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COMPARATIVE STUDY OF DEXMEDETOMIDINE AND CLONIDINE AS AN ADJUVANT WITH BUPIVACAINE IN ULTRASOUND-GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK IN UPPER LIMB SURGERIES

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ABSTRACT **INTRODUCTION:** Supraclavicular brachial plexus block is a common regional anaesthetic technique used to provide anaesthesia and analgesia for upper extremity surgery. The anaesthetic and analgesic requirements get reduced to a huge extent by the use of adjuvants.

METHODS: 130 ASA class-I/II adult patients, aged 20-60 years undergoing elective surgical procedure of the upper limb were selected and randomly allocated in 2 groups (n=65). Patients in Group A received 28 ml of bupivacaine 0.25% with 2ml (1µg/kg diluted in saline) clonidine and patients in Group B received 28 ml of bupivacaine 0.25% with 2ml (1µg/kg diluted in saline) dexmedetomidine. We assessed the onset and duration of sensory and motor block, duration of analgesia, haemodynamic parameters and the proportion of cases with complications.

RESULTS: There was no statistically significant difference in the onset of sensory and motor block in both the groups. The duration of sensory & motor block, and the duration of analgesia was significantly lesser in Group A compared to Group B. (P<0.001)

KEYWORDS : Clonidine, Dexmedetomidine, supraclavicular brachial plexus block, bupivacaine

INTRODUCTION

The taxonomy committee of International Association for the Study of Pain (IASP) defines pain as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage."^[1] Inadequate pain control, apart from being inhuman, may result in increased morbidity or mortality. Regional anaesthesia of the upper extremity has several clinical applications and is reported to have several advantages over general anaesthesia. These advantages, such as improved postoperative pain relief, decreased postoperative opioid administration, and reduced recovery time, have led to widespread acceptance of a variety of regional nerve blocks.

Brachial plexus block is a popular and a widely employed regional nerve block of the upper extremity. Anaesthesiologists have approached the nerves of the upper limb at every anatomic division of the brachial plexus, from the level of the nerve roots to that of the isolated peripheral nerves. There are numerous approaches to perform brachial plexus block like interscalene^[2], parascalene^[3], subclavian perivascular^[4], supraclavicular, infraclavicular^[5], axillary^[6] and midhumeral. Supraclavicular approach to the brachial plexus is popularly used for upper limb surgeries. The plexus is compactly arranged here thus providing more complete and consistent block.

Local anaesthetics alone for supraclavicular brachial plexus block provide good operative conditions but have shorter duration of postoperative analgesia. Hence, in recent years addition of various adjuvants to local anaesthetic solution in an attempt to increase its efficacy and duration has gained popularity. It minimizes systemic adverse effects and results in a reduction in the total dose of local anaesthetic used.

Clonidine, an imidazoline, α_2 adrenoreceptor agonist, has been extensively studied as an adjuvant to local anaesthetic in peripheral nerve blocks. Dexmedetomidine is also an α_2 adrenoreceptor agonist and its selectivity to α_2 adrenoreceptor is 8 times greater than clonidine^[7]. The anaesthetic and analgesic requirements of local anaesthetic agents get reduced to a huge extent by the use of these two adjuvants because of their analgesic properties and augmentation of local anaesthetic effects. Their use is known to increase both sensory and motor block of local anaesthetics and decrease the post operative analgesic requirements.

The key to success of block depends on the accuracy of needle placement and placement of right amount of local anaesthetic in right concentration and spread of local anaesthetic around the nerve in the right fashion. In recent years, there has been growing interest in the development of ultrasound guided brachial plexus blocks. It provides excellent anatomical images of the brachial plexus^[8].

We conducted a study to compare the effects of clonidine and dexmedetomidine as adjuvants with bupivacaine in ultrasound guided supraclavicular brachial plexus block in upper limb surgeries.

METHOD

This hospital based, randomized, double blind interventional study was conducted in the Department of Anaesthesiology – Department of Orthopaedic Surgery, S.M.S Medical College and attached group of hospitals, Jaipur with due permission from the institutional ethics committee and review board and written informed consent from the patient. 130 ASA class-I and II adult patients, aged 20-60 years undergoing elective surgical procedure on upper limb of duration 1-4 hours were allocated in two groups of 65 each, in a randomized, double-blinded manner.

On arrival in the operation theatre, fasting status, consent and PAC were checked and baseline heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and oxygen saturation of blood (SpO₂) were recorded using a multipara monitor. An intravenous access was secured in the nonoperative upper limb in all the patients and infusion of Ringer's lactate was started as per the standard calculation of perioperative fluid replacement therapy. The patients were randomly divided into two groups of 65 patients by sealed envelope method. This was done and the medications were prepared by another person so that the patient and the person doing the study did not know in which group a particular patient has been allotted.

- **Group A** patients received 28 ml of bupivacaine 0.25% with 2ml clonidine (1µg/kg diluted in saline) for supraclavicular brachial plexus block.
- **Group B** patients received 28 ml of bupivacaine 0.25% with 2ml dexmedetomidine (1µg/kg diluted in saline) for supraclavicular brachial plexus block.

The patient was placed in supine position with a rolled sheet in the interscapular area. The head was turned to the opposite side and the ipsilateral arm was placed by the side of the body. After painting the area with chlorhexidine (2%), it was covered with sterile hole towel. After aseptic preparation of the area, ultrasound-guided supraclavicular brachial plexus block was performed on the side to be operated.

After performance of nerve block, patients were evaluated for onset of sensory block every minute till the block was established by pin prick test. The onset of sensory block was defined as time from injection of local anaesthetic till the disappearance of pain by pinprick at skin dermatomes C4-T2 in the distribution of median, radial, ulnar and musculocutaneous nerves.

Motor blockade was checked every minute by asking the patient to move the arm, elbow and fingers. The onset of motor block was defined as time from the injection of the local anaesthetic solution till motor paralysis equivalent to Bromage Score 3 was achieved.

Haemodynamic parameters were monitored intra operatively and upto 12 hours post operatively.

Time of complete return of sensory and motor blockade was noted. The duration of sensory block was defined as the time interval between the onset of sensory block (Grade 2) and complete resolution of anaesthesia (Grade 0), as determined by pin-prick. The duration of motor block was defined as the time between the onset of motor block (Bromage Score 3) to complete return of motor power (Bromage Score 0).

Rescue analgesic (Inj. Diclofenac 75 mg IV) was administered at a VAS score of ≥ 4 and the time was noted. The duration of analgesia was defined as the time between the end of local anaesthetic administration and the administration of rescue analgesic.

All the patients were observed for any side effects like nausea, vomiting, dryness of mouth and complications like sedation, pneumothorax, haematoma, local anaesthetic systemic toxicity and change in haemodynamic parameters in the intra and post-operative periods.

RESULTS

Both groups were comparable in terms of demographic profile such as age, sex, body weight and ASA physical status. Duration of surgery was almost the same in both the groups i.e. 77.28 \pm 12.06 minutes in Group A and 78.06 \pm 11.00 minutes in Group B.

Table 1: Demographic data

	Group A	Group B	P value
Mean Age (years)	31.94 \pm 10.69	31.80 \pm 10.68	0.941
Sex Ratio (M:F)	52:13	57:8	0.340
Body weight (kg)	58.57 \pm 5.61	58.80 \pm 6.04	0.821
ASA Physical status (Grade 1/Grade)	52/13	56/9	0.483

Values are expressed as mean \pm SD

There was no significant difference in the time of onset of motor and sensory block between both the groups. The duration of both, sensory and motor block as well as the duration of analgesia was significantly lesser in Group A as compared to Group B. The duration of analgesia was significantly longer in the dexmedetomidine group than in the clonidine group.

Table 2: Block characteristics

	Group A Mean \pm SD (minutes)	Group B Mean \pm SD (minutes)	P value
Onset time of sensory block	8.82 \pm 2.56	9.58 \pm 2.09	0.063
Onset time of motor block	11.66 \pm 2.71	12.46 \pm 2.77	0.098
Duration of sensory block	418.15 \pm 96.70	586.77 \pm 85.31	<0.001
Duration of motor block	350.77 \pm 91.18	504.62 \pm 79.07	<0.001
Duration of analgesia	497.92 \pm 104.46	694.31 \pm 90.47	<0.001

The baseline haemodynamic parameters were comparable in both groups.

Table 3: Baseline Clinical Variables

Variables	Group A Mean \pm SD	Group B Mean \pm SD	P value
Heart Rate (beats/minute)	73.20 \pm 6.55	74.65 \pm 4.44	0.143
Systolic BP (mm Hg)	119.54 \pm 8.01	122.09 \pm 8.20	0.075
Diastolic BP (mm Hg)	78.46 \pm 5.29	79.69 \pm 5.31	0.187
MAP (mm Hg)	92.15 \pm 5.49	93.84 \pm 6.10	0.100
SpO2 (%)	99.48 \pm 0.53	99.38 \pm 1.32	0.601

In the intraoperative and post operative periods, there was a decrease in heart rate as well as blood pressure observed in both the groups, with the dexmedetomidine group showing a greater decrease. There was a

statistically significant decrease in the heart rate and blood pressure in the dexmedetomidine group as compared to the clonidine group from 20 minutes after the time of administration of block till 1 hour post operatively. However, no drug therapy was required. No significant variation was observed in oxygen saturation, intraoperatively and postoperatively.

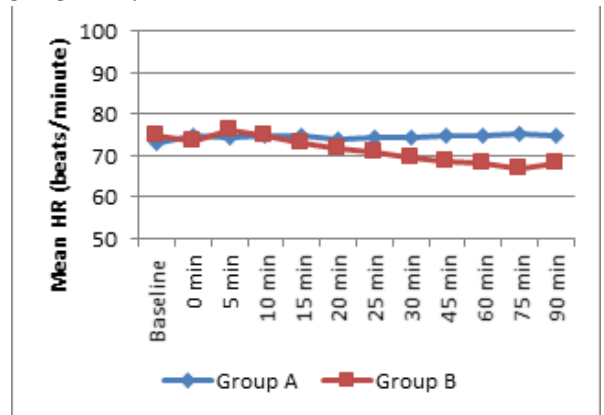


Fig 1- Trends of intraoperative mean heart rate at various time intervals

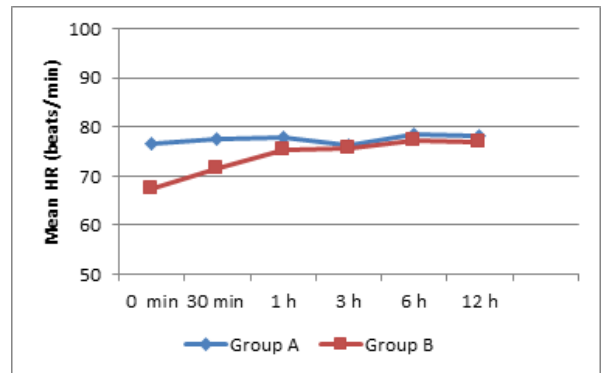


Fig 2-Trends of postoperative mean heart rate at various time intervals

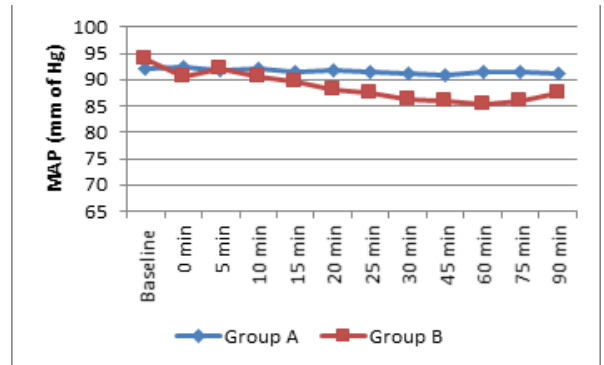


Fig 3-Trends of intraoperative mean blood pressure at various time intervals

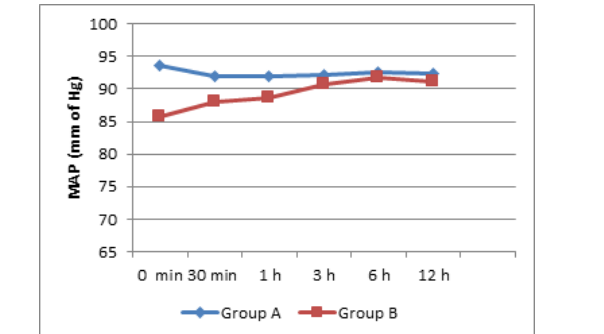


Fig-4Trends of postoperative mean blood pressure at various time intervals

No major complications were seen in either group. Hypotension and bradycardia that occurred in a few patients did not require any drug treatment.

DISCUSSION

Supraclavicular approach to the brachial plexus is popularly used for upper limb surgeries. To prolong the duration of analgesia in order to avail maximum benefit of single shot blocks, various adjuvants have been added to local anaesthetics.

Dexmedetomidine and clonidine are both α_2 adrenergic agonists. They are promising adjuvants administered perineurally and are known to increase both, the sensory and motor block of local anaesthetics.

Our study aimed to compare the efficacy of clonidine and dexmedetomidine as an adjuvant to 0.25% bupivacaine in ultrasound-guided supraclavicular brachial plexus block in terms of onset, degree and duration of sensory and motor block, duration of analgesia and to detect any potential complications.

The difference in the time of onset of sensory and motor block between the two groups was found to be statistically non significant. These results are consistent with the studies of Tripathi et al^[9] and Swami et al^[10], where no significant difference was seen in the time of onset of block with dexmedetomidine and clonidine when added as an adjuvant in supraclavicular block.

The difference in grade of maximum sensory and motor block at the commencement of surgery was not statistically significant between the two groups. This could be attributed to the higher accuracy in the placement of blocks as it was done under ultrasound guidance.

Dexmedetomidine provided longer duration of both motor and sensory blocks, and prolonged duration of analgesia as compared to clonidine. Similar results were seen in the studies conducted by Tripathi et al and Swami et al where it was observed that there was significant prolongation in the durations of sensory and motor block with dexmedetomidine as compared to clonidine when added to bupivacaine in supraclavicular brachial plexus block. The α_2 agonists dose dependently enhance local anaesthetic potency and prolong its duration by combining at the α_2 receptors at the peripheral level, thereby producing analgesia by reducing release of norepinephrine and causing α_2 receptor-independent inhibitory effect on nerve action potentials^[11]. Centrally, α_2 adrenoreceptor agonists produce analgesia by inhibition of substance P release in the nociceptive pathway at the level of the dorsal root neuron and by activation of α_2 adrenoreceptors in locus coeruleus^[12]. The other possible mechanisms by which the α_2 agonists improve local anaesthetic action include vasoconstriction around the site of injection, thus the absorption of local anaesthetic drug will be delayed, resulting in a prolongation of the local anaesthetic effect. The greater anaesthetic and analgesic effect seen with dexmedetomidine when compared to clonidine has been attributed to its greater α_2 selectivity.

A fall in heart rate was seen in both the groups following the administration of block, however, a greater decrease in heart rate occurred in the dexmedetomidine group as compared to the clonidine group. This could be explained by the fact that α_2 agonists enhance baroreceptor sensitivity and presynaptically mediate inhibition of norepinephrine release at the neuroeffector junction or by the vagomimetic effect. Dexmedetomidine having a greater selectivity towards α_2 receptors, produced a greater fall in heart rate when compared to clonidine.

Statistically significant fall in blood pressure was observed after 20 minutes of administration of block till 1 hour post operatively, with both the groups showing a fall in the above variables during the above specified time. There was a greater fall seen with dexmedetomidine. Clonidine and dexmedetomidine act by stimulating α_2 receptors in the vasomotor centre in the brainstem, which decreases peripheral vascular resistance, thereby lowering blood pressure. This binding of the drugs to the receptors decreases the presynaptic calcium levels, thus inhibiting the release of norepinephrine. The net effect is a decrease in the sympathetic tone, resulting in a decrease in blood pressure. Dexmedetomidine has a higher specificity as compared to clonidine towards the presynaptic α_2 receptors, thus produces a greater fall in blood pressure.

CONCLUSION

The addition of dexmedetomidine (1 μ g/kg) significantly prolongs the duration of sensory and motor block and duration of analgesia, and improves the quality of anaesthesia as compared to clonidine (1 μ g/kg) when injected with 0.25% bupivacaine in ultrasound guided supraclavicular brachial plexus block.

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