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Clonidine as an Adjuvant to 0.5% Ropivacaine for Supraclavicular Brachial Plexus Block in Patients Undergoing Orthopedic Surgery of Forearm and Hand - A Randomized Controlled Trial

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Abstract
Background: *Regional anesthesia blocks are being increasingly used to cater to the variety of surgical procedures for the forearm and hand. Methods to enhance the duration of analgesia and shorten the onset and lengthen the duration of sensory and motor block can reduce the need for general anesthesia to many patients. Use of adjuvants has an important role in achieving this goal.*
Materials and Methods: *110 patients requiring supraclavicular block for procedures of the forearms and hand were randomly assigned to two groups- group A were administered 0.5% ropivacaine with 150µg clonidine and group B with 0.5% ropivacaine alone.*
Results: *Patients given ropivacaine-clonidine combination demonstrated duration of analgesia of 734 minutes compared to the ropivacaine-only group (504 minutes). The onset was shortened and duration of sensory and motor block was prolonged for the combination group. The difference between the two groups was highly statistically significant.*
Conclusions: *Clonidine has an important role in prolonging the analgesic effect of supraclavicular brachial plexus block. In addition, its hortens the onset and prolongs the duration of motor and sensory block.*
Keywords: *Adjuvant, clonidine, ropivacaine, supraclavicular block.*

Introduction

Regional anesthesia is the preferred method for surgery of the extremities and brachial plexus block is commonly used for surgical procedures of the forearm and hand. In addition to avoiding general anesthesia with its potential adverse effects, regional anesthesia techniques enable surgical procedures with short hospital stay and consequent cost reduction. Ropivacaine, a new aminoamide local anesthetic is a long acting anesthetic and is suggested as a substitute for bupivacaine.

The use of adjuvants in conjunction with agents for regional anesthesia blocks has been reported to

have beneficial effects and several agents have been suggested.[1,2,3,4,5,6] Clonidine is an α agonist with partial action on α-2 receptors and is being used as a centrally acting antihypertensive agent. The addition of clonidine as an adjuvant to local anesthetics has beenreported to prolong the duration of analgesia and motor block.[1,3,4,7,8,9] However, studies on the adjuvant effects of clonidine have primarily focused on using intermediate acting local anesthetic agents.

The few studies using clonidine as an adjuvant of ropivacaine in plexus blocks have contradictory results – some have reported a significant prolongation of nerve block, while others showed no significant prolongation.[10,11,12] Moreover, there is a lack of data on the effect of this combination in the Asian population.

The aim of this trial was to study the effect of clonidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block with regards to its analgesic action and duration of sensory and motor block.

Materials and Methods

This randomized controlled trial was initiated following approval of the protocol by the Research Methodology and Human Ethical Committee. Patients above 18 years reporting for supraclavicular brachial plexus block for surgeries of the forearm and hand constituted the study population. Patients with Mallampati class IV, contraindication to axillary brachial plexus block or to the study medications and pregnant or lactating women were excluded from the study. After explaining the details of the study, informed consent was obtained from the study participants prior to inclusion in the study.

A total of 110 patients of American Society of Anesthesiologists (ASA) 1, 2 and 3 categories undergoing orthopedic surgery of forearm or hand were randomly assigned to two groups using computer generated random number tables. After preoperative evaluation and patient preparation, the patient details were recorded in the proforma. The patients were randomly allocated to the two groups - group A (0.5% ropivacaine 30mL + 1 ml 150µg clonidine) and group B (0.5% ropivacaine 30mL+ 1ml 0.9% saline).

Supraclavicular brachial plexus block was administered with peripheral nerve stimulator to deliver the drugs. Post-operative analgesia was defined as the time until first analgesic request after the initial administration of the drugs mentioned above. The duration of analgesia, onset and duration of sensory block, onset and duration of motor block were recorded at the 1st minute and at 5, 10, 30, 60, 120, 180, 240, 360 and 480 minutes after completion of injection.

Sensory block (SB) was determined by pin prick test. Patient was requested to compare the pinprick (26 G needle) sensation on the test arm to that in the contra lateral arm as reference on a scale range of 0 = no sensation to 100 = full sensation. Sensory block onset was defined as reduction in sensibility to 30% or less[13]. If, at the end of 30 minutes after injection, any of the major nerves involved in the area of planned surgical intervention had a sensibility of more than 30%, they were separately blocked or alternative method of anesthesia was chosen and the patient was excluded from further investigation under this study. Duration of sensory block was defined as the time interval between injection and complete recovery of sensation[13]. The patients were asked to note the complete recovery of sensation, which was then verified by the anesthetist.

Motor block (MB) was determined using the modified British Medical Research Council rating scale ranging from 5 (normal power) to 0 (complete paralysis). Motor block onset is defined as a reduction in power to 3 or less[13].

Statistical Analysis

Data were analyzed using computer software, Statistical Package for Social Sciences (SPSS) version 10. Data are expressed in its frequency and percentage as well as mean and standard deviation. To elucidate the associations and comparisons between different parameters, chi square (χ^2) test was used as nonparametric test.

Student's t test was used to compare mean values between two groups. Mann-Whitney U test was employed as non-parametric test to compare scores between groups. For all statistical evaluations, a two-tailed probability of value, $P < 0.05$ was considered as statistically significant.

Results

Table 1 shows the demographic profile and surgical characteristics of the two groups. No significant differences ($P > 0.05$) were observed between them.

Table 2 summarizes the findings obtained from the study. The mean duration of analgesia in the ropivacaine-clonidine group is 734 minutes, while in the ropivacaine-only group, it was 504 minutes. Comparison of the two groups showed the differences to be highly statistically significant. The onset and duration of sensory and motor block between the two groups were also highly statistically significant.

Discussion

This study examined the effect of adding clonidine to ropivacaine for supraclavicular brachial plexus block in patients undergoing orthopedic surgery of forearm or hand in prolonging the duration of analgesia and sensory and motor block.

Only patients of ASA 1, 2 and 3 were included in the study. ASA 4 cases were excluded to avoid morbidity due to the reported side effects of clonidine like hypotension and bradycardia. In our study, majority (97.27%) of the patients were of ASA 1 and 2. Majority of the patients were males (61.80%) in group A and (61.80%) in group B. This pattern of age and sex distribution is understandable as all were undergoing orthopedic surgery for fractures sustained by road traffic accidents. Patients attending the hospital due to road traffic accidents have a similar age and sex distribution. The patient characteristics of the two groups were comparable.

The duration of post-operative analgesia was longer in the ropivacaine-clonidine group (734.45±28.28 minutes), in comparison with the ropivacaine-only group (504.82±21.84 minutes), indicating a mean prolongation of 230 minutes. The difference was found to be highly significant statistically.

Similar results were obtained by El Saied et al [8] who reported prolongation of analgesia from 587 minutes to 828 minutes with a mean difference of 241 minutes. Popping et al[1] in a meta-analysis of twenty randomized trials investigated the effect of adding clonidine as an adjuvant to local anesthetic agents for nerve or plexus blocks. They observed clonidine to prolong the postoperative analgesia, sensory and motor block. Erlacher et al[7] evaluated the effects of clonidine on three local anesthetics - mepivacaine 1%, ropivacaine 0.75% and bupivacaine 0.5% and achieved increased duration with the bupivacine-clonidine combination only.

The exact mechanism by which clonidine prolongs the duration of block in combination with local anesthetic agents in plexus blocks has not been elucidated. Duma A et al[9] suggested that clonidine exerts an effect directly on the nerve fiber, as a result of a complex interaction between clonidine and axonal ionotropic, metabolic, or structure proteins/receptors. Other α-2 agonists have been observed to be effective adjuvants to local anesthetic agents - opioids, clonidine, ketamine and neostigmine (Klein et al[14])

Studies suggest that perineurally injected clonidine has an analgesic effect through systemic reabsorption. Only two studies compared clonidine across routes. Patients received 150 micrograms of clonidine subcutaneously or added to mepivacaine for brachial plexus block[15]. The duration of postoperative analgesia was longer in patients receiving clonidine into the plexus sheath. In another study, 140 micrograms of clonidine was added to ropivacaine for sciatic-femoral nerve block or was injected intramuscularly. In that trial, clonidine had no effect on the quality or duration of postoperative analgesia through either route.

The onset of sensory and motor block was shortened by the addition of clonidine by an average of 1.4 min and 1.7 min respectively. The

difference was observed to be statistically significant. However, whether a difference of 1.4 min and 1.7 min has any clinical relevance is doubtful.

El Saied et al [8] reported no difference in onset of sensory and motor block between ropivacaine and ropivacaine-clonidine group.

Mean duration of sensory block in the ropivacaine-clonidine group was 682.91±42.12 minutes while in the ropivacaine-only group, it was 487.64±20.59 minutes. This difference of 195 minutes showed a statistically significant difference in the prolongation of the duration of the sensory block. The study by El Saied[8] concluded that the clonidine group of patients showed an increase in duration of sensory loss of 138 minutes. Mean duration of motor block in group A was 533.98 ±40.78 minutes while in group B it was 335.98±23.85 minutes. This denotes a mean difference of 198 min.

The findings from the present study suggest the benefit of using clonidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block for orthopedic surgeries. A prolongation of the nerve block by nearly four hours could be achieved in addition to the limited benefit on the onset and duration of sensory and motor block. Further research is required to understand the mechanism of this effect and generalizability to other surgical procedures. In the long term, effective regional blocks will reduce patient morbidity and treatment costs.

Table 1 – Baseline characteristics

	Group A	Group B	P value
Age (mean in years)	44±14.42	40.2±15.32	> 0.05
Gender (male, %)	61.8	61.8	> 0.05
ASA score Grade 1	36	38	> 0.05
Grade 2	16	17	
Grade 3	3	0	

Table 2 - Duration of analgesia, motor block, sensory block

	Group A	Group B	P value
Duration(minutes)	734.45±28.28	504.82±21.84	<0.001
SB onset	15.38±1.48	16.8±1.33	<0.001
MB onset	17.09±1.19	18.8±1.21	<0.001
SB duration	682.91±42.12	487.64±20.59	<0.001
MB duration	533.98±40.78	335.98±23.85	<0.001

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