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Original research article

The effects of combination of Dexmedetomidine and Ropivacaine with Ropivacaine alone for Supraclavicular brachial plexus block

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Abstract

The advantages of effective postoperative pain management include patient comfort and therefore satisfaction; earlier mobilization, fewer pulmonary/cardiac complications, reduced risk of deep vein thrombosis, speedy recovery with less likelihood of developing neuropathic pain and reduced expenses. Thirty cases in each group were recruited for the study and were randomized to receive Ropivacaine alone or Ropivacaine with Dexmedetomidine. A pilot study was conducted to arrive at the actual mean differences, and the outcome parameters being studied with the visual analogue scale (VAS), Modified Bromage score and mean time for first analgesic requirement. Randomization was done based on computer generated randomization method. There was no statistically significant difference in mean VAS between both the groups at baseline (p=0.784), 5 minutes (p=0.897), 10 minutes (p=0.936), 15 minutes (p=0.196), 30 minutes (p=0.050), 45 minutes (p=0.084), 60 minutes (p=0.084), 75 minutes (p=0.062), and 105 minutes (p=0.141). There was a statistically significant difference at 90 minutes (p=0.044) and from 120 minutes onwards and thereafter (p<0.05) during follow up. Dexmedetomidine group had lower VAS compared to the control group.

Keywords: Dexmedetomidine, Ropivacaine, Supraclavicular brachial plexus block

Introduction

Indications for a supraclavicular block are operations on the elbow, forearm and hand. Blockade occurs at the distal trunk – proximal division level. At this point, the brachial plexus is compact and a small volume of solution produces rapid onset of reliable blockade of the brachial plexus. An additional advantage is that the block can also be performed with the patient's arm in any position [1].

Reliable supraclavicular blockade requires elicitation of a paraesthesia or motor response. The classic block may be somewhat difficult to describe and to teach. A proposed modification of the technique, the so-called plumb-bob approach, may decrease complications and simplify the concept of this block [2].

The advantages of effective postoperative pain management include patient comfort and therefore satisfaction; earlier mobilization, fewer pulmonary/cardiac complications, reduced risk of deep vein thrombosis, speedy recovery with less likelihood of developing neuropathic pain and reduced expenses [3, 4].

Supraclavicular brachial plexus block is the preferred regional anaesthesia for upper limb surgeries. Here, the brachial plexus is presented most compactly at the proximal division or at the trunk level that provides most reliable anaesthesia for upper limb surgeries by anaesthetising the middle and lower trunks over 80% of the times (median, radial and ulnar) [5].

Ropivacaine is a local anaesthetic with long duration of action, having similar pharmacology to bupivacaine; however, it has a wider safety margin and was shown to possess less cardiotoxicity in comparison to bupivacaine.

Adjuvants with local anaesthetics in brachial plexus block are being used to achieve a quick, dense and prolonged block. One among these being dexmedetomidine, a selective alpha 2 adrenoceptor agonist, which has higher affinity to alpha 2 receptors compared to clonidine [6].

Dexmedetomidine added to local anaesthetics shortens the onset time and prolongs the duration of block

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and postoperative analgesia in brachial plexus block. Addition of dexmedetomidine in clinically relevant doses to ropivacaine results in a dose dependent increase in the duration of sensory and motor block. However their combination in supraclavicular brachial plexus block has not been studied until now, hence the need for the study.

Methodology

Thirty cases in each group were recruited for the study and were randomized to receive Ropivacaine alone or Ropivacaine with Dexmedetomidine. A pilot study was conducted to arrive at the actual mean differences, and the outcome parameters being studied with the visual analogue scale (VAS), Modified Bromage score and mean time for first analgesic requirement. Randomization was done based on computer generated randomization method.

Type of study

A prospective study was conducted in patients of either sex requiring elective upper limb surgeries after obtaining an informed consent.

Inclusion criteria

- Age: 18 - 70 years.
- American society of anaesthesiologists (ASA) physical status I – III.
- Elective upper limb surgeries.

Exclusion criteria

- Patient refusal for procedure.
- ASA IV and V.
- Any bleeding disorder or patient on anticoagulants.
- Severe respiratory disease.
- Neurological deficits involving brachial plexus.
- Patients with allergy to local anaesthetics.
- Local infection at the injection site.
- Patients on any sedatives or antipsychotics.
- Body mass index (BMI) >35.
- Cardiac arrhythmias.
- Advanced heart block and/or severe ventricular dysfunction.
- Those on other vasodilators or negative chronotropic agents.
- Altered sensorium and/or CNS disorders.
- Pregnant and nursing women.

Sixty patients scheduled for Elective upper limb surgery were randomized and divided into two equal groups in a double blind fashion.

Group A (control): Patients in this group (n=30) received 30millilitres (mL) of 0.5% Ropivacaine + 1mL saline.

Group B (cases): Patients in this group (n=30) received 30mL of 0.5% Ropivacaine +1microgram (µg)/kilogram (kg) Dexmedetomidine.

Results

Table 1: Comparison of demographic variables

Parameters	Group A (Mean ± SD)	Group A (Mean ± SD)	p value
Age (Years)	40.63±15.203	40.97±15.517	0.933
Gender (Male/Female)	20/10	20/10	1.000
Weight (kg)	62.11±8.880	64.88±11.291	0.296
Height (m)	1.61±0.069	1.64±0.087	0.240
BMI (kg/m2)	23.3±3.246	23.7±4.000	0.629
ASA Grade(I/II/III)	15/2/13	15/5/10	0.432
Type of Surgery Orthopaedic/Vascular/Plastic	14/11/5	14/9/7	0.766
Duration of Surgery	100.33±39.347	91.00±37.975	0.354

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Table 2: Comparison of mean time of onset of sensory block between the groups

Mean time of onset of sensory block (mins)	Group A (Mean ± SD)	Group B (Mean ± SD)	p Value	Remark
	13.00±4.102	9.47±5.806	0.009	Significant

Onset of blockade was faster in group B (9.47±5.806) compared to group A (13.00±4.102 mins): this difference was statistically significant (p=0.009).

Comparison of mean time of onset of motor block (mins) between the study groups

Table 3: Comparison of the mean time of onset of motor block between the groups

Mean time of onset of motor block (mins)	Group A (Mean ± SD)	Group B (Mean ± SD)	p Value	Remark
	23.50±5.631	15.60±6.339	<0.001	Significant

Onset of blockade was faster in group B (15.60±6.339mins) compared to group A (23.50±5.631): this difference was statistically significant (p<0.001).

Table 4: Comparison of the mean duration of sensory block between the groups

Mean duration of sensory block (mins)	Group A (Mean ± SD)	Group B (Mean ± SD)	p Value	Remark
	400.77±86.589	630.60±208.247	<0.001	Significant

Duration of sensory blockade was prolonged in group B (630.60±208.247) compared to group A (400.77±86.589): this difference was statistically significant (p<0.001).

Table 5: Comparison of the mean duration of motor block between the groups

Mean duration of motor block (mins)	Group A (Mean ± SD)	Group B (Mean ± SD)	p Value	Remark
	346.90±76.934	545.90±224.044	<0.001	Significant

Duration of motor blockade was prolonged in group B (545.90±224.044) compared to group A (346.90±76.934): this difference was statistically significant (p<0.001).
Comparison of mean duration of analgesia between the groups

Table 6: Comparison of the mean duration of analgesia between the groups

Mean duration of analgesia (mins)	Group A (Mean ± SD)	Group B (Mean ± SD)	p Value	Remark
	411.00±91.250	805.67±205.891	<0.001	Significant

Duration of analgesia was prolonged in group B (805.67±205.891) compared to group A (411.00±91.250): this difference was statistically significant (p<0.001).

Discussion

Dexmedetomidine is an α2 selective agonist. It acts in a manner similar to clonidine which is also an α2 selective agonist.

A study by Brummet *et al*, [2] showed that dexmedetomidine enhances duration of bupivacaine anaesthesia and analgesia of sciatic nerve block in rats without any damage to the nerve. The histopathological evaluation of these nerve axons and myelin were normal in both control and dexmedetomidine plus bupivacaine groups.

In an another study, perineural dexmedetomidine added to ropivacaine for sciatic nerve block in rats prolonged the duration of analgesia by blocking the hyperpolarization-activated cation. This effect was reversed by a hyperpolarization-activated cation channel enhancer but not by a α2 adrenoceptor antagonist. This shows that the analgesic effect of peripheral perineural dexmedetomidine was caused by enhancement of the hyperpolarization-activated cation current, which prevents the nerve from returning from a hyperpolarized state to resting membrane potential for subsequent firing [7].

Kousugi *et al* in their study found that high concentrations of dexmedetomidine inhibit compound action potential (CAP) in frog sciatic nerves without α2 adrenoceptor activation. Their result showed that dexmedetomidine reduced the peak amplitude of CAPs reversibly and in a concentration dependent manner. This action was not antagonized by α2 adrenoceptor antagonists (i.e., yohimbine and Atipamezole); rather, α2 antagonists reduced the CAP peak amplitude. Clonidine and oxymetazoline, two other α2 agonists, also inhibit CAPs. The maximum effect of clonidine was only 20%. On the other hand, adrenaline, noradrenaline and α1 agonist phenylephrine and beta agonist isoprenaline had no effect

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on CAPs [8].

The efficacy of peripheral perineural dexmedetomidine added to bupivacaine and ropivacaine for sciatic nerve blocks in rats has been established. The increase induration of analgesia is dose dependent and the effect is peripheral (i.e., not caused by centrally mediated or systemic analgesia) [9].

However, all the studies carried out so far to prove the peripheral action of α2 agonists were animal studies. There are very few human studies, i.e. greater palatine and axillary brachial plexus nerve blocks have subsequently demonstrated that increased duration of sensory blockade can be achieved by adding dexmedetomidine to bupivacaine and levobupivacaine, respectively. Keeping these facts in mind this study was decided to study the action of dexmedetomidine on a less cardiotoxic local anaesthetic like ropivacaine in supraclavicular brachial plexus block, so that by increasing the duration of analgesia with a single shot block we can achieve a longer duration of postoperative analgesia without significant clinical side-effects and hence can avoid continuous catheterization.

In this study, dexmedetomidine was used as an adjuvant to local anaesthetic. The assessment of onset and duration of block was carried out by the principal investigator who was blinded to the drugs administered during the block.

In this study, there was no statistically significant difference among the demographic data, duration of surgery and type of surgery between the study groups. The onset of sensory and motor block was earlier and there was prolonged duration of sensory and motor block and duration of analgesia in the group receiving dexmedetomidine.

Esmaoglu *et al* [10] added dexmedetomidine to levobupivacaine for axillary brachial plexus block and showed that it shortens the onset time of both sensory and motor block, prolongs the duration of block and the duration of postoperative analgesia. This may be because peripheral α2 agonist produces analgesia by reducing release of norepinephrine, leading to α2 receptor independent inhibitory effects on nerve fibreaction potentials. In this study there was early onset and prolongation of duration of sensory and motor block. It was also found that there was lesser pain scores and hence prolonged duration of analgesia in those who received dexmedetomidine with ropivacaine for the block. All these findings were statistically significant.

Conclusion

We conclude that perineural dexmedetomidine added to ropivacaine in supraclavicular brachial plexus block is extremely effective in reducing the time of onset and prolonging the duration of sensory and motor blockade.

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