Efficacy of Clonidine as an Adjuvant to Ropivacaine in Supraclavicular Brachial Plexus Block in Patients undergoing Upper limb Surgery: A Randomized Controlled Trial

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ABSTRACT

Introduction: Adjuncts to local anaesthetics for peripheral nerve blocks are often required to enhance the duration of analgesia and improve the onset and duration of sensory and motor blocks. The present study was conducted to evaluate the effect of Clonidine as an adjuvant to Ropivacaine in supraclavicular brachial plexus block for upper limb orthopaedic surgeries.

Methods: 60 ASA I or II adult patients posted for upper limb surgeries under supraclavicular brachial plexus block were randomly divided into two groups of 30 each. Patients in Group A were administered 30mL of 0.5% Ropivacaine with Clonidine 75µg and patients in Group B were administered 30mL of 0.5% Ropivacaine alone. The onset time and duration of sensory and motor blockade were recorded. Haemodynamic variables and any other side effects were recorded.

Results: The onset of sensory and motor blocks was hastened and the duration of sensory and motor blocks were prolonged in Group A as compared to Group B and the difference was statistically significant (P<0.001). Haemodynamic variables were stable and no side effects of Ropivacaine and Clonidine were recorded.

Conclusion: Clonidine (75µg) in combination with 30mL of Ropivacaine (0.5%) hastened the onset of sensory and motor block, and improved the duration of sensory and motor block when used in supraclavicular brachial plexus block, without producing any adverse events.

Keywords: Supraclavicular, Brachial Plexus Blocks; Clonidine; Ropivacaine.

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Introduction

Brachial plexus blocks provide a useful alternative to general anaesthesia for upper limb surgeries. They provide good operating conditions by producing complete muscular relaxation, maintaining stable intraoperative haemodynamics, and also providing postoperative analgesia without any systemic side effects.[1]

Ropivacaine is an aminoamide type local anaesthetic agent, pure S-enantiomer. It produces effects by inhibition of sodium ion influx in nerve fibres. Ropivacaine has lower lipid solubility than bupivacaine and is less likely to penetrate large myelinated motor fibres, resulting in a relatively reduced motor blockade. Thus, Ropivacaine has a greater degree of motor-sensory differentiation, which could be useful when the motor blockade is undesirable. The reduced lipophilicity is also associated with decreased potential for central nervous system toxicity and cardiotoxicity.[2]

Several agents have been suggested for use as adjuvants with agents for regional anaesthesia

blocks and reported to have beneficial effects. Clonidine is an imidazoline alpha-2 adrenergic agonist mainly used as an anti-hypertensive agent. Alpha-2A receptors mediate sedation, analgesia, and sympatholysis. Clonidine is known to produce anti-nociception and enhance the effect of local anaesthetics when given intrathecally, epidurally, and in peripheral nerve blocks.[2] Clonidine produces this effect by modulating pain pathways through presynaptic alpha-2A adrenergic receptors. It also produces sedation through acting on pontine locus ceruleus where the highest density of alpha-2 receptors is present.

The aim of this present study was to evaluate the analgesic action and duration of sensory and motor block of clonidine when used as an adjuvant with ropivacaine in supraclavicular brachial plexus block for upper limb orthopaedic surgeries.

Material and Methods

This prospective double-blinded randomised clinical study was conducted after obtaining Institutional Ethical Committee approval and informed written consent from the patients. Patients with ASA Grade I and II, between 18 – 60 years of age, of either sex, posted for the elective orthopaedic surgery of arm and forearm under supraclavicular plexus block were included for the study. Patients who are having known allergy to the local anaesthetic agent, patients with cardiac insufficiency, ischemia, arrhythmia, valvular heart disease, hypertension, renal failure, liver failure, peripheral neuromuscular disease, bleeding or coagulation disorder, patients with a history of epilepsy/seizure disorder, patients receiving chronic analgesics, psychotropic medications, chronic alcoholism or drug abuse, pregnant and breastfeeding females, deaf and dumb patients were excluded from the study. Patients were divided into two groups of 30 patients each using computer-generated numbers – Group A (0.5% ropivacaine 30 ml + 0.5 ml 0.75mcg clonidine) and Group B (0.5% ropivacaine 30 ml + 0.5 ml 0.9% normal saline). After obtaining written consent, preoperative evaluation, and patient preparation, vital monitors attached and details were recorded, intravenous access secured with 20 G cannula and RL fluid started.

Supraclavicalar brachial plexus block was performed using a peripheral nerve stimulator and the prepared volume of the drug was delivered with the serial negative aspiration to avoid intravascular injection. The duration of analgesia, onset, and duration of sensory block, onset, and duration of motor block were recorded.

Sensory block was evaluated by pinprick test. The onset of sensory block was defined as the time elapsed between injection of the drug and a dull sensation to pinprick and complete loss of sensation was defined as a complete sensory blockade.
Motor block was evaluated by using Modified Bromage Scale for upper extremities.

Grade 0: Normal motor function with full flexion and extension of elbow, wrist and finger.
Grade 1: Decreased motor strength with ability to move the fingers only.
Grade 2: Complete motor block with inability to move the fingers.

Even after 30 minutes of the drug delivery if any of the major nerves involved in the surgical dermatomal area remains unaffected, an alternative plan of anaesthesia was chosen and the case was excluded from the study.

Heart rate, non-invasive blood pressure, and oxygen saturation were also monitored.
Duration of sensory block (the time elapsed between injection of drug and appearance of pain requiring analgesia) and duration of motor block (the time elapsed between injection of the drug and complete return of muscle power) were also recorded.

Injection Diclofenac sodium intramuscularly was given as a rescue analgesic when patients complain of pain.

Statistical Analysis

All statistical analyses were performed by using SPSS 22.0 software package (SPSS Inc., Chicago, IL, USA). Yates continuity correction test *(Chi-square test), Fisher's exact test, and Fisher---Freeman---Halton test were used for comparison of qualitative data.

All data were summarized as mean ± SD for continuous variables, numbers, and percentages for categorical variables. A P & lt; 0.05 was accepted as statistically significant.

Results

A total of 60 patients of age group 18-55 were included in the study, 30 in each group. Both groups were comparable in regard to age, gender, ASA grade, and the type of surgery. There were no significant differences (P>0.05) **[Table 1]**.

Parameters	Group A	Group B	P value
Age (mean in years)	33.67±11.59	33.87±9.86	>0.05
Gender (male %)	61.8	61.8	>0.05
ASA score Grade I	23	24	>0.05
Grade II	7	6	>0.05

Table 1: Demographic profile of patients

The time to complete sensory blockade [group A (6.38±1.12 min); group B (10.35±1.06 min)] and complete motor blockade [group A (9.85±1.28 min); group B (12.85±1.283min)] was faster in group A and the difference was statistically significant (P<0.001) **[Table 2]**. The duration of sensory block [group A (660±0.60 min); group B (480±0.60 min)] and motor block [group A (600±0.68 min); group B (420±0.65min)] was longer in group A and the difference was statistically significant (P<0.001) **[Table 2]**.

The baseline haemodynamic parameters in both the groups were comparable at all the times.

Parameters	Group A	Group B	P value
Complete sensory block	6.38±1.12	10.35±1.06	<0.001
Complete motor block	9.85±1.28	12.85±1.28	<0.001
Sensory block duration	660±0.60	480±0.60	<0.001
Motor block duration	600±0.68	420±0.65	<0.001

Table 2: Onset and duration of sensory and motor block

Discussion

Brachial plexus block is commonly used for the surgeries of the arm, elbow, forearm. Various adjuvant drugs like opioids, midazolam, neostigmine and ketamine[3-6] have been used as adjuvants with local anaesthetics to prolong the period of analgesia, Clonidine is known to produce antinociception and to enhance the effect of local anaesthetic when administered intrathecally and epidurally. Clonidine produces this effect by its action on Alpha 2

adrenergic receptors found in peripheral nerves.

Hence the study was conducted to evaluate the efficacy of Clonidine as an adjuvant to the local anaesthetic agent (Ropivacaine) in supraclavicular brachial plexus block in terms of onset time, duration of analgesia, and haemodynamic variables.

The results of our study signifies that both the groups were comparable with respect to demographic profile, duration, and type of surgery. Haemodynamic parameters were comparable in both groups. In our study, we found that the time to complete sensory and motor blockade was significantly faster in patients who received a combination of Clonidine and Ropivacaine. Time to complete sensory blockade [group A (6.38±1.12 min); group B (10.35±1.06 min)] and complete motor blockade [group A (9.85±1.28 min); group B (12.85±1.283min)]. This could be due to a local direct action of Clonidine and its synergistic action with that of local anaesthetics.

The onset of sensory block was found to be faster than the onset of motor block in both groups. Our results showed that sensory block tended to last longer as compared to motor block which agrees with the observation by de Jong et al and Singh S et al.[7] These authors explained that large fibres require a higher concentration of local anaesthetic than small fibres. The minimal effective concentration of local anaesthetic for large (motor) fibres is greater than for small (sensory) fibres. Thus, the motor function returns before pain perception, and the duration of the motor block is shorter than the sensory block.

In our study, the mean duration of sensory block [group A (660±0.60 min); group B (480±0.60 min)] and motor block [group A (600±0.68 min); group B (420±0.65min)] was significantly longer in group A (P< 0.001). A prospective, randomized, double-blind, controlled study was conducted by Rohan B et al[8] to assess the efficacy of Clonidine as an adjuvant to Ropivacaine in brachial plexus block. They observed that use of clonidine with ropivacaine results in the early onset of sensory and motor block and a prolonged duration of analgesia and motor block. These results are comparable with our study.

Various studies in which Clonidine was used in peripheral nerve block found that Clonidine with Ropivacaine improves analgesic characteristics compared to Ropivacaine alone. Siddarth Srban et al[9] found that a Ropivacaine and Clonidine combination increases the onset and duration of motor and sensory block compared to Ropivacaine alone when administered for brachial plexus block.

Popping et al[10] added clonidine as an adjuvant to a local anaesthetic agent for nerve or plexus block and observed that clonidine prolonged the postoperative analgesia and sensory and motor block. Clonidine produces this additive effect on local anaesthetics by its action on the presynaptic alpha-2 receptor complexes present on peripheral nerves.

The prolonged analgesia in Group A could be due to the action of Clonidine by inhibiting the action potential of A & C fibers in peripheral nerves as demonstrated by Gaumann et al.[11] Many authors favour the hypothesis that Clonidine exerts its local anaesthetic-prolonging effect directly on nerve fibre, as a result of a complex interaction between Clonidine and axonal ion channels or receptors.[12] Masuki et al.[12] suggested Clonidine may produce local vasoconstriction resulting in delayed absorption of local anaesthetic and block prolongation.

Conclusion

Hence the study concludes that the use of Clonidine as an adjuvant to Ropivacaine in supraclavicular brachial plexus block, enhances the onset of sensory and motor block, increases the duration of analgesia and duration of sensory and motor block with stable haemodynamics and no significant side effects.

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