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Original article

Efficacy of Dexmedetomidine Compared to Clonidine added to Ropivacaine in Supraclavicular Nerve Blocks: A Prospective, Randomized, Double Blind Study

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ABSTRACT

Background: The supraclavicular brachial plexus blocks are one of the most commonly performed upper limb brachial plexus blocks. These blocks not only provides very good analgesia intraoperatively but also reduces incidence of complications like hypotension, bradycardia, delayed recovery from anaesthesia and also provides very good pain relief post operatively. Alpha-2 adrenergic agonists have become popular to prolong the duration of anaesthesia. In our study we have added dexmedetomidine and clonidine with ropivacaine 0.5% instead of bupivacaine since it is more cardio stable. **Aims:** The present study was aimed to test the hypothesis that dexmedetomidine produces a better analgesia, motor block and post operative analgesia when added as an adjuvant to ropivacaine 0.5% in supraclavicular brachial plexus block compared with clonidine. **Material and Methods:** One hundred patients, scheduled for various elective orthopedic surgeries on the upper limb belonging to ASA (American society of anaesthesiologists) class I and II were assigned randomly into two groups. Group RC received ropivacaine 0.5% (29 cc) + clonidine 1 μg/kg. Group RD received ropivacaine 0.5% (29 cc) + dexmedetomidine 1 μg/kg. Onset and recovery time of sensory and motor block, duration of analgesia and quality of block were studied in both the groups. **Results**: Dexmedetomidine prolongs the duration of sensory and motor block and enhances the quality of block as compared with clonidine when used as an adjuvant to ropivacaine in peripheral nerve block. **Conclusion:** Dexmedetomidine when added to ropivacaine for brachial plexus block is a better adjuvant compared to clonidine.

KEYWORDS: Dexmedetomidine, Clonidine, Ropivacaine, supraclavicular block

INTRODUCTION

The supraclavicular brachial plexus blocks are one of the most commonly performed upper limb brachial plexus block to provide anaesthesia below the mid arm surgeries. The brachial plexus bock was first performed by William Steward Halsted in 1889 using cocaine. The brachial plexus block not only provide very good analgesia intraoperatively but also reduces incidence of complications and side effects and provides very good pain relief post operatively also [1,2,3]. However these benefits can be short lasting if the duration of the action of local anaesthetics (LA) are short, resulting in conversion to general endotracheal anaesthesia which may be sometimes difficult to provide in the middle of the surgery especially in lateral positions.

Various methods have been used to extend the duration of analgesia like using higher volume of local anaesthetics [4] but it may also increase the risk of LA systemic toxicity [5]. Continuous catheter-based nerve blocks provide very good postoperative analgesia [6, 7] but their placement requires additional time, cost and skill [8]. There always been a search for an ideal adjuvant. Many adjuvants [9] have been used with varying degrees of success.

Alpha-2 adrenergic agonists become popular because for their has sedative, analgesic, antihypertensive, antiemetic actions in addition to reducing the anesthetic drugs requirement. Alpha-2 adrenergic agonists have been tried either alone or in combination with other drugs, in epidural, intrathecal and peripheral injections, to prolong the duration of anaesthesia [10].

Clonidine has been used as an adjunct to local anaesthetic agents in various regional techniques to extend the duration of block. The results of previous studies on the usefulness of clonidine on brachial plexus block have been mixed. Few studies have shown that clonidine prolongs the effects of local anaesthetics [10,11,12] but other studies have failed to show any effect of clonidine, Moreover, others have indicated an increased incidence of adverse effects like sedation, hypotension and bradycardia [13, 14, 15].

Dexmedetomidine is a highly selective α_2 adrenergic agonist with an affinity of eight times greater than clonidine [16]. Various studies have shown that dexmedetomidine prolongs the duration of sensory and motor block and provides very good analgesia when used as an adjuvant to LAs for nerve blocks [17,18,19,20]. The anaesthetic and the analgesic requirement get reduced to a huge extent by the use of dexmedetomidine because of its analgesic properties and augmentation of local anaesthetic effects as they cause hyperpolarisation of nerve tissues by altering transmembrane potential and ion conductance at locus coeruleus in the brainstem[21]. The stable haemodynamics and the decreased oxygen demand due to enhanced sympathoadrenal stability make it a very useful pharmacologic agent.

Till now most of the studies have used dexmedetomidine and clonidine with bupivacaine. In our study we have used ropivacaine 0.5% instead of bupivacaine has it is more cardio stable than bupivacaine. Ropivacaine is less lipophilic than bupivacaine and that, together with its stereo selective properties, contributes to ropivacaine having a significantly higher threshold for cardiovascular and CNS toxicity than bupivacaine in animals and healthy volunteers [22]. The present study was aimed to test the hypothesis that dexmedetomidine produces a better analgesia, motor block and post operative analgesia when added as an adjuvant to ropivacaine 0.5% in supraclavicular brachial plexus block compared with clonidine.

MATERIALS AND METHODS

Study population: One hundred patients, scheduled for various elective orthopaedic surgeries on the upper limb. The study was carried out in the department of anaesthesiology, Sanjay gandhi institute of trauma and orthopaedics, Bangalore. Patients were randomized into two groups. Group RC: Ropivacaine 0.5% (29 cc) + clonidine 1 μg/kg. Group RD: Ropivacaine 0.5% (29 cc) + dexmedetomidine 1 μg/kg. The allocation sequence was generated by random number tables.

Inclusion criteria: Patients belonging to ASA class I and II were included in the study after obtaining ethical committee clearance as well as informed consent from all patients. The patients were normotensive with age varying from 18 to 60 years belonging to both sexes.

Exclusion criteria: Patients with hypertension, with heart rate less than 60bpm, systolic blood pressure less than 100mm of Hg, presence of 1st, 2nd or 3rd degree heart block, hyperthyroid patients, patients on adrenoreceptor agonist or antagonist therapy, with known hypersensitivity to local anaesthetic drugs, pregnant women and pre-existing peripheral neuropathy, were excluded from the study.

Method: On arrival of the patient in the operating room, an 18-gauge intravenous line was secured in the unaffected limb and Ringer's lactate was started. Baseline heart rate, blood pressure and oxygen saturation were recorded. The patients were connected to multichannel monitor which records Heart rate (HR), non-invasive measurements of systolic, diastolic and mean arterial pressure(SBP, DBP, MAP), continuous ECG monitoring and oxygen saturation

The total volume of the solution used was 30ml and it was kept same in both the groups by adding saline when ever needed. The study drug was prepared by a senior anaesthesiologist who was not involved in the study. Under aseptic precautions, perivascular supraclavicular brachial plexus block performed using paresthesia technique. A negative aspiration for blood was performed before each incremental injection of 5ml to a total volume of 30ml of drug solution was given. A brief massage for one minute was performed to facilitate an even drug distribution.

Onset of sensory block was assessed by the spirit swab method. Assessment of motor block was carried out using the Bromage three point score [0= normal motor function with full flexion and extension of elbow, wrist and fingers, 1= decrease motor strength with ability to move fingers and/or wrist only, 2= complete motor blockade with inability to move fingers] by the same observer at each minute till complete motor blockade after drug injection. Sedation of patient was assessed by the Ramsay Sedation Score [23] .

Ramsay Sedation Score

Score	Response
1	Anxious or restless or both
2	Cooperative, orientated and tranquil
3	Responding to commands
4	Brisk response to stimulus
5	Sluggish response to stimulus
6	No response to stimulus

Blood loss assessment was done and fluid was administered as per the loss. Duration of surgery was noted. All patients were monitored for any side-effects like nausea, vomiting, dryness of mouth and complications like pneumothorax, haematoma, local anaesthetic toxicity and post-block neuropathy in the intra- and post-operative periods.

The duration of sensory block was defined as the time interval between the end of local anaesthetic administration and the complete resolution of anaesthesia on all nerves. The duration of motor block was defined as the time interval between the end of local anaesthetic administration and the recovery of complete motor function of the hand and forearm.

Statistical methods employed

Independent sample‘t’ test (to measure difference between two groups i.e. intergroup comparison). Contingency table analysis (for association between the rows and columns) $p < 0.05$ was considered as significant and $p < 0.001$ was considered as highly significant.

RESULTS

Table 1: Demographic data of the study subjects

	Group RC	Group RD	p value
Age(years) (Mean±SD)	32.19±11.11	32.88±10.12	0.962
Weight(kg) (Mean±SD)	59.35±4.26	62.23±7.22	0.54
Height(cm) (Mean±SD)	168.88±1.66	164.33±2.10	0.42
Gender (M/F)	12/13	15/10	0.38

Table 1 shows the demographic data of the patient's studied. There was no statistically significant difference between the groups with respect to mean age, weight, height and gender.

Table 2: Type of Fracture in the study subjects

Type of Fracture	Group RC	Group RD
Fracture Lower end humerus	10(20%)	8(16%)
Fracture Olecranon	7(14%)	9(18%)
Fracture Radius and Ulna	8(16%)	8(16%)
Total	25(50%)	25(50%)

Table 2 shows the type of fractures in the patients studied. Fracture lower end humerus was the most common fracture with total of 18 cases (10 in group RC and 8 in group RD), followed by fracture olecranon with 16 cases (7 in group RC and 9 in group RD) and fracture radius and ulna with 16 cases (8 in group RC and 8 in group RD) each.

Table 3: Characteristics of sensory and motor block in both the groups

	Group RC	Group RD	p value
Onset time of sensory block(min)	3.26±1.4	2.59±2.2	0.081
Onset time of motor block(min)	5.36±3.2	4.12±1.6	0.052
Duration of sensory block(min)	212.90±24.8	399.5±61.7	0.001
Duration of motor block(min)	189.65±14.2	363.11±54.2	0.001
Duration of analgesia(min)	227.88±24.9	414.32±14.2	0.001

Table 3 shows the characteristics of sensory and motor block in both the groups. There was no statistically significant difference between the groups with respect to the onset of sensory and motor block. There was significant prolongation of sensory block, motor block and duration of analgesia in group RD compared to group RC ($p = 0.001$).

Table 4: Comparison of pulse rate in both the groups

Duration	Group RC	Group RD	P value
Baseline	86	85	0.758
15 min	82	80	0.662
30 min	77	75	0.628
60 min	72	68	0.231
120 min	70	62	0.052
180 min	66	60	0.066

Table 4 shows the comparison of pulse rates in both the groups. Pulse rate in both the groups were comparable without any statistical significance. Significantly lower pulse rate was observed at 60, 120 and 180 min, but not less than 60 beats/min.

Table 5: Comparison of mean arterial pressure (MAP) in both the groups

MAP	Group RC	Group RD	P value
Baseline	88	87	0.788
15 min	86	84	0.625
30 min	84	80	0.112
60 min	80	77	0.231
120 min	78	74	0.088
180 min	78	72	0.061

Table 5 shows the comparison of mean arterial pressure in both the groups The mean arterial pressures were comparable in both the groups without any statistical significance.

DISCUSSION

Brachial plexus block is one of the most commonly performed peripheral nerve blocks in day today practice. It can be used as the sole anaesthetic technique or in combination with general anaesthesia for intraoperative and postoperative analgesia. Brachial plexus roots present between the scalenus anterior and medius muscle, where they combine to form the trunks. It is at this level supraclavicular blocks are performed. Trunks of the brachial plexus carry the entire sensory, motor and sympathetic innervations of the upper extremity in a very small surface area. As a result block is rapid in onset, predictable and dense anaesthesia along with its high success rate.

In our study, the drugs selected for supraclavicular block were ropivacaine, dexmedetomidine and clonidine. Ropivacaine, has structural similarity to bupivacaine but without cardiotoxic effects of bupivacaine [22], has been introduced to Indian market recently. Dexmedetomidine and clonidine has been studied by various authors as an adjuvant to local anaesthetic in supraclavicular block. Few studies have compared ropivacaine with dexmedetomidine and clonidine for supraclavicular block in India. Hence ropivacaine with dexmedetomidine and clonidine combination was selected for our study.

Presynaptic activation of alpha-2A adrenoceptor in the locus ceruleus inhibits the release of nor-epinephrine and results in the sedative and hypnotic effects [24]. In addition, the locus ceruleus is the site of origin for the descending medullospinal noradrenergic pathway, known to be an important modulator of nociceptive neurotransmission. Stimulation of alpha-2 adrenoceptors in this area terminates the propagation of pain signals leading to analgesia. Postsynaptic activation of alpha-2 receptors in the CNS results in decrease in sympathetic activity leading to hypotension and bradycardia [25].

Alpha -2 adrenoceptors present on primary afferent terminal (peripheral and spinal endings),in the superficial laminae of the spinal cord and within several brainstem nuclei have been implicated in the analgesia, supports the possibility of analgesic action of alpha agonist at peripheral, spinal and brainstem site. The direct action of clonidine on the nerve can be explained, by enhancing activity-dependent hyperpolarisation generated by the Na/K pump during repetitive stimulation, increases the threshold for initiating the action potential causing slowing or blockage of conduction [17,26].

We observed that the mean time of onset of sensory and motor block was earlier is dexmedetomidine group as compared to clonidine group, though the difference was not statistically significant. The mean duration of sensory

block in dexmedetomidine group was significantly prolonged (p <0.001) in compare to clonidine group. The mean duration of motor block was significantly longer in dexmedetomidine group than clonidine group. The duration of analgesia in dexmedetomidine group was significantly longer than clonidine group (p value <0.001). Our finding was similar to those of the study conducted by Swami SS, Keniya VM [10]. Patients in both the groups did not require sedation intraoperatively and they were comfortable throughout the surgery with arousable sedative effects. This can be explained on the basis that some amount of systemic absorption of drug could be present [27].The mean pulse rate and mean arterial pressure were comparable, although after giving block the scores were low in group RD as compared to group RC, but were statistically insignificant. None of the patients in any group suffered bradycardia and hypotension. Nausea and vomiting were negligible and comparable in both the groups.

CONCLUSIONS

From the present study it can be concluded that, dexmedetomidine prolongs the duration of sensory and motor block and enhances the quality of block as compared with clonidine when used as an adjuvant to ropivacaine in peripheral nerve block.

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