00(00-00)	1.000
1600min	00(00-00)	00(00-00)	1.000	00(00-00)	00(00-00)	1.000

Table 2: Comparison Of Mean Heart Rates Per Minute Mean Arterial Pressure (MAP) At Different Time Interval

	Heart Rates per minute			Mean Arterial Pressure (MAP)		
	Group RD [N=31]	Group RX [N=31]	p-value	Group RD [N=31]	Group RX [N=31]	p-value
0 min	91.94±8.23	88.0±8.08	0.115	90.84±7.85	90.06±7.72	0.697
5 min	92.16±7.49	89.19±8.08	0.139	91.03±8.03	88.84±7.43	0.269
10 min	87.52±8.68	87.77±8.34	0.905	89.71±7.26	87.81±5.57	0.252
15 min	84.45±7.65	83.45±9.11	0.641	89.13±6.32	86.10±6.25	0.062
20 min	78.23±8.43	81.35±7.99	0.139	83.94±4.84	82.19±5.04	0.170
40 min	75.32±7.88	78.74±5.57	0.102	79.61±3.62	77.94±3.44	0.067
60 min	72.35±6.91	74.26±6.64	0.065	75.77±3.72	75.55±3.16	0.798
80 min	70.16±9.81	72.16±6,03	0.065	74.52±3.57	73.77±3.21	0.393
100 min	69.06±8.09	71.10±5.67	0.252	75.87±3.86	75.26±3.55	0.518
120 min	69.81±9.21	72.32±6.61	0.222	74.65±4.01	75.87±3.32	0.191
140 min	70.16±9.81	74.10±4.59	0.050	75.48±4.60	76.87±3.67	0.194
160min	75.77±3.72	75.55±3.16	0.506	78.32±4.59	80.06±4.96	0.157
400 min	74.52±3.57	73.77±3.21	0.401	79.58±4.32	81.71±5.29	0.085
640 min	78.74±8.65	77.42±5.83	0.483	82.32±5.04	83.48±4.28	0.332
880 min	81.16±8.29	81.16±5.53	1.00	85.65±5.43	84.42±4.21	0.325
1120 min	83.90±8.42	83.29±5.75	0.739	86.77±6.07	85.39±4.01	0.293
1360 min	88.06±6.86	86.65±5.18	0.362	91.19±5.71	89.06±3.02	0.073
1600 min	89.00±6.42	86.00±7.22	0.089	95.87±5.72	93.77±4.54	0.099

DISCUSSION:

Brachial plexus blockade provides an excellent alternative technique to general anaesthesia for upper limb surgical procedures. It not only offers excellent intraoperative pain relief but also good post-operative analgesia. Supraclavicular technique was chosen for this study because it provides a rapid onset, dense and predictable anaesthesia with high success rate.

In our study, ultrasound guidance was employed as the technique for performing supraclavicular brachial plexus blocks. This technique allows the direct visualisation of nerves and anatomical structures. Avoidance of complication and reduce the dose of local anaesthetic agents.

Several studies have demonstrated that Dexmedetomidine significantly increases the duration of brachial plexus blocks compared to local anaesthetics alone, suggesting its potent analgesic and sedative properties (5,6). In contrast, Dexamethasone, a corticosteroid, reduces inflammation and oedema at the injection site, which can also prolong the block, but to a lesser extent than Dexmedetomidine (7). This result aligns with findings from Mert et al., who reported that Dexmedetomidine provides a more significant prolongation of block duration compared to Dexamethasone (8).

In our study, the onset of sensory blockade in Group RD-Ropivacaine with Dexmedetomidine was 9.94±1.73 minutes and the sensory onset in Group RX- Ropivacaine with Dexamethasone was 12.39±2.25 minutes. The difference in the onset time between the two groups was statistically significant (P=0.000), Group RD showing a faster onset of sensory block when compared to group RX. Mokkarala et al.[9] The study found that the mean onset time of sensory block was 12.11±3.41 minutes for Group DS and 10.14±2.98 minutes for Group DM. Parineeta Thapa et al. [10] The median onset of sensory block was 9 minutes for Group A, 12 minutes for Group B, and 9 minutes for Group C.

In this present study the onset of motor block in group RD-Ropivacaine with Dexmedetomidine was 13.81±1.99 minutes and Group RX-Ropivacaine with Dexamethasone was 16.32±1.80 minutes which was statistically significant (p– value 0.004). Mokkarala et al. [5] The study demonstrated that the mean time of motor block was 17.24±3.87 minutes for 15 ml of 0.5% ropivacaine with 8 mg of dexamethasone and 13.55±4.02 minutes for 15 ml of 0.5% ropivacaine with 100 mcg/ml of dexmedetomidine.

In our study the duration of sensory block in group RD-Ropivacaine with Dexmedetomidine was 825.2±68 minutes while in group RX-Ropivacaine with Dexamethasone was 630.96±83.81 minutes. The shorter sensory duration in both the groups of our study compared to former study can be due to larger volume of local anaesthetic (30ml Ropivacaine) used and increased dose of dexamethasone (8mg) used by the researcher in their study. In the study conducted by Parineeta Thapa et al. [10], comparing the effects of dexamethasone and dexmedetomidine as adjuvant to ropivacaine for supraclavicular brachial plexus block. The duration of sensory block was found to be 465min for normal saline with 20 ml 0.5% ropivacaine, 510min for 4 mg dexamethasone with 20 ml 0.5% ropivacaine, and 457 min for received 50 mcg dexmedetomidine with 20 ml 0.5% ropivacaine, showing no significant difference (p=0.73).

The duration of motor block in group RD-Ropivacaine with Dexmedetomidine was 766.5±99.9 minutes and in group RX-Ropivacaine with Dexamethasone was 590.96±78.2 minutes which

was statistically highly significant (p value 0.000). Group Ropivacaine with Dexmedetomidine showing a longer duration of motor block when compared to group Ropivacaine with Dexamethasone. Simillarly Mokkarala et al. [9] found the mean duration of motor block was 702.52±32.14 minutes for Group DS and 844.23±35.84 minutes for Group DM. these differences were statistically significant. Parineeta Thapa et al [10] The duration of motor block was 540mins for Group B (4 mg dexamethasone), and 472.2 mins for Group C (50 mcg dexmedetomidine) (p=0.83).

In present study the duration of analgesia in group RD-Ropivacaine with Dexmedetomidine was 1097.7±90.1 minutes while in Group RX-Ropivacaine with Dexamethasone was 725.8±84.6 minutes which was statistically significant. Group RD showing prolonged duration of analgesia when compared to group RX. Simillar findings were found by Mokkarala et al. [9] study the mean duration of analgesia was significantly longer in the dexmedetomidine group compared to the dexamethasone group, with durations of 1142.47±28.32 minutes and 1045.95±78.55 minutes, respectively. Nidhi Singh et al [3] found that the duration of analgesia was extended in dexmedetomidine and dexamethasone in addition to ropivacaine, (1218.0 ± 224.6 and 1128.0 ± 207.5 minutes, respectively) compared to only ropivacaine (768.0 ± 273.7 minutes; $P < 0.001$).

CONCLUSION:

In upper extremity surgeries without shoulder involvement, ultrasound-guided supraclavicular blocks are the preferred and reliable choice, known for their safety and rapid onset of anaesthesia. Our study concludes that using 1mcg/kg Dexmedetomidine as an adjuvant is superior to 4mg Dexamethasone in enhancing the onset and duration of sensory and motor blocks, as well as the analgesic profile of 20ml 0.5% Ropivacaine in Ultrasound Guided Supraclavicular Brachial Plexus Blocks. The dexmedetomidine group exhibited quicker onset of sensory and motor block, as well as prolonged durations of sensory block, motor block, and analgesia. Hemodynamic parameters and 24-hour analgesia consumption were similar in both groups.

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