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Original Research Article

Efficacy of Dexmedetomidine as an Adjuvant to Local Anesthetic for Ultrasound Guided Supraclavicular Brachial Plexus Block: A Prospective, Randomized Controlled Study

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Conflict of interest: Nil

Abstract:

Background: Brachial plexus block is one of the most commonly performed regional anesthesia techniques. Several drugs have been studied as adjuvant to brachial plexus block. Our aim was to study the efficacy of dexmedetomidine as an adjuvant to local anesthetics supraclavicular brachial plexus block done using ultasonography.

Methods: 60 adults in the age group of 18-60 years, with American society of anesthesiology class I or II, posted for elective upper limb surgery, were randomized into two groups. Block was performed using ultrasound. Group I patients received a local anesthetic mixture of 0.5% bupivacaine (15ml) + 2% lignocaine with adrenaline (15ml) + normal saline (0.5ml) and Group II Patients received 0.5% bupivacaine (15ml) + 2% lignocaine with adrenaline (15ml) + Dexmedetomidine (50µg). Parameters recorded intraoperatively and postoperatively were pulse rate, mean arterial pressure, sensory block, motor block and sedation. Adverse effects if any were recorded**.**

Results: The mean duration of onset of sensory & motor block was faster in group II in comparison to group I ($p<0.001$). The duration of sensory & motor blockade was prolonged in group II ($p<0.001$). Duration of analgesia was higher in group II. Requirement of rescue analgesics were less in group II with better sedation scores.

Conclusion: Dexmedetomidine as an adjuvant to local anesthetics for supraclavicular brachial plexus block significantly reduces the onset time of sensory & motor block with prolongation of the duration of anesthesia & provides good post-operative analgesia.

Keywords: Supraclavicular Brachial Plexus Block, Dexmedetomidine, Bupivacaine.

Introduction

Brachial plexus blockade is one of the most commonly employed regional anesthesia techniques of upper limb, supraclavicular approach being considered easiest and most effective. The advent of ultrasound in regional anesthesia has further popularized this technique as it increases the accuracy and safety of nerve plexus blockade [1].

There has been extensive research to find a good adjuvant to regional nerve blockade which can prolong the duration of analgesia with less adverse effects [2-4]. Some of the drugs which have been studied as adjuvants are dexamethasone, magnesium sulphate, opioids, sodium bicarbonate, ketamine, neostigmine, midazolam, cortisol, and α2-adrenergic [5-7]. Alpha-2 adrenergic receptor agonists are one such group of drugs which have been the focus of interest as adjuvants because of their sedative, analgesic and perioperative anxiolytic effects with reduced anaesthetic requirements.

Dexmedetomidine is a potent α2 agonist, which has eight times more α2 selectivity than clonidine [8]. It has been used as an adjuvant in various regional anesthesia techniques [9]. Animal studies by Brummett et al., showed that dexmedetomidine as an adjuvant to bupivacaine for sciatic nerve block in rats enhances duration of anesthesia and analgesia without any significant evidence of histopathological damage to the nerve [10,11]. However, there remains limited knowledge on its analgesic efficacy and duration in peripheral nerve and nerve plexus blockade.

This study was aimed to evaluate the efficacy of dexmedetomidine as an adjuvant to local anaesthetics for ultrasound guided supraclavicular

brachial plexus blockade. The primary objectives were to study the onset time and duration of sensory and motor block.

Materials and Methods

This prospective, double blind, randomized controlled study was carried out over a period of one year after obtaining institutional ethical committee clearance. Informed written consent was taken from 60 adults in the age group of 18-60 years, with ASA physical status of I or II, who were undergoing elective upper limb surgery. They were divided into two equal groups of 30 each and randomized using randomization table. Group I Patients received a mixture of 0.5% bupivacaine (15ml) + 2% lignocaine with adrenaline (15ml) + normal saline (0.5ml), while Group II patients received 0.5% bupivacaine (15ml) + 2% lignocaine with adrenaline (15ml) + Dexmedetomidine (0.5ml).

Patient refusal, ASA grade III and IV patients, history of any bleeding disorders, local site infection, neuromuscular disorders, respiratory compromise and any known allergy to local anaesthetic drugs were the exclusion criteria.

Pre anesthetic evaluation was done prior to surgery and the procedure was explained to the patients. They were reassured to alleviate their anxieties. Routine blood investigations were carried out. Patients were kept nil per oral as per the fasting guidelines.

20G intravenous cannula was inserted in the other upper limb & ringer lactate was started. Standard monitors like pulse oximetry, non-invasive blood pressure & electrocardiography were attached in the operating room and basal readings were recorded. Patient was Premedicated with intravenous Midazolam 1mg and Fentanyl 50µg. Supplemental oxygen was given through nasal prongs. Patient was made to lie supine with head turned to opposite side and arm adducted & pulled down gently.

High frequency (13-6 MHz) linear probe of sonosite ultrasound machine was set up for the procedure with the necessary aseptic precautions. Under sterile conditions, probe was placed in the supraclavicular region and brachial plexus was identified. Local infiltration was done with 2% lignocaine and a 22 G spinal needle was inserted by in-plane technique. After real-time visualization of vessels, plexus and needle tip, local anaesthetic mixture was administered after repeated aspiration and the drug distribution was observed around the plexus. The patient was closely monitored during and after the procedure for any block associated complications and for local anesthetic toxicity.

Parameters & recordings:

The following parameters were noted:

1. **Onset time of Sensory blockade:** Time interval between local anesthetic administration to loss of pin prick sensation.
2. **Onset time of Motor blockade:** Time interval between local anesthetic administrations to loss of movements.
3. **Duration of sensory blockade:** Interval between sensory onset time to appearance of pin prick sensation.
4. **Duration of motor blockade:** Interval between motor onset time to appearance of the movements.
5. **Duration of Analgesia:** Time interval between onset of block and first rescue analgesic administration.
6. **Vital parameters:** Blood pressure, heart rate & oxygen saturation.

The pinprick sensation was checked every 3 minutes till the onset of sensory blockade and then then every 30 minutes in the postoperative period till the regain of sensation. Movements were assessed every 3 minutes till the onset of motor blockade and then every 30 minutes in the postoperative period till the regain of movements. Sensory blockade was assessed by pin-prick sensation using a short bevelled 25G hypodermic needle. Scoring was done accordingly; 0: No pain, +: Mild pain- Grimace, ++: Moderate pain- Withdraws, +++: Severe pain- Screams.

Motor blockade was assessed and graded accordingly; 1: Flicker of contraction, 2: Movement with gravity eliminated, 3: Movement against gravity, 4: Movement against gravity & some resistance, 5: Normal power. Pulse rate, arterial blood pressure & oxygen saturation were recorded every 5 minutes throughout the procedure & then at an interval of every 30 minutes postoperatively. Hypotension was defined as a fall in systolic blood pressure of more than 30% from baseline or MAP<60mmHg and was managed with IV fluids & IV Mephentermine 6mg in increments. Bradycardia was defined as HR < 50/min and was managed with Inj. Atropine 0.6mg iv. Pain was assessed using Visual analogue scale (VAS) every 30 minutes. Inj. Paracetamol 1gm IV was used for rescue analgesia.

Complications if any were noted and treated accordingly.

The block was considered unsuccessful if there was inadequate sensory & motor blockade beyond 30 minutes following the infiltration. These cases were excluded from the study. In case the block was partially effective, it was supplemented with intravenous fentanyl 1µg/kg & propofol infusion at the rate of 50-100µg/kg/min. In circumstances of complete failure of the block, general anesthesia was administered.

Statistical analysis

The data was recorded and entered using MS Excel software and analysis was done using SPSS 20 version software to determine the statistical significance. Results were expressed in terms of mean ± standard deviation. Proportions were compared using Chi-square test. The "student's t test" was used to determine statistical difference between the two study groups. "P" value of >0.05 was considered not to be statistically significant, <0.05 was considered to be statistically significant, a value of <0.01 was highly statistically significant & a "P" value of <0.001 was considered as extremely statistically significant.

Results

The groups were comparable with respect to demographic variables like age, sex & weight.

There was no statistically significant difference among the groups ($p > 0.05$) as shown in table 1.The mean onset time of sensory & motor blockade was faster in group II (9.9±2.34, 14.8±2.48) when compared to group I (17.7±2.35, 21.4±3.22). The mean duration of sensory & motor blockade was more in group II (535.67±38.92, 428±38.54) compared to that in group I (386±42.23, 347±37.52). Duration of analgesia was higher in group II (684.36±41.27) than in group I (469.15±28.9). We noted that these differences were statistically highly significant with a p value of <0.001 (table 2). The sedation score was better in group II compared to group I & this difference is statistically significant ($p<0.001$).

Dexmedetomidine resulted in decrease in heart rate & mean arterial pressure, but not significant to warrant any intervention.

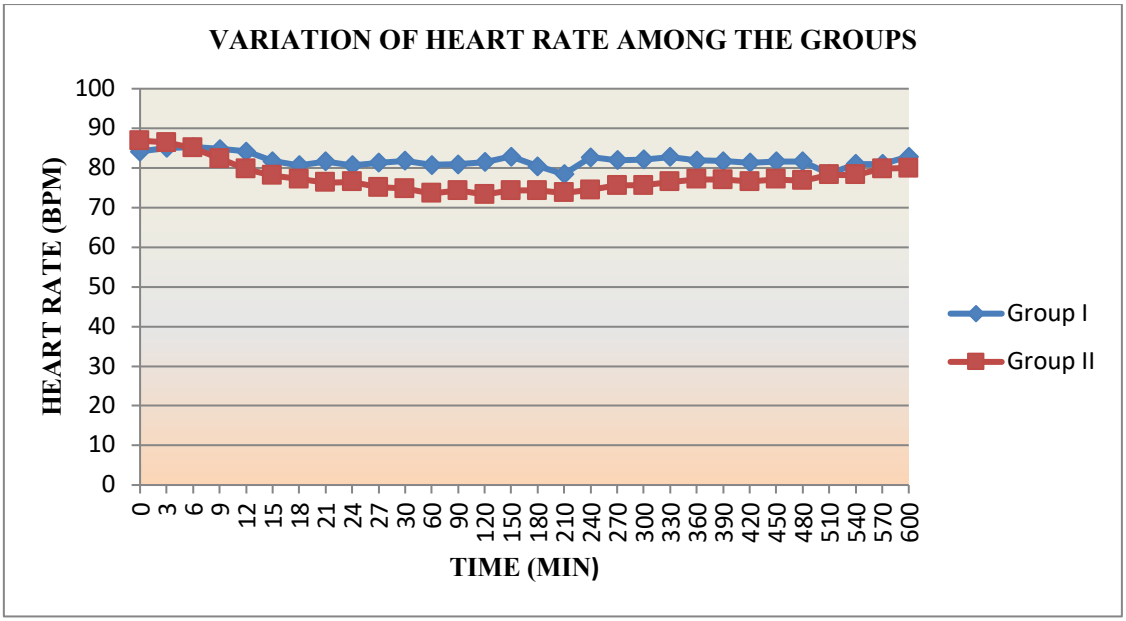
However, significant bradycardia was observed in 3 cases, it was transient & responded well to awakening the patient. The changes in blood pressure were without significant clinical impact & hypotension was seen in only 1 patient, which was easily managed with bolus IV fluids & inj. Mephentermine bolus.

Table 1: Comparison of demographic data among the groups:

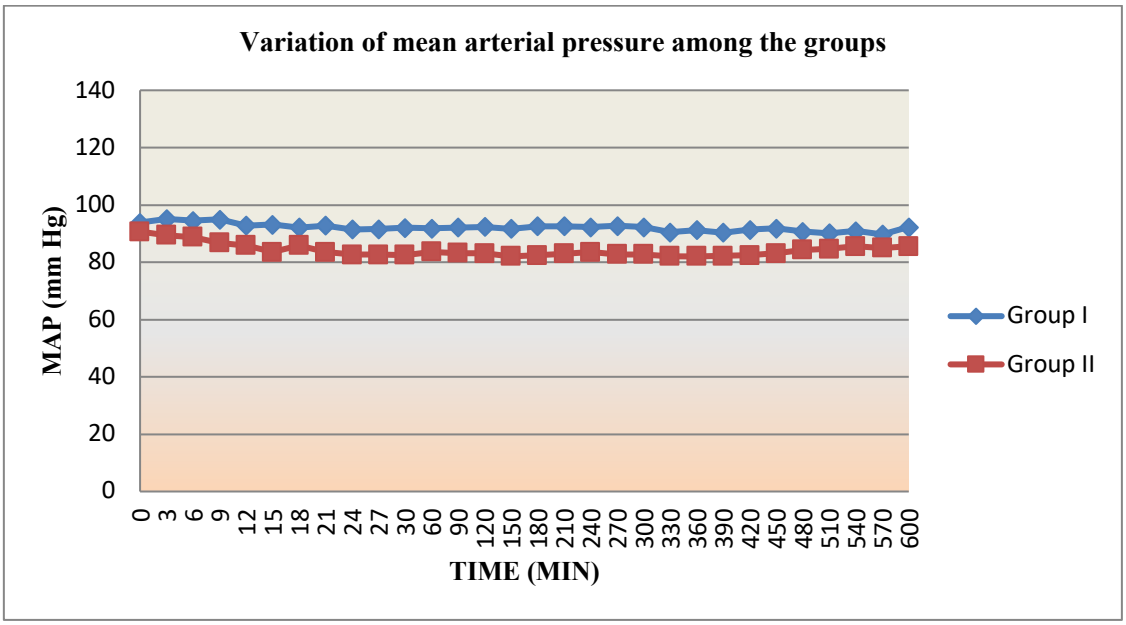
		Group I (Control Group)	Group II (Dexmedetomidine Group)	P Value
Age		33.7±13.57	31.5± 13.76	0.53
Sex	**Males**	24	25	0.73
	Females	6	5	
Weight		65.9±8.1	64±7.16	0.33

Table 2: Comparison of characteristics of block among the groups:

Characteristics	Group I (Control group) Mean±SD	Group II (Dexmedetomidine group) Mean±SD	P Value
Onset of sensory block (mins)	17.7±2.35	9.9±2.34	<0.001
Onset of motor block (mins)	21.4±3.22	14.8±2.48	<0.001
Duration of sensory block (mins)	386±42.23	535.67±38.92	<0.001
Duration of motor block (mins)	347±37.52	428±38.54	<0.001
Duration of analgesia (mins)	469.15±28.9	684.36±41.27	<0.001



Graph 1: Variation of heart rate among the groups:



Graph 2: Variation of Mean arterial blood pressure among the groups:

Discussion

Peripheral nerves and nerve plexus blocks are widely employed, cost effective anesthetic techniques. Ultrasound guided regional anesthesia techniques are in great demand due to the excellent quality of anesthesia and analgesia provided with negligible adverse effects. With these techniques, airway instrumentation and hemodynamic consequences of general anesthesia can be avoided. Brachial plexus block is an easy and relatively safe procedure for upper limb surgeries [12].

Dexmedetomidine is a α2 selective agonist which is similar to clonidine, but the specificity for the alpha-2 receptor is 8 times that of clonidine. The mechanism by which dexmedetomidine may increase the duration of a peripheral nerve block is not fully understood but is believed to most likely be a perineural mechanism rather than a systemic or central mechanism, which appears to prolong the duration by blocking the cation current [13]. Various studies have been carried out to assess the efficacy of dexmedetomidine as an adjuvant. In our study, the rationale for adding 50µg of Dexmedetomidine to local anesthetic was supported by study done by Esmaoglu et al [14]. They concluded that 50µg of Dexmedetomidine as an adjuvant to levobupivacaine shortened block onset time with prolongation of duration of block and analgesia. The mean onset time of sensory & motor blockade was faster in dexmedetomidine group.

F. W. Abdallah et al [15] did a Systematic Review and Meta-Analysis of all randomized controlled trials (RCTs) comparing the effect of dexmedetomidine as an LA adjuvant to LA alone on neuraxial and peripheral nerve blocks. The results showed that Sensory block duration was prolonged by 150 minutes with intrathecal dexmedetomidine and perineural dexmedetomidine used in Brachial Plexus block prolonged the mean duration of sensory block by 284 min. Motor block duration and time to first analgesic request was prolonged for both intrathecal and Brachial Plexus block. Dexmedetomidine produced reversible bradycardia in 7% of Brachial Plexus block patients, but no effect on the incidence of hypotension. No patients experienced respiratory depression. They concluded that Dexmedetomidine is a potential LA adjuvant that can exhibit a facilitatory effect when administered intrathecally as part of spinal anaesthesia or peripherally as part of a BP block.

In our study, the onset time for sensory and motor blockade was less in dexmedetomidine group. The duration of sensory & motor blockade was also prolonged in this group. These were statistically significant. Several studies done using dexmedetomidine as an adjuvant showed similar results. Sarita S swamy et al [9] compared clonidine and dexmedetomidine as an adjuvant to local anaesthetic agent in supraclavicular brachial plexus and concluded that dexmedetomidine when added to local anaesthetic in supraclavicular brachial plexus block enhanced the duration of sensory and motor block and also the duration of analgesia.

A comparative study of levobupivacaine alone and levobupivacaine with dexmedetomidine in supraclavicular brachial plexus block by Sudhir Sachdev et al [16] showed that dexmedetomidine group showed prolonged duration of sensory and motor block.

Sandhya Agarwal et al [17] compared the effects of adding dexmedetomidine to 0.325% bupivacaine in supraclavicular brachial plexus block and showed that Dexmedetomidine added as an adjuvant to bupivacaine for supraclavicular brachial plexus block significantly shortens the onset time and prolongs the duration of sensory and motor blocks and duration of analgesia.

Duration of analgesia in dexmedetomidine group was prolonged in our study. In a study done by Suneet Kathuria et al [18] to assess the efficacy of dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block, the results were similar to our study with respect to onset and duration of block, along with an increased duration of analgesia. A study to assess the effect of dexmedetomidine with bupivacaine by Shahryar Sane et al [19] concluded that dexmedetomidine reduced postoperative pain significantly with better block characteristics.

Heart rate & mean arterial pressure were lower in dexmedetomidine group compared to control group. All these findings were statistically significant. There was no statistically significant difference among the demographic data between the study groups.

Bradycardia & hypotension seen in dexmedetomidine group were clinically insignificant. There were no other side effects like nausea, vomiting or respiratory depression, making dexmedetomidine a better adjuvant for peripheral nerve blocks. Rachana Gandhi et al [20] conducted a prospective double-blind study to compare the postoperative analgesic efficacy and safety of dexmedetomidine (30µg) for brachial plexus blockade along with bupivacaine (0.25%). It was observed that dexmedetomidine group had better hemodynamic stability and greater postoperative analgesia.

From our study, we would like to suggest that dexmedetomidine can be safely used with local anesthetics in peripheral nerve blocks; however, further studies are required to assess its efficacy and also to determine any toxic effects on human nerves.

Limitations

1. Volume of local anesthetics used in the study could be reduced significantly as the block was done under ultrasound guidance.
2. Mixing of local anesthetics could be avoided.

Conclusion

We conclude that dexmedetomidine added to bupivacaine- lignocaine combination in supraclavicular brachial plexus block is:

1. Effective in reducing the time of onset of both sensory & motor blockade.
2. Effective in prolonging the duration of both sensory & motor blockade and duration of analgesia.
3. With very less incidence of clinically significant bradycardia & hypotension.

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