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Original Research Article

A comparative study between 0.5% Ropivacaine with clonidine versus 0.5% Ropivacaine with dexmedetomidine in ultra sound guided supraclavicular brachial plexus block

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ABSTRACT

Background: Adjuvants in blockade of the brachial plexus can lengthen patient care and hasten the ambulation with stable hemodynamics. Brachial plexus block has possible complications like local anaesthetic systemic toxicity, pneumothorax, nerve injury etc. which can be overcome by use of ultrasound guidance with adjuvants like dexmedetomidine and clonidine for postoperative analgesia. Ropivacaine has higher motor to sensory differentiation and lesser cardiotoxicity.

Setting and Design: A prospective blinded study comprising of 90 subjects posted for elective upper extremity surgeries.

Aim: To compare the onset, duration of sensory and motor blockade and analgesia of 0.5% ropivacaine with clonidine 1mg.kg-[1] and 0.5% ropivacaine with dexmedetomidine 1mg.kg-[1].

Materials and Methods: Ninety patients aged 18 – 60yrs were chosen and randomly allocated into two groups of 45 participants. 20mL of 0.5% Ropivacaine and dexmedetomidine 1mg.kg-[1] was administered to Group A and Group B received Ropivacaine and clonidine 1mg.kg-[1].

Results: In Group A, 73.3% of the subjects showed onset of sensory block of 8 minutes while it was 10 minutes in 26.7% of the subjects. In Group B, 44.4% of the patients showed onset of sensory block of 8 minutes, and 26.7% of the patients showed onset of sensory block of 10 min. Statistically, subjects in Group A showed decrease in onset of block and a higher mean duration of sensory and motor block in contrast to Group B.

Conclusion: Addition of dexmedetomidine to 0.5% ropivacaine in supraclavicular brachial plexus block decreased the time of onset of sensory and motor block and extended the period of analgesia.

1. Introduction

Use of ultrasound guided anaesthesia blocks has been found to be safer and more effective compared to paraesthesia and nerve stimulation techniques.[1,2] Local anaesthetic Ropivacaine has greater degree of motor to sensory differentiation, which may further help in early ambulation.[3,4] Furthermore with the use of adjuvantscan extend the period of analgesia. Currently use of ultrasound in blockade of brachial plexus has been well received, which reduces volume and dose of local anaesthetic requirement and avoids complications related to needle placements.[5–13] This study is intended to compare the efficacy between dexmedetomidine and clonidine with 0.5% ropivacaine following supraclavicular brachial plexus block for upper limb surgeries with the help of ultrasound. The primary objective of the study was to check the onset of sensory and motor blockade, duration and quality of sensory and motor blockade. The secondary objective was to assess the

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hemodynamic variables, any side effects related to the drug used and the technique employed.

2. Materials and Methods

After the approval of the institutional ethical committee, the study was implemented as a prospective double – blinded one. Informed written consent was obtained from 90 subjects between the ages of 18 – 60 years of American Society of Anaesthesiologist's Physical Status Classification I and II. The study participants were allocated randomly. Group A was administered 20 mL of 0.5% ropivacaine with dexmedetomidine 1 mg.kg-[1]. Group B was given 20 mL of 0.5% ropivacaine with clonidine 1 mg.kg-[1]. The subjects aged 18 – 60yrs with ASA Physical Status 1 and 2, planned for elective surgeries of lower arm, and at the level of elbow, forearm, and hand were selected for the study. Subjects of ASA Physical Status 3 and 4, neurological deficits, bleeding disorder, infection at the site of injection were excluded from study. Preanaesthetic evaluation was carried out in all patients. Subjects were positioned in supine. Head was turned to contralateral side, under asepsis, brachial plexus block was performed with the aid of ultrasound. Sensory blockade was assessed with pinprick test using 3 – point scale, 0 – Normal sensation, 1 – Loss of sensation of pinprick (analgesia) 2 – loss of sensation of touch (anaesthesia) and motor block evaluated every 2 minutes until 30 minutes after injection using Modified Bromage Scale.[14] Grade 0 – No block, total arm and forearm flexion, Grade I – Partial block, total forearm and partial arm flexion, Grade II – Almost complete block, inability to flex the arm and decreased ability to flex the forearm, Grade III – Total block, inability to flex both the arm and forearm.

Onset of sensory block was defined as interval between Ropivacaine administration and complete sensory block. Duration of sensory block was defined interval between Ropivacaine administration and complete resolution of anaesthesia. Onset of motor block defined as the interval between the end of Ropivacaine administration and complete motor block. Duration of motor block was defined as interval between Ropivacaine administration and complete resolution of motor block. Inability to move arm and forearm was defined as complete motor bock. Hemodynamic variables were recorded every 5 minutes till completion of the procedure. Adverse effects were corrected with appropriate measures.

Statistical analysis: Simple randomization was implemented. The study period was approximately 6 months.

Randomization was done by using a computer-generated random number table. A sample size of 90 was arrived at using the formula mentioned below. Sample size was decided in consultation with a statistician. After observing results of similar studies (Swami and colleagues), it was considered that a clinically significant benefit of using dexmedetomidine would be a prolongation in sensory block duration by 40% compared with the clonidine group. Based on this, we calculated a sample size that would permit a type I error of α=0.05 and power of 80%. Enrollment of 45 patients in each group was required.[15]

The formula employed to arrive at the sample size:

Sample size=$\frac{Z^{2*}(p)*(1-p)}{c^2}$

Where:

Z = Z value

p = percentage picking a choice,

c = confidence interval

The data was formulated using MS Excel and interpreted using SPSS 22 software. Results were expressed as mean, median, mode, standard deviation and proportions. Since the data doesn't follow normality, the non-parametric tests are applied. The Wilcoxon – Mann – Whitney U test was employed to determine whether there was a statistical difference among the groups. Friedman test was applied to find the difference within the group. P value of < 0.05 was contemplated to be significant.

Post – operative pain was noted using Visual Analogue Scale. 0 – Patients does not complain of pain, 1 – 3: Patient complaining of mild pain, 4 – 6: Patients complaining of moderate pain, 7 – 8: Patient complaining of severe pain, 9 – 10: Patient complaining of excruciating pain. Rescue analgesia of diclofenac sodium 75mg intramuscularly was administered when patient visual analogue score is >4.

3. Results

The study groups were comparable with respect to age, gender, weight, duration of surgery (Table 1). Sensory onset of block in Group A: None (0%) of the patients belonged to the onset sensory of 6 minutes, the majority of the patients 33 (73.3%) belongs to 8 minutes of onset sensory, 12 (26.7%) patients between 10 minutes. Group B: 20 (44.4%) of the patients belonged to the onset sensory of 8 minutes of onset sensory, 12 (26.7%) patients between 10 minutes. The Mean and Standard deviation of sensory onset in Group A: 8.53 ± 0.89 with mean rank 56.33, and Group B: 7.33 ± 1.35, with mean rank of 34.67. Comparing of both groups using Mann – Whitney – U test statistic = 525.0, p value 0.000, since p <0.05, it indicates there is a significant difference in sensory onset between the groups (Table 2).

Table 1: Data in mean standard deviation

Demographics	A(n=45)	B(n=45)	P value
Age	46.4±4.42	43±4.85	0.487
Gender M/F	24/21	23/22	0.675
ASA I/II	25/20	26/19	0.344
Weight (mean)	68.12	65.45	0.652
Duration of surgery in min	106±7	113±10	0.432

Table 2: Onset of sensory block

Onset sensory	Mean	Median	Mode	SD	Min	Max	Mean Rank	Sum of Ranks	Mann-Whitney U	P value
Group A	8.53	8.0	8.0	0.89	8	10	56.33	2535.0	525.0	0.000
Group B	7.33	8.0	6.0	1.35	6	10	34.67	1560.0		

Table 3: Onset of motor block

Onset motor	Mean	Median	Mode	SD	Min	Max	Mean Rank	Sum of Ranks	Mann-Whitney U	P value
Group A	13.22	12.0	12.0	1.31	12	15	61.50	2767.5	292.5	0.000
Group B	10.93	10.0	10.0	1.45	8	14	29.50	1327.5		

The Mean and Standard deviation of onset of motor block in Group A: 13.22 ± 1.31 with mean rank 61.50, and Group B: 10.93 ± 1.45, with mean rank 29.50. Comparing of both groups using Mann – Whitney – U test statistic = 292.5, p value 0.000, since p <0.05 there is a significant difference in motor onset among the groups (Table 3).

The Mean and Standard deviation of sensory duration in Group A: 394.7 ± 61.6 with mean rank 23.0, and Group B631.3 ± 47.3, with mean rank 68.0. Comparing of both groups using Mann – Whitney – U test statistic = 1.000, p value 0.000, since p<0.05 there is a significant difference in sensory blockade (Table 4).

Table 4: Duration of sensory block

Sensory Duration	Mean	SD	P value
Group A	394.7	61.6	0.0000
Group B	631.3	47.3	

The Mean and Standard deviation of motor duration in Group A: 548.7 ± 37.6 with mean rank 27.2, and Group B 606.4 ± 33.0, with mean rank 63.8. Comparing of both groups using Mann – Whitney – U test = 191.0, p value 0.000, since p <0.05 there is a significant difference in motor duration (Table 5).

Table 5: Duration of motor block

Motor Duration	Mean	SD	P value
Group A	548.7	37.6	0.0000
Group B	606.4	33.0	

The Mean and Standard deviation of analgesia duration in Group A: 413.8 ± 61.8 with mean rank 23.0, and Group B 1054.9 ± 96.6, with mean rank 68.0. Comparing of both groups using Mann – Whitney – U test statistic = 0.000, p value 0.000, since p <0.05 there is a significant difference in analgesia duration (Table 6).

Table 6: Duration of analgesia

Analgesia	Mean	SD	P value
Group A	413.8	61.8	0.0000
Group B	1054.9	96.6	

4. Discussion

In our study, the demographic data as regards to age, weight, height, sex, ASA physical status and duration of surgery were compared and the differences between the parameters between two groups were statistically not significant. This prospective study was done to evaluate the onset of sensory block, onset of motor blockade, duration of sensory and motor blockade, duration of analgesia and time for rescue analgesia and side effects of dexmedetomidine with ropivacaine vs clonidine with ropivacaine given by ultrasound guided brachial plexus block approach for elective upper limb forearm and hand surgeries. Ultrasound helped to visualize the nerves, needle and spread of local anaesthetic at the brachial plexus block site. Caliber of block and span of postoperative analgesia can be boosted by various adjuvants. The period of sensory and motor block was significant in our study. Enhanced prolongation of sensory and motor blockade when dexmedetomidine and clonidine was used has been reported in earlier studies.

In our study, the dexmedetomidine group (Group B), showed faster onset of sensory block, 7.33 ± 1.35 minutes, faster onset of motor block, 10.93 ± 1.45 minutes, whereas in clonidine group (Group A) showed a delayed onset of sensory block, 8.53 ± 0.89 minutes and motor block of 13.22 ± 1.31 minutes.

Kenan Kaygusuz MD et al and Singelyn FJ et al, Chakraborthy S et al conducted a study with a small dose (30 mg) of clonidine as adjuvant to 0.5% bupivacaine significantly prolonged the duration of analgesia without producing any adverse effects other than sedation.[16–18] The use of dexmedetomidine resulted in faster onset of sensory and motor block. The role of clonidine as adjuvant to ropivacaine in faster onset of sensory and motor block

is controversial, while previous date showed no effect on onset of block but with the use of dexmedetomidine with local anaesthetics have shortened the onset time of sensory and motor block. [19,20] Singh S et alconducted study with clonidine and dexmedetomidine as adjuvants to local anaesthetics found adjuvants were added to Ropivacaine for supraclavicular brachial plexus blocks shorten the onset times for sensory and motor blocks and prolong the duration of motor block and duration of analgesia. Both Clonidine and Dexmedetomidine have the added advantage of conscious sedation, hemodynamic stability, and minimal side effects which makes them a potential adjuvant for nerve blocks. [21]

Regional anaesthesia makes a simple demand that the appropriate dose of the drug to be given in the correct place. The principal challenge encountered during our study was the unreliability of conventional methods for confirming precise nerve demarcation due to anatomical variation. The real – time ultrasound has been used to localize the peripheral nerve or plexus, accurate needle placement and confirmation of local anaesthetic spread in the appropriate tissue planes. Most comparative 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.

In present study it was found that addition of clonidine and dexmedetomidine to 0.5% ropivacaine are effective in supraclavicular brachial plexus block. However, dexmedetomidine is a better alternative to clonidine to obtain early onset and prolonged duration of sensory and motor block and postoperative analgesia. The difference in the need of rescue analgesia between the two groups is statistically highly significant. The observation suggests that patients who were given Ropivacaine + Dexmedetomidine needed much less rescue analgesia as compared to the group who received Ropivacaine + Clonidine.

The difference in the need of rescue analgesia between the two groups Group C and Group D is statistically highly significant (p-value <0.001). The observation suggests that patients who were given Ropivacaine + Dexmedetomidine needed much less rescue analgesia as compared to the group who received Ropivacaine + Clonidine.

5. Conclusion

Dexmedetomidine is a better adjuvant than clonidine for brachial plexus blocks when added to ropivacaine. Compared to clonidine, dexmedetomidine provides faster onset of sensory/motor block, longer post-operative analgesia, and comparable intra-operative sedation and side effects. The mechanism of action appears to be peripheral rather than central. Dexmedetomidine enhances the duration and quality of the nerve block, making it a valuable adjuvant for peripheral nerve blocks with local anaesthetics. Dexmedetomidine and local anaesthetic agents have a synergistic action. When used with ropivacaine in an ultrasound – guided brachial plexus block, we examined the effectiveness of clonidine and dexmedetomidine as adjuvants. When compared to clonidine, dexmedetomidine has the advantage of a faster onset of the sensory and motor block. It was determined that the creation of intra-operative sedation and adverse effects were equivalent between clonidine and dexmedetomidine. Dexmedetomidine and clonidine enhanced the calibre of the block. The action of dexmedetomidine was presumably local rather than centrally mediated. However, dexmedetomidine was found to be a better alternative to clonidine to obtain early onset and enhanced interval of sensory and motor block and postoperative pain relief. Regardless of mechanism of action, dexmedetomidine was found to be a valuable adjuvant for peripheral nerve blocks when added to local anaesthetic solution.

6. Source of Funding

None.

7. Conflict of Interest

None.

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