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ORIGINAL RESEARCH

A Randomised Double Blind Controlled Interventional Study Comparing Effect of Dexmedetomidine as an Adjuvant to Ropivacaine in Supraclavicular Brachial Plexus Block

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ABSTRACT

Background and aim: Supraclavicular brachial plexus block under USG guidance is a safer and better alternative to blind blocks or general anesthesia for upper extremity surgeries and also provides good postoperative pain relief. This study aimed to compare theanesthetic effect of dexmedetomidine as an adjuvant to 0.5% ropivacaine in supraclavicular brachial plexus block for upper extremity surgery. **Method:** This Randomised double blind controlled interventional study includes sixty ASA physical status I and II patients of either sex for elective upper limb surgery under USG guided supraclavicular brachial plexus block divided into two groups of 30 each. Group A received 20ml of 0.5% ropivacaine+5ml of normal saline(total volume 25ml) and Group B received 20ml of 0.5%ropivcaine+50µg dexmedetomidine(0.5ml) +4.5ml normal saline(total volume 25ml).Study parameters were hemodynamic profile (HR ,SBP, DBP, MBP), SpO2, onset time and duration of motor and sensory blockade, time of 1st dose of rescue analgesia, duration of analgesia, and side effects. **Result:** Demographic profile of both groups were same but there is statistically significant difference in mean onset time and duration of motor and sensory blockade and analgesia duration.**Conclusion:** Dexmedetomidine when used as an adjuvant to ropivacaine in supraclavicular plexus block hastens the onset time and increases the duration of sensory and motor blockade along with it prolongs the duration postoperative analgesia.

Keywords: Brachial plexus block, dexmedetomidine, ropivacaine, ultrasound.

INTRODUCTION

Nerve block is a better alternative to general anesthesia for upper extremity surgery and also provides good postoperative pain relief.[1,2]Various approaches are used to block the brachial plexus like supraclavicular, interscalene, axillaryand infraclavicular. The supraclavicularblock is the preferred approach for hand and forearm surgeries, as it is safe, has a rapid onset, and gives reliable anesthesia.[3] This block technique was First introduced in 1911 by Kulenkampff as a landmark-based approach.[4]

Supraclavicular block can be approached by various techniques like landmark technique, peripheral nerve stimulator guided technique, and ultrasound-guided technique. Ultrasound guided supraclavicular brachial plexus block is a safe practice because there is real time visualisation of nerve plexus and drug deposition so decreased incidence of complications related with blind techniques like pneumothorax, intravascular-injection, hematoma etc., and it also reduces the quantity of local anesthetic required for anaesthesia thus less chances of local anaesthetic toxicity.[5,6]

Various local anesthetics like levobupivacaine, ropivacaine, bupivacaine, and lignocaine are used to block the brachial plexus but among these ropivacaine is preferredbecause it is a long-acting amide local anesthetic which possesses less cardiotoxic property

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than bupivacaine.[7]Many additives like opioids, tramadol, dexamethasone, clonidine, ketamine, buprenorphine, etc. are used with local anesthetics to potentiate their action and also provide postoperative pain relief for a long duration. [8,9] Nowadays, a newer selective α2 adrenoceptor agonist-dexmedetomidine is used as an additive to local anesthetics because it has additional analgesic and anxiolytic properties.

The primary objective of the study is to determine the difference in mean onset time and duration of sensory and motor block in both groupsand the secondary objective is to determine the difference in the mean duration of analgesia in both groups and to determine side effects if any.The current work is focused on evaluating the effect of dexmedetomidine, added to 0.5% ropivacaine as an adjuvant in supraclavicular brachial plexus block, in terms of onset and duration of motor and sensory block and duration of postoperative analgesia.

METHODOLOGY

The study was done at a Tertiary care hospital after the ethics committee approval. 60 patients of either sex, age between 18 to 60 years, weight 40 to 70 kg, ASA grades I and II, undergoing elective upper limb surgeries at the level of elbow or below elbow wereincluded in this study. The study was conducted between November 2020 to August 2021. Patients who wereuncooperative, had gave negative consent, had pathology at the injection site, had a convulsion history, allergic to the study drugs, and suffered from any bleeding disorders, coagulopathies, severe neurological deficit, and contralateral diaphragmatic paralysis were excluded from this study.

According to a previous study, a sample size of 30 cases in each group were required with 95% confidence and 80% power to verify the expected minimum difference of 12.45(±8.62) min in the onset time of sensory block of both groups [1]. This sample size was adequate to cover all other study variables.

It was a randomised, double blind, controlled, interventional study. Randomization was done by using thesealed opaque envelope method. Soin this study neither patient nor the researcher which analyses the data know about the group allocation. Patients who had given their written and informed consent were divided into following two groups (30 in each)

Group A- received 20 ml of 0.5% ropivacaine + 5ml normal saline(total volume 25ml) in USG-guided supraclavicular brachial plexus block.

Group B- received 20 ml of 0.5% ropivacaine + 0.5 ml (50µg) dexmedetomidine + 4.5 ml normal saline(total volume 25ml)in USG guided supraclavicular brachial plexus block.

It was a double blind study, so equal drug volume was given in both groups by adding normal saline in the control group. Syringes were labelled as A and B. The anaesthetist who was preparing drugs was different from anaesthetist who gave anaesthesia and recorded data.Preanesthetic checkups of patients were done a day prior to surgery.On the day of surgery patients were taken in operation theatre,identity, Nil per oral status confirmed. Multipara monitors applied and baseline vital parameters like BP, Heart Rate, ECG, and SpO2 were recorded. 18G IV cannula was taken in the nonoperative arm as an intravenous access and IV fluid was started.

To perform block, the patient was positioned supine with the head turned towards the contralateral side and ipsilateral arm adducted and the shoulder pushed down. Painting and draping done,supraclavicular nerve plexus was identified by using linear ultrasound transducer (10-13 MHz). Under all aseptic precautions,drug deposition was done with a 22G hypodermic needle using out of plane technique. With the help of the ultrasound real time drug deposition in the region of brachial plexus was visualized.

The onset of sensory and motor block was evaluated every 2 minutes after the completion of injection of local anesthesia and till the onset of sensory and motor block had achieved. The sensory and motor block onset time was noted.Here we used **Cold Test** [10]to establish sensory blockade. It is a 3-point scale where Grade- 0 means: No block (patient can feel cold), Grade- 1: Analgesia (patient can feel touch not cold), and Grade- 2: Anaesthesia (patient cannot feel touch also).

Motor block was assessed by **Modified Bromage Scale,**[11]according to this: - Grade- 0: Normal motor function with full flexion and extension of elbow, wrist, and fingers, Grade-1: Decreased motor strength with the ability to move the fingers only, Grade- 2: Complete motor block with the inability to move a finger.

Sensory block's onset time was defined as the time interval from the completion of the total dose of local anesthetic administration to achieve grade- 2 sensory block and motor block's onset time was defined as the time interval from the completion of the total dose of local anesthetic administration to achieve grade- 2 motor block. After attaining complete sensory and motor block,patients were sedated with 0.02mg/kg iv midazolam.

Intraoperatively vital parameters were recorded every 5 minutes for the 1st 30 minutes thereafter every 15 minutes. Postoperatively the duration of sensory and motor block werenoted. The time of the first dose of rescue analgesia and duration of analgesia were also noted.

Duration of sensory block was defined as the time interval from the onset of sensory block to complete resolution of anesthesia and duration of motor block ~~was~~ the time interval from the onset of motor block to complete return of motor power of hand and forearm. The Time interval from the completion of total local anesthetic administration to the first dose of rescue analgesic administration was considered as the duration of analgesia.

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Postoperatively haemodynamic parameters and pain scores were evaluated at 30 min, 1hr, 3hr, 6hr, 9hr, 12hr, 18hr, and 24hr. Pain score was assessed by **NRS (Numeric Rating Scale)**11point scale (0 to 10). According to this :-0: No pain, 1-3: Mild pain, 4-6: Moderate pain, 7-9: Severe pain, 10: Worst imaginable pain. If rating scale was ≥4 than rescue analgesia (inj. Diclofenac 75 mg/ml) was administered.

Ramsay sedation score [12]was used to assess postoperative sedation which was as follows:

1= Patient is anxious or agitated or restless, or both
2= Patient cooperative, oriented and tranquil
3= Patient responds to commands only
4= Patient exhibits, but a brisk response to a light glabellar tap or loud auditory stimulus
5= Patient exhibits, sluggish response to a light glabellar tap or loud auditory stimulus
6= Patient exhibits, no response

Patients were asked and observed for any side effects like nausea, vomiting, hematoma, pneumothorax, systemic toxicity of local anesthetic, dryness of mouth, bradycardia, and hypotension during the intraoperative and postoperative period.Statistical data was performed with the SPSS (Statistical Package for the Social Science), version 17 windows statistical software package (SPSS inc. Chicago, IL, USA)

Categorical data, that is sex ratio was presented as proportions. The data were analysed in two groups and the difference in proportion was analysed using the chi-square test. Demographic data (Age, weight), duration of surgery, onset time of the block, duration of sensory, motor block, and analgesia, and NRS score were expressed in mean ± SD. The difference in the mean between the two groups was analysed using Student's t-test. For significance p value < 0.05 was considered significant for both types of data.

RESULTS

There was no significant difference in between both study groups regarding demographic variables like age, sex and weight.The mean onset time of sensory and motor block in group B was 8.87±2.80 min, 14.63±2.97 min respectively and in Group A was 16.13±3.65 min, 23.17±4.11 min respectively (P Value <0.001 S). Hence group B had earlier block onset time than group A.

The duration of sensory and motor block in Group B was 806.13±148.19 min, 741.03±165.20 min respectively and in Group A was 497.47±94.32 min, 434.77±105.04 min respectively. (P value <0.001S). Hence in group B duration of sensory and motor blocks wasprolonged.

Duration of postoperative analgesia was also longer in group B (910.07±150.16 min) ascompared to group A (568.17±100.11 min) (P value <0.001).

Postoperatively pain was assessed by NRS Score, according to this there was a significant difference between 9 to 12hrsafter surgery in both groups. This indicates that the first rescue analgesia time was also longer in group B than in group A. Both study groups were comparable as per haemodynamic profile. Most of the Patients in this study had sedation scores ≤3. Also, there were not any other major side effects in any group.

(Table 1: Demographic variables)

Variable	Group A	Group B	P Value
Age (Years)	35.10 ± 12.95	27.23 ± 7.96	0.747
Weight(kg)	61	59.50	0.197
Duration of Surgery(min)	73.50±28.29	75.40±38.87	0.829
Gender			
Males	23	24	1.00
Females	7	6	
ASA Grade			
I	29	30	1.00
II	1	0	

(Table 2: Block Characteristic)

Variable	Group A	Group B	P Value
The onset of sensory block(min)	16.13±3.65 min	8.87±2.80 min	<0.001
The onset of motor block(min)	23.17±4.11 min	14.63±2.97 min	<0.001
Sensory block duration(min)	497.47±94.32 min	806.13±148.19 min	<0.001
Motor block duration(min)	434.77±105.04 min	741.03±165.20 min	<0.001
Duration of analgesia(min)	568.17±100.11 min	910.07±150.16 min	<0.001

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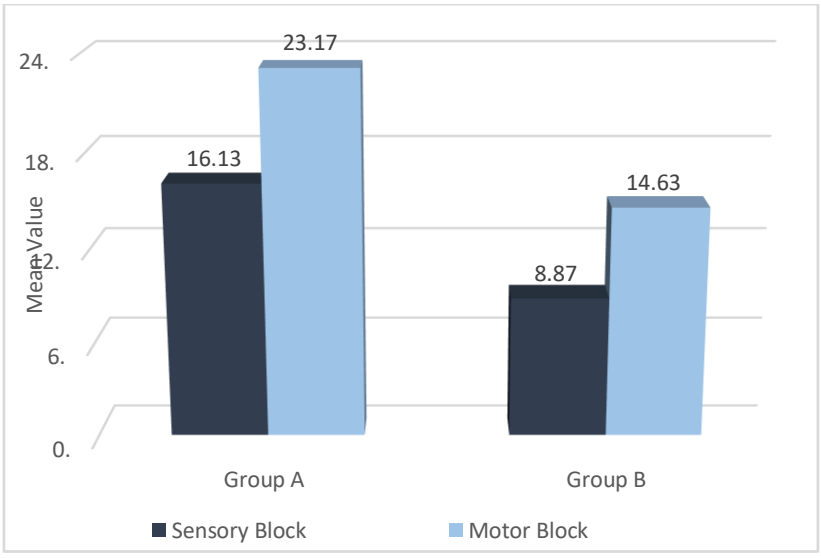

Fig 1: Onset of Sensory and Motor Block

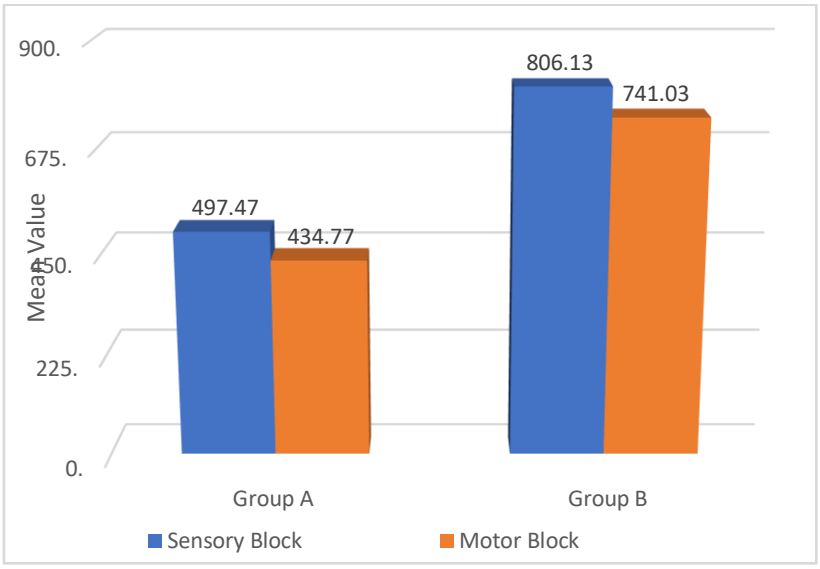

Fig 2: Duration of Sensory and Motor block(in minutes)

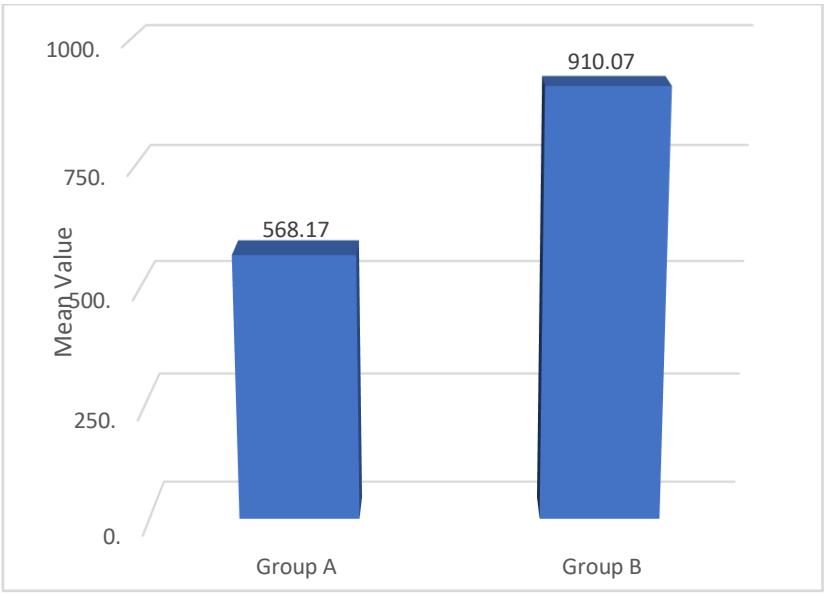

Fig 3: Duration of analgesia

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DISCUSSION

Nowadays USG guided brachial-plexus block technique is a popular and safe anaesthesia method for upper extremity surgeries. Dexmedetomidine is a selectiveα-2 adrenergic receptor agonist that has anxiolytic and analgesic properties. When it is used as an additive with local anaesthetics in brachial plexus block it increases the duration of motor and sensory block, along with it increases duration of postoperative analgesia also. [13]In our study, we used dexmedetomidine as an adjuvant to 0.5% ropivacaine in USG-guided supraclavicular brachial plexus block for upper extremity surgeries.

In our study, in dexmedetomidine group mean onset time for sensory block was 8.87±2.80 min and for the motor block was 14.63± 2.97 min which was almost similar to the study results of Kathuria S, Gupta S, and Dhawan I [1] wherethe mean onset time for sensory block was 9.75±4.23min and mean onset time for motor block was 18.75 ± 6.37 min.

In another study which was done by Dharmarao PS, Holyachi R. the durationof motor and sensory blockade in dexmedetomidine group was 649.56±42.73 and 801.75±46.07min respectively which was almost similar to our dexmedetomidine group results where the sensory blockade duration was 806.13±148.49 and motor blockade duration was 741.03±165.02 min.[14]

Reddy BS, Gaude YK, Vaidya S, Kini GK, Budania LS, Eeshwar MV. also concluded in their study in 2021 that perineural added dexmedetomidine causes the hasty onset of motor and sensory blockade and, also increases the duration of motor and sensory blockade as compared to intravenous dexmedetomidine group.[15]

Also, in our study mean analgesia duration in the dexmedetomidine group was 910.07±150.16 mins and in the control group, it was 568.17±100.11 mins which corresponds to the results of the study ofBiswas S, Das RK, Mukherjee G, Ghose T., they used dexmedetomidine as an adjuvant to levobupivacaine in supraclavicular brachial-plexus block they found that the duration of analgesia in the dexmedetomidine group was 997±154.23 min. [16]So α2 adrenergic agonist, dexmedetomidine when added to local anesthetics extends its effect and makes longer duration of peripheral nerve block.[17]

Dexmedetomidine also shows analgesic and anxiolytic properties. It acts on adrenoreceptors and activates them which results in suppression of adenylate cyclase so cyclic adenosine monophosphate (cAMP) production decreases and hyperpolarisation of noradrenergic neurons (mainly presynaptic neurons) occurs because of potassium exit and blocked entry of calcium ions in the neuron terminals. By this action stimulation of locus coeruleus, dorsal horns, and extraspinal localizations are inhibited which causes a reduction in the discharge of nociceptive fibers Aδand C and produces an analgesic effect.[18]

No major side effects are seen in this study. In dexmedetomidine group there was bradycardia in three patients and hypotension in one patient.It was resolved after awakening or after giving intravenous fluid. Also, in the dexmedetomidine group patients were less agitated.Therewere two limitations of our study, first one was that we studied only 18 to 60yrs age group patientsso we couldn't extrapolate the results of study to paediatric age group further studies has to be needed in paediatric age group.Another one was - This was a single-center study and also the sample size was small if it will be done at multiple centers and includes more patients it would be more informative.

CONCLUSION

From this study, we concluded that the addition of dexmedetomidine to 0.5% Ropivacaine in USG-guided supraclavicular block, extends the peripheral nerve block duration in terms of sensory and motor blockade and also hasten the onset time of both motor and sensory block . It also prolongs the duration of postoperative analgesia and was not associated with any major side effects.

In this study we have taken patients of age group between 18 to 60 yrs. only so by this study we couldn't explain effect of dexmedetomidine as an adjuvant to local anaesthetic in supraclavicular block for all age groups. Here we had given a constant amount of drug to all patient irrespective to their body weight.

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