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Original Research Article

ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK BY PARASAGITTAL APPROACH FOR UPPER LIMB SURGERIES USING DEXMEDETOMIDINE AS AN ADJUVANT TO ROPIVACAINE : A RANDOMIZED PROSPECTIVE CLINICAL STUDY

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ABSTRACT

Background: Ropivacaine is used for supraclavicular brachial plexus block because of its wide safety profile and less cardiotoxicity. Dexmedetomidine is used as adjuvants to Ropivacaine. The aim is to compare the effectiveness by addition of Dexmedetomidine to Ropivacaine in supraclavicular brachial plexus for analgesic duration. Along with Analgesia onset, duration of sensory and motor blockade was compared.

Materials and Methods: A prospective randomized comparative study was carried out among 70 patients of ASA I and II aged 20-60 years, scheduled for elective upper limb surgeries under supraclavicular brachial plexus block by parasagittal approach. Group RO received 20ml of 0.75% ropivacaine along with 1ml of 0.9 % Normal saline while Group ROD received 20ml of 0.75% ropivacaine along with 0.5mcg/kg dexmedetomidine which amounts to1ml. Statistical analysis is student t-test was used for demographic and hemodynamic parameter data analysis. Unpaired t-test was used for evaluation of data which includes onset, duration of sensory and motor blockade along with duration of analgesia. The results were statistically significant if p-value <0.05 and <0.001 was considered highly significant.

Results: The Duration of analgesia lasted longer in Group ROD (990.90± 16.35) when compared to Group RO (543.03 ± 18.09). Onset time for sensory and motor blockade were rapid in Group ROD (7.70± 1.79, 13.76± 1.01) when compared to Group RO (10.15 ± 1.02, 18.59 ± 1.64). Duration of sensory and motor blockade was prolonged in Group RD (779.66± 31.39,726.07 ± 24.98) when compared to Group RO (456.07± 20.18, 398.04 ± 25.08). VAS scores were less in patients of Group ROD which led to reduced total analgesic requirement in Group ROD (0.75 ± 1.14) when compared to Group RO (2.31 ± 1.49) (p-value <0.001). Sedation scores were higher in Group ROD when compared to Group RO.

Conclusion: Addition of Dexmedetomidine to Ropivacaine provided much superior analgesia along with faster onset and longer duration of sensorimotor blockade when compared Ropivacaine alone.

Keywords: Dexmedetomidine, Ropivacaine, Supraclavicular, Brachial plexus block, Parasagittal, Sensory, Motor.

INTRODUCTION

Supraclavicular Brachial plexus block is regional anesthesia technique alternative to General Anesthesia for upper limb surgeries and for peri-operative pain relief. Advancements in regional anesthesia techniques with respect to Amides, newer adjuvants and use of ultrasound guided regional blocks for safe and successful conduct of block has increased its popularity. It shortens hospital stay, lessens financial burden and also leads to avoidance of undesirable side-effects of General Anesthesia like airway manipulation, polypharmacy, cardio depression from inhalational agents.[1]

Ropivacaine is an amide group of drug known as local anesthetic effective for both intraoperative anesthesia and post-operative analgesia by binding to voltage-gated sodium channels thus increasing the frequency of nerve depolarization in a reversible and concentration dependent manner. Ropivacaine has lower lipid solubility causes greater sensory and motor differential blockade, which is beneficial.[2,3]

Adjuvants are added to increase the duration of nerve block. Adjuvant drugs such as opioids, dexamethasone, alpha-2 adrenergic receptor agonists, preservative free ketamine and others can be used to increase duration of block. Dexmedetomidine is selective alpha-2 adrenergic receptor agonist,[4] its action in peripheral nerve blockade is due to increase in hyperpolarization activated cation current that prevents the nerve from returning to resting membrane potential.[1]

MATERIALS AND METHODS

Patients belonging to ASA status I & II, aged between 20-60 years scheduled for elective upper limb surgeries by ultrasound guided supraclavicular brachial plexus block by parasagittal approach at Faculty of medical Sciences Khaja Banda Nawaz University, for a prospective randomized single blinded study. Patients with bleeding disorders, coagulopathy, uncontrolled diabetes mellitus, renal and liver diseases, pregnant and lactating women, patients with epilepsy, neurological diseases & known hypersensitivity to local anesthetics were excluded from the study. The patients in whom block was not found effective were excluded from the study and given general anesthesia.

Patients were randomly allocated into two groups based on open envelope method, Group RO and ROD. Based on a previous study conducted by Kathuria et al,[1] with a confidence level of 80% and keeping mean time of duration of analgesia as one of the primary variables at the p value of < 0.05, we selected 35 patients in each group for our study. Group RO - patients received 20ml of 0.75% ropivacaine along with 1ml of 0.9% normal saline. Group ROD - patients received 20ml of 0.75% ropivacaine along with 0.5mcg/kg of dexmedetomidine amounts to 1ml.

All patients underwent detailed pre anesthetic checkup and evaluation. The day before surgery patients were examined, explained regarding the procedure in there understandable language and were taught to interpret the visual analogue scale (VAS). Written informed consent was obtained.

NPO guidelines were followed. Night before surgery patients were Premedicated with oral tablet Alprazolam 0.25 mg and tablet pantoprazole 40mg and on the day of surgery inj. Ondansetron 4mg & pantoprazole 40mg, 30 minutes prior to surgery. Also night before surgery patients were given with lignocaine test dose and Antibiotic test dose.

Patients were monitored using standard ASA monitor under anesthesia which includes heart rate, non-invasive arterial blood pressure (NIBP), ECG and oxygen saturation (SpO2) were started. Intravenous line was secured with 18G cannula in the unaffected limb and I.V. Fluids were given according to Holliday seger formula.

All necessary drugs and equipment's for the block were kept ready. Both groups RO and ROD receiving the block were blinded i.e. unaware of the composition of the drugs used. Patients were educated about the block and were positioned supine on the table with soft pillow under the patient shoulder with the head turned on contralateral side to make the landmarks more prominent. Ultrasound machine with linear type probe was used, under strict aseptic skin preparation probe was placed in parasagittal plane in the front of supraclavicular fossa, after local anesthetic skin infiltration with lignocaine, a 22 Gauge spinal needle was introduced from the anterior border of the trapezius muscle. A 10cm extension was attached to the needle. By in-plane technique the needle was advanced till the tip enters the sheath of plexus, and then volume of prepared local anesthetic mixture either with 1ml of 0.9% normal saline or 0.5mcg/kg of Dexmedetomidine constituted to 1ml was injected after negative aspiration for blood. Sensory block was assessed with touch, temperature and motor blocks were assessed by asking patient to move upper limb and flex his finger as soon as the block was given. Patients were followed up for the duration of analgesia in the post-operative period.

The study characteristics of block were defined and interpreted as below: Duration of analgesia was defined as time between complete sensory block and first time when patients complains of pain.

Sensory onset was defined as the time when patient has no pain after complete administration of local anesthetic.

Duration of sensory block was defined as the time interval between the complete sensory block and complete resolution of anesthesia.

Motor onset defined as the time interval between complete local anesthetic administration and complete motor block in the patient.

Duration of motor block was defined as the time interval from complete motor block to complete recovery of motor function.

Sensory block assessment was done by placing a soft cotton and spirit cotton over the patient's skin at the desired dermatomal level and appreciating the patient's response to the stimuli.

Motor block was assessed by thumb abduction (radial nerve), thumb opposition (median nerve), thumb adduction (ulnar nerve) on a 3-point scale for motor function.

0 -Normal motor function,

1-Decreased motor strength but patient is able to move fingers,

2-Complete motor block

Dexmedetomidine was used as an adjuvant and causes sedation hence sedation was assessed by Ramsay Sedation Scale (RSS). By Ramsay Sedation Scale (RSS) intra-operatively & post-operatively as follows: 1-Awake, anxious, agitated, or restless 2-Awake, cooperative, oriented, or tranquil 3-Awake, Patient responds to commands only 4-Asleep, brisk response to light, glabellar tap, or loud noise. 5-Asleep, sluggish response to light, glabellar tap, or loud noise. 6-Asleep, no response to light, glabellar tap, or loud noise

Any adverse events like Arrhythmia, Bradycardia, Hypotension, Hypoxia, Sedation, Respiratory depression, nausea and vomiting were noted. Bradycardia was defined as fall in heart rate by 15 % percent from baseline, and hypotension was defined as fall in blood pressure by < 20% from the baseline recordings. Vitals were assessed intra-operatively and post-operatively. Visual Analogue Scale (VAS) was used to assess pain and if VAS >4, rescue analgesia was considered. Rescue analgesic used in the post-operative period was injection Tramadol 100mg in 100ml NS over 15mins and its requirement in 24 hours' post-operative period was noted in both groups Group RO and Group ROD and computed accordingly.

Data was computed and entered in MS excel/analyzed using SPSS software version 16. Student t-test was used for demographic and hemodynamic parameter data analysis. Unpaired t-test was used for evaluation of data which includes onset, duration of sensory and motor blockade along with duration of analgesia. The results were statistically significant if p-value <0.05 and <0.001 was considered highly significant.

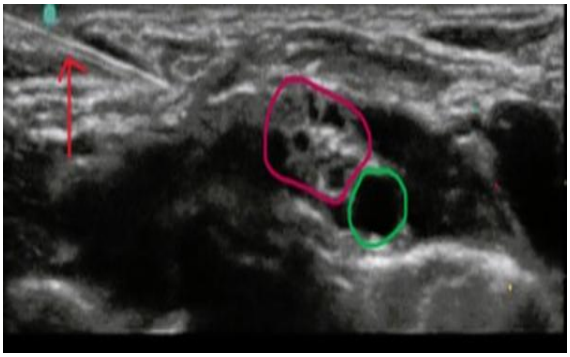


Figure 1: Ultrasound image of brachial plexus in parasagittal approach

[Figure 1] showing needle advancement towards the plexus. Needle (with a red arrow), Brachial plexus in pink (Bunch of Grape appearance) and Subclavian Artery in green.

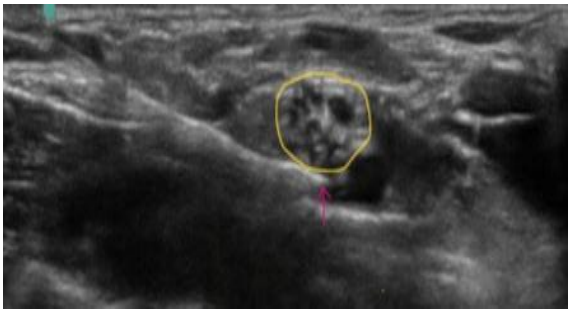


Figure 2

[Figure 2] showing Needle in pink arrow beneath the Brachial plexus in yellow.

RESULTS

Seventy patients were enrolled for the study, There was no patchy or block failure during the study in any of the groups. Both the groups RO and ROD were comparable with respect to age, sex distribution, weight, height (demographic variables), ASA grading and duration of surgery [Table 1]. Duration of analgesia lasted longer in Group ROD (990.90± 16.35) when compared to Group RO (543.03 ± 18.09) (p-value <0.001) [Table 2]. As per the observation noted in Table 3, the onset time for sensory and motor blockade were rapid in onset in Group ROD (7.70± 1.79, 13.76± 1.01) when compared to Group RO (10.15 ± 1.02, 18.59 ± 1.64) with p-value < 0.05. By addition of Dexmedetomidine to Ropivacaine in our study, we noticed early occurrence of sensory and motor blockade. The duration of sensory blockade was prolonged in Group ROD (779.66± 31.39) when compared to Group RO (456.07± 20.18) with p-value of <0.001 [Table 4]. Duration of motor blockade was also enhanced in Group ROD (726.07 ± 24.98) when compared to Group RO (398.04 ± 25.08) (p-value <0.001) [Table 4]. VAS scores were less in patients of Group ROD which led to decreased total rescue analgesic requirement in Group ROD (0.75 ± 1.14) when compared to Group RO (2.31 ± 1.49) (p-value <0.001) [Table 4] [Graph 4]. Sedation scores were higher in Group ROD when compared to Group RO due sedation property of Dexmedetomidine

[Graph 5]. As per the observations noted in [Graph 6-8] hemodynamic stability was maintained in patients of both the groups without any significant variations. Two patients in Group ROD had bradycardia which was managed responded injection glycopyrrolate 0.2mg. One patient in Group ROD had transient hypotension and was treated intravenous fluids and 6mg bolus of intravenous mephentramine. There was no hypoxia or

desaturation, nausea, vomiting and respiratory depression in any of the patients among both the groups [Table 5].

Table 1: Demographic Profile

Demographic Profile	Group RO	Group ROD	P-value
Age (in yrs)	37.12 ± 14.86	37.28 ± 17.37	0.414
Height (in cms)	157.24 ± 6.98	158.6 ± 6.14	0.527
Weight (in kgs)	60.17 ± 9.08	62.19 ± 8.93	0.479
Sex (male/female)	21(52.4%)/19(47.6%)	20(50%)/20(50%)	0.834
ASA distribution (I/II)	18(45%)/22(55%)	21(52.5%)/19(47.5%)	0.637
Duration of Surgery (in mins)	68.49± 19.22	64.57± 18.54	0.316

P-value >0.05, not significant

Table 2: Duration of Analgesia

Variables	Group RO	Group ROD	P-value
Duration of Analgesia (in min)	543.03 ± 18.09	990.90± 16.35	<0.001
Rescue analgesia- Injection Tramadol 100mg	2.31 ± 1.49	0.75 ± 1.14	<0.001

P-value <0.001, statistically significant

Table 3: Onset time of Sensory and Motor block

Variables	Group RO	Group ROD	P-value
Onset of sensory block (in min)	10.15 ± 1.02	7.70± 1.79	<0.001
Onset of motor block (in min)	18.59 ± 1.64	13.76± 1.01	<0.001

P-value <0.001, statistically significant

Table 4: Duration of Sensory and Motor block

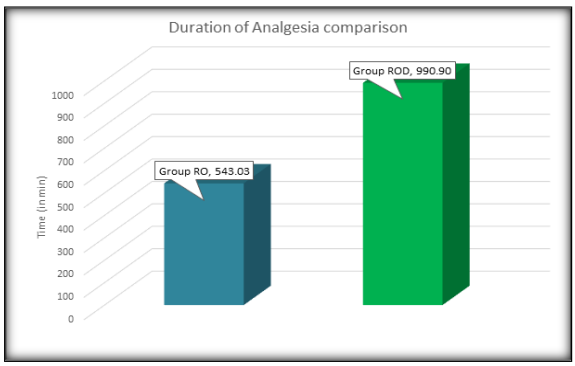
Variables	Group RO	Group ROD	P-value
Duration of sensory block (in min)	456.07± 20.18	779.66± 31.39	<0.001
Duration of motor block (in min)	398.04 ± 25.08	726.07 ± 24.98	<0.001

P-value <0.001, statistically significant

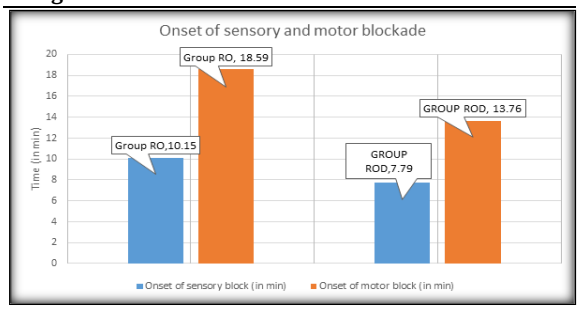
Table 5: Side effects

Variables	Group RO	Group ROD
Hypotension	0	1
Nausea	0	0
Vomiting	0	0
Bradycardia	0	2
Hypoxemia	0	0
Respiratory depression	0	0

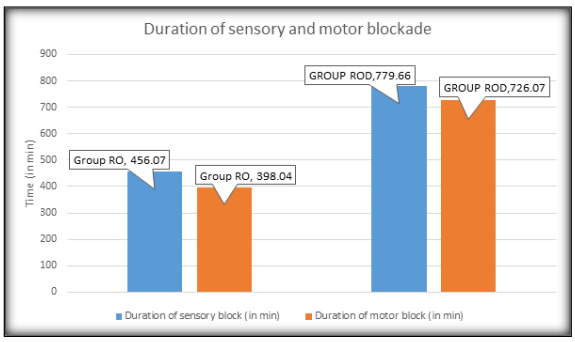
P value >0.05, insignificant



Graph 1: Graphical representation of duration of analgesia



Graph 2: Graphical representation of onset of sensory and motor blockade



Graph 3: Graphical representation of duration of sensory and motor blockade

DISCUSSION

Ultrasound guided Supraclavicular blocks are performed at the level of the brachial plexus trunks. These blocks provides rapid onset and dense anesthesia along with high success rate. Local anesthetics alone for USG guided supraclavicular brachial plexus block provide good operative conditions but can have a shorter duration of postoperative analgesia.[5]

General anesthesia when used for patients undergoing upper limb surgeries results in significant hemodynamic disturbances along with adverse effects that includes post op nausea, vomiting, polypharmacy, airway manipulation, airway edema, bronchospasm, post op sore throat, cardio depression from inhalational agents and respiratory insufficiency. To avoid all these adverse effects supraclavicular brachial plexus block is commonly used minimizing prolong stay at hospital, cost factor, no airway manipulation, polypharmacy is avoided. With the use of ultrasound, the nerve clusters can be easily imaged and block quality is also impressive and risk of intra-arterial injection and pneumothorax can be easily avoided.

Ropivacaine was developed as an enantiomer which is structurally related to bupivacaine which is less cardiotoxic and neurotoxic and it is a well-tolerated local anesthetic which is effective for perioperative analgesia.

Adjuvants increase the duration of nerve block. Dexmedetomidine is selective alpha-2 adrenergic receptor agonist,[4] its action in peripheral nerve blockade is due to increase in hyperpolarisation activated cation current that prevents the nerve from returning to resting membrane potential.[1]

Ribeiro RN et al,[5] suggested that Dexmedetomidine has emerged as an adjuvant for local anesthetics for epidural anaethesia, spinal anaethesia. Dexmedetomidine alpha-2 agonists is known to cause sedation is believed to be due to central inhibition of substance P release in the nociceptive pathway and it has well been documented that patients are easily arousable.

Side effects were taken into consideration, as we did not notice any major adverse effects of Dexmedetomidine. Dexmedetomidine with a dose of 50mcg prolongs analgesic duration of block and thus reduces rescue Analgesic requirements. Dexmedetomidine, thus acted as a good additive to Ropivacaine.

From our study has provided superior block characteristics along with prolonged post-operative analgesia by addition of Dexmedetomidine as an adjuvant to 0.75% Ropivacaine when compared to Ropivacaine alone in supraclavicular brachial plexus block. Our study had some limitations, we chose 50mcg of dexmedetomidine as previous studies had a mention of bradycardia and hypotension with higher doses. Hence, we evaluated the efficacy of lower dose concentration of dexmedetomidine in supraclavicular block keeping in view of not causing any adverse effects. However, further studies need to be carried out with larger samples to validate our observations using different dosage protocols.

Very similar to the study conducted by Adrian Searle et al,[6] in our study we used posterior parasagittal approach to the brachial plexus at the supraclavicular level, utilizing the arc of the first rib to provide a deep limit to needle transit, and probe stability by resting against the scalene muscles medially, and clavicle anteriorly. In this parasaggital approach, subclavian vein is well-separated from the brachial plexus from the subclavian artery, the plexus being positioned posterior to the artery. Injury to major structures before the needle reaches the brachial plexus is thus prevented. This method ensures that the needle tip does not trespass the first rib or the pleural dome thus reducing the risk of pneumothorax. Hence we used this approach.

Ranjit et al,[7] in the study concluded that perineural dexmedetomidine prolonged the analgesia duration and reduced 24-hour postoperative rescue analgesia consumption (8h 36min +/- 1h 36min and 10h 42min +/- 1h 36min) when used as an adjuvant to bupivacaine in fascia iliaca block. They also concluded that intravenous dexmedetomidine is less efficacious than perineural dexmedetomidine in terms of evaluating block characteristics. Intravenous analgesics were used for patients for postoperative analgesia in comparison to perineural administration of Dexmedetomidine, it was concluded that perineural adjuvant added to local anesthetic provided more superior analgesia than intravenous Dexmedetomidine.

Our study correlates with the study conducted by Faraj et al,[8] where in they have randomized patients into three groups, Dex-P, Dex-IV and control group, duration of analgesia was 10.9 hours on addition of 0.5 mcg/kg Dexmedetomidine to 0.5 % Ropivacaine (Dex-P). Dexmedetomidine also reduced the 24-hour cumulative morphine consumption to 63.9mg (Dex-P) compared to Group Dex-IV

Lot of studies are being done using Dexmedetomidine as an adjuvant to local anesthetics, accordingly superiority has been established by using Dexmedetomidine perineurally in various studies.

Sarita et al,[9] in there study compared the efficacy between the two alpha-2 agonists, dexmedetomidine and clonidine in brachial plexus block, they found out that the patients who received Dexmedetomidine had prolonged duration of analgesia (456+/-97min) when compared to patients who received clonidine (289+/-62 min), thus they concluded that Dexmedetomidine when compared to clonidine provided superior analgesia in the supraclavicular brachial plexus block.

Srinivasa Rao et al,[10] in his study, they randomly allotted patients into Group LD50 and Group LD100. Group LD50 received 0.5% levo bupivacaine with 50mcg of dexmedetomidine. Group LD100 received 0.5% levobupivacaine with 100mcg of dexmedetomidine. They concluded that 100mcg dose of dexmedetomidine in brachial plexus block provides rapid in onset and prolongs the duration of sensorimotor blockade and analgesia, but with adverse effects of bradycardia and sedation. From the above study Keeping this into consideration, we have used 0.5mcg/kg of Dexmedetomidine rather than 1mcg/kg dosage.

Hence In our study, we have used 0.5mcg/kg of Dexmedetomidine as an additive to Ropivacaine and

we found out that Dexmedetomidine prolongs the duration of sensory and motor blockade and also the duration of analgesia was also enhanced . The rescue analgesia doses of injection tramadol requirement was less used in the post-operative in the group ROD which received Dexmedetomidine These observations in our study correlates to a similar study which was conducted by Gurajala et al.[2] They used 50mcg of Dexmedetomidine as an adjuvant to 0.5% Ropivacaine and noted that onset of motor block was much earlier and durations of analgesia, sensory and motor blockade were significantly prolonged in group ROD who received Dexmedetomidine.

Suneet Kathuria et al,[1] in his study they found that sensory and motor block onset was much earlier in group who received Dexmedetomidine. The duration of sensory and motor block, duration of analgesia was also prolonged in group who received Dexmedetomidine perineurally when compared with group who received intravenous Dexmedetomidine.

CONCLUSION

We conclude from our present study that addition of 0.5mcg/kg of Dexmedetomidine to 0.75% Ropivacaine enhanced the quality of block as the duration of analgesia was significantly prolonged and onset of both sensory and motor blockade was rapid. It also prolonged the duration of sensory and motor blockade, making it as one of the potential adjuvants for ropivacaine in upper limb forearm upper limb surgeries.

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