RESEARCH ARTICLE

Clonidine Enhances Bupivacaine-Lignocaine Supraclavicular Block for Upper Limb Surgery in Tertiary Care Hospital, Salem, Tamil Nadu: A Prospective Study

Arjun Ganesan[1], K Viveka[2], Rasikapriya M[1], VA Sabapathy[1*]

[1]*Department of Anaesthesiology, Vinayaka Mission's Kirupananda Variyar Medical College & Hospitals, VMRF, Salem, Tamil Nadu, India.*

[2]*Department of Anaesthesiology, Chettinad Hospital and Research Institute, Kelambakkam, Tamil Nadu, India.*

Received: 15th November, 2023; Revised: 20th November, 2023; Accepted: 18th January, 2024; Available Online: 25th March, 2024

ABSTRACT

Background and Aims: The novel amides bupivacaine and lignocaine are long-acting local anesthetics with distinct blocking properties. The quality of blocking peripheral nerve is enhanced when clonidine is combined with local anesthetics. This investigation aims to evaluate clonidine's effects on the features of the brachial nerve plexus supraclavicular block induced by ropivacaine.

Material and Methods: Two groups of thirty adults each were randomly selected from a total of 60 patients. Group I: About 60 subjects will receive 15 mL each of lignocaine and 0.5% bupivacaine 2% with adrenaline (1:200000) combination. Group II: 30 subjects will receive a mixture of 15 mL each 0.5 and 2% bupivacaine and lignocaine, respectively with adrenaline (1:200000) combined with clonidine (30 mcg).

Results: Group II experienced sensorimotor block onset earlier than group I, with sensory block starting at 11.28 ± 1.53 minutes and motor block starting at 9.53 ± 1.32 minutes (19.06 ± 1.7 minutes for blocking sensory nerve and 15.33 ± 2.09 minutes for blocking motor nerve). $p < 0.05$ determined that both differences were statistically significant. The need for rescue analgesia was significantly higher in group A ($p < 0.05$). Blocking both sensory and motor nerve blocks occurred more quickly and lasted longer than expected. Hemodynamic measurements, including SPO_2 (oxygen saturation), heartbeat, and cardiovascular blood pressure measurements (systolic and diastolic), did not show any discernible variation.

Conclusion: The supraclavicular brachial plexus block quality is greatly improved when clonidine is added to ropivacaine as an adjuvant. This results in a quicker onset of anesthesia, increased post-operative pain relief, an extended period of sensory and motor blockage, and none at all at the dose that is given.

Keywords: Supraclavicular plexus of the brachia, Clonidine, Bupivacaine, Lignocaine.

International Journal of Pharmaceutical Quality Assurance (2024); DOI: 10.25258/ijpqa.15.1.54

How to cite this article: Ganesan A, Viveka K, Rasikapriya M, Sabapathy VA. Clonidine Enhances Bupivacaine-Lignocaine Supraclavicular Block for Upper Limb Surgery in Tertiary Care Hospital, Salem, Tamil Nadu: A Prospective Study. International Journal of Pharmaceutical Quality Assurance. 2024;15(1):341-345.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

For patients with upper limb surgery, brachial plexus blocks are used as an alternative to general anesthesia. They establish favorable operating conditions by allowing total muscular relaxation, stable intraoperative hemodynamics, and the corresponding inhibition of the sympathetic nervous system. Peripheral nerve blockade's use for managing chronic pain and post-operative discomfort was extended outside of the operating room.[1]

A peripheral nerve block is a specialism in anesthetic practice, required by the recent rise in the control of pain, the preference for regional anesthesia over general anesthesia in emergency situations, and the growing significance of ambulatory (outpatient) surgery.[2,3]

The supraclavicular brachial plexus block is the recommended regional anesthesia for treating the upper limbs. Here, at the proximal division or trunk level, the brachial plexus is most compactly displayed, providing the most dependable anesthesia for procedures on the upper limbs, achieved by numbing the middle and lower plexuses. Since the nerves in a supraclavicular block are closely packed in a bundle, it is also referred to as the "Spinal of the Arm" since it causes anesthesia throughout the whole limb that is not attached to the shoulder.[4]

**Author for Correspondence: sabapathyv.appavoo@gmail.com*

In many surgical operations, local anesthetics used as regional nerve blocks are used to restrict signal traffic to the dorsal horn, so post-operative pain is relieved. Several drug classes, including as benzodiazepines (midazolam), opioids (fentanyl/ morphine), neostigmine (AchE inhibitors), hyaluronidase, etc.,[1] have been added to lipophilic acid anhydride (LA) in an attempt to change the block's quality in terms of a quicker start, longer duration, and improved post-operative pain management. However, these showed questionable efficacy or negative systemic effects.[5,6]

Numerous investigations have revealed that clonidine, when administered locally, intrathecally, or epidurally, is well recognized to supply anti-nociception and amplify the effects of anesthetics administered locally.[7-9] Researchers have focused on the pain-relieving (analgesic) effects of clonidine in the peripheral nervous system since it was discovered that the drug acts at the spinal cord level. Therefore, there is a strong need for a comprehensive analysis of the benefits of clonidine when used in conjunction with local anesthetics for procedures for supraclavicular brachial plexus blocks.

Aim of the Study

- Using the peripheral nerve stimulator method, investigate the effectiveness and efficiency of clonidine as a local anesthetic adjuvant for the supraclavicular brachial plexus block.
- The effects will be examined with respect to the beginning and length of motor and sensory blockage, as well as the length of post-operative analgesia.

The major objective is to determine how long post-operative analgesia lasts, how much sensory and motor blockade there is, and when it starts when clonidine is added as an adjuvant to local anesthetics for supraclavicular brachial plexus block during upper limb operations using the peripheral nerve stimulator method.

MATERIALS AND METHODS

In Salem, (VMKVMCH) Vinayaka Missions Kirupananda Variyar Medical College & Hospitals conducted the study and was prospective, randomized, double-blinded, and comparative. About 60 adult patients of both sexes, with 30 patients each, were split into groups A and B for brachial plexus block elective treatments involving the upper limbs. Prior to conducting this investigation, ethical committee approval was secured. Every patient enrolled in the trial provided written and informed consent.

Criteria for inclusion

ASA grades I, II, and III; age greater than 18; patients who gave informed & written consent. The exclusion criteria for this study include patients who are unwilling to provide consent, individuals with an infection at the puncture site, those with a known allergy to local anesthetics, individuals classified as ASA grade IV or above, and those with abnormal coagulopathy who are taking anticoagulants. Patients with a previous history of nerve injury in the upper limb are also excluded from participation.

Every patient had a standard pre-operative evaluation. The patients were then randomly split into two groups (group A and group B).

Each group comprises of 30 patients medications that two groups were given:

Group A: About 50 participants will be given 15 mL each of 2% lignocaine, 0.5% bupivacaine, and a combination of adrenaline (1:200000).

Group B: About 30 patients will be given a combination containing thirty milligrams of clonidine (30 mcg) and 15 mL 0.5 and 2% of bupivacaine and lignocaine, mixed with 1:200000 adrenaline.

Patients were fasted for a sufficient amount of time the night before surgery. The patients were educated about the importance of cooperation during the process and that they would experience diverse sensations such as pins and needles and warmth on the part of the limb that will be obstructed.

An 18 G cannula was used to achieve intravenous access in the limb that was not having surgery. All of the patients had routine monitors attached and being watched over, including non-invasive blood pressure, pulse oximetry, and ECG monitoring.

Individuals were premedicated with an injection of midazolam 1-mg. The block is applied to the patient in a semi-seated position with their head turned to the side. The individual is instructed to lower his or her shoulder and flex his or her elbow such that the forearm is placed comfortably on the individual's abdomen. The wrist joint was placed in a supinated position so as to point the palmar surface towards the patient's face.

The SCM muscle's lateral (posterior) border is found and tracked distally to where it meets the clavicle. At this level, a parasagittal line is drawn to identify a pneumothorax-prone area medial to it. The entrance point of the needle is situated lateral to this parasagittal plane, spaced around 1 inch (2.5 cm) lateral to the clavicle's SCM insertion. This is where the palpating index finger is positioned.

All baseline parameters were continuously monitored and recorded every 10 minutes intraoperatively, including non-invasive blood pressure (NIBP), pulse oximetry (SpO_2), heart rate (HR), and electrocardiography (ECG). Hypotension, bradycardia, seizures, restlessness, drowsiness, disorientation, and other complications were monitored frequently. The time of initiation of blocking sensory nerve was recorded every second with a pinprick until the blockade occurred. The interval between administering the medication and its absence of pain on pinprick is the onset of sensory nerve conduction block. Utilizing the modified Bromage score, the beginning of motor blockade. Every minute till the motor blockade occurred, it was assessed.

Data Analysis

The Statistical Package for Social Services was then used to compile and analyze the data (SPSS vs 18). The student's t-test was used to assess the quantitative data. The qualitative

data was examined using the Chi-square test. A *p-value* was considered statistically significant if it was less than 0.05.

RESULTS

The research comprised 60 adult patients (male or female) ASA I, II, or III who had been scheduled for upper limb procedures such as brachial plexus block over the clavicle. The research examined the effectiveness of a standard combination of lignocaine 2%, bupivacaine 0.5%, and adrenaline (1:200000) with clonidine (30 µg) in conjunction with brachial plexus block via supraclavicular route.

The patient had to be at least 18 years old. The average age of patients in groups B and C was 32.7 ± 12.32 and 33.6 ± 10.81 years, respectively. The age-related incidences in the two groups showed no significant difference.

Table 1 and Figure 1 show the start of group B, the mean sensory block was 11.28 ± 1.5 minutes, while group A, had a mean of 19.06 ± 1.7 minutes. According to the findings, compared with group A, group B's sensory blocking started much earlier, as per the statistical analysis done with the help of the student's unpaired "t" test.

In Table 2 shows group B, the onset of motor block had a mean of 9.53 ± 1.32 minutes, while group A had a mean of 15.33 ± 2.09 minutes. Our results showed that group B experienced a motor block at an earlier onset than group A, with a *p-value* < 0.005 as per the analysis done using the unpaired student's 't' test.

In the 24-hour post-operative period, Table 3 displays 73% of patients in group B required only one rescue analgesic dose, whereas 27% required two. In the first 24 hours following surgery, 77% of patients in group A required 2 and 23% required 3 rescue analgesic doses. The chi-square test revealed that statistically, the variations between the groups' dosages of rescue analgesics showed evident significance.

Table 1: The duration of blocking the sensory nerve (minutes)

Study group	*Onset time (min)*	*Mean difference*	*t* value*	*p-value*	*Significance*
A	19.06 ± 1.7	7.82	24.13	$p < 0.001$	HS
B	11.28 ± 1.5				

*Pupil unpaired t test HS - Extremely significant

Table 2: The length of the block of motor nerves (minutes)

Study group	*Onset time (min)*	*Mean difference*	*t* value*	*p-value*	*Significance*
A	15.33 ± 2.09	5.74	16.38	$p < 0.001$	HS
B	9.53 ± 1.32				

*Student's unpaired t-test (HS): Very significant

Table 3: How many rescue analgesics were used in the first 24 hours after surgery

No. of RA in 24 hours post-op	*Group A*	*Group B*
1	0	22 (73)
2	23 (77)	8 (27)
3	7 (23)	0

X2 = 61.25 $p < 0.0001$ Highly Significant

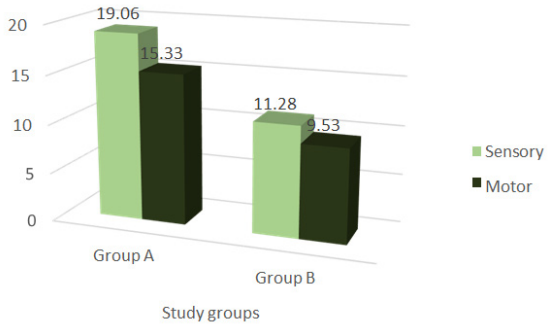

Figure 1: Onset of block

Hemodynamic Variables

Measurements of pulse rate and blood pressure measures included systolic, diastolic, and oxygen saturation at 0, 5, 15, 30, 60 minutes, 2, 6, 12, and 24 hours.

Group A's average heart rate was 76 ± 6.5 to 78 ± 7.0 beats per minute, and in group B, it was 76 ± 7.0 to 79 ± 7.4 beats/min. These meanpulse rates were statistically analyzed. It showed that the value was statistically insignificant and that the two groups' respective pulse rates did not differ computationally.

The average blood pressure (SBP & DBP) in each groups A and B did not vary statistically significantly, according to statistical analysis using the unpaired student's "t" test.

DISCUSSION

Numerous receptors on peripheral sensory axons mediate anti-nociception. Certain medications (Adjuncts) injected peripherally may reduce systemic side effects and relieve pain. Many adjuncts, including as neostigmine, tramadol, verapamil, and opioids, are given into the brachial plexus sheath concurrently with local anesthetics seeking to enhance analgesia after surgery. This study's objective was to identify if injecting clonidine, an alpha-2 adrenoceptor, into the brachial plexus sheath could provide further anesthetic and analgesic effects.[10,11]

The study included 60 patients in ASA I, II, and III. Two groups of 30 patients each, A and B, were formed from the patients. Add adrenaline (1:200000) to 15 mL each of 2% lignocaine and 0.5% bupivacaine to block the brachial plexus in group A. Group B was given a brachial plexus block that included 30 µg of clonidine and 15 mL each of 2% lignocaine, 1:200000 adrenaline, and 0.5% bupivacaine. The length of the analgesia, the start of the motor blockage, the start of the sensory blockage, the length of the motor blockade, and the sedation score were all measured.

With a mean age of 33.6 ± 10.81 years, group A and group B had different mean ages. 32.7 ± 12.32 years. Thus, the ages of the two groups were similar. The ratio of men to women was nearly equal.

Our results showed that subjects receiving a combination of clonidine and local anesthetics experienced a considerably faster commencement of the nerve senses and motor activity blocks. In group B, the block of sensory started at 11.28 ± 1.5 minutes, while in group A, it started at 19.06 ± 1.7 minutes. In group B, the blocking motor nerve started at 9.53 ± 1.32 minutes, while in group C, it started at 15.33 ± 2.09 minutes.

This could be explained by the way that clonidine acts locally, both directly and in concert with other local anesthetics. It was shown that in both groups, the motor block started earlier than the block of senses did. Winnie *et al.* saw the same thing and provided an explanation: they discovered that motor fibers are distributed more peripherally than sensory fibers at the trunk level of a nerve bundle, a phenomenon known as the somatotropic distribution of fibers. Thus, a perineurally delivered local anesthetic will start blocking the motor nerve fibers before reaching the CNS sensory fibers.

Our results confirmed the findings of Gabriel *et al.*[12] by showing that the sensory block remained longer than a motor block. These authors claim that a larger dose of local anesthetic is needed for big fibers than for tiny fibers. Compared to tiny (sensory) fibers, large (motor) fibres need a larger minimum effective dose of local anesthetic. As a result, blocks of motor nerves last less than the blocks of sensory nerves and motor function return before pain perception. In our investigation, the mixing of bupivacaine with clonidine with lignocaine extended how long the motor block. Group B's duration was 8.15 ± 0.58 hours, whereas group A's duration was 5.11 ± 0.45 hours.

How long it has been since the injection and the onset of discomfort necessitating analgesia was seen to be much higher ($p < 0.05$) in group B's mean sensory block than in group A. Group B lasted 13.79 ± 1.23 hours, while group A lasted 5.86 ± 0.49 hours.

In peripheral nerve block trials, clonidine only enhances the analgesic properties of local anesthetics when combined with bupivacaine. According to McCartney *et al.*, bupivacaine and clonidine together, as opposed to bupivacaine alone, improved utilization for various peripheral nerve blocks post-operative analgesia. Reduced plasma concentrations of clonidine following brachial plexus block suggest it affects peripheral nerves locally.[13] This additive action of clonidine on local anesthetics is mediated by its interaction with presynaptic alpha-2 receptor complexes on peripheral neurons. Analgesia was shown to continue longer following bupivacaine blockage of the popliteal fossa.[14,15] It was found that combining clonidine with bupivacaine increased the effectiveness of caudal analgesia in children. An effective spinal anesthesia was produced by intrathecally administering clonidine in combination with a low dose of bupivacaine, which improved the analgesic's duration and spread.[16]

Group B participants in our study had a much lower mean quantity of additional analgesic boluses needed and a notably smaller number of individuals in need of rescue analgesia. Similar findings were achieved by Chakraborty *et al.* in the previously mentioned investigation. The capacity of clonidine to suppress the action potential in peripheral nerves of A and C fibers may be the cause of group B's persistent analgesia. A number of researchers think that clonidine's dynamic interactions with axonal ion channels result in a direct anesthetic-prolonging impact on nerve fibers. Clonidine may promote local vasoconstriction, which could lengthen the block length and postpone the local anesthetic's absorption.[17,18] It has been shown that clonidine directly binds to alpha-2 adrenergic receptors on presynaptic peripheral nerves to elicit in the rat sciatic nerve fibers, tonic and phasic inhibition of neuronal transmission.[19-21] This modifies the excitability of neurons.

Since clonidine has been used to peripheral neuropathy before with no apparent side effects, we examined it at a dose of 30 µg. Up to 150 mcg of clonidine is hemodynamically safe, according to Bernard *et al.*'s investigation into the results of using a local anesthetic and 30 to 300 mcg of clonidine for brachial plexus block. Similar findings were reported by Singelyn *et al.*, who said that 0.5 to 1 mcg/kg of clonidine adds time to the analgesic effect of the local anesthetic in blocks of the peripheral nerve without seriously affecting alpha-2 agonism's hemodynamic adverse effects.

In our trial, we did not find any significant sedation in either group, and both groups' Ramsay sedation scores were 2. Not a single patient needed help breathing or had their airway compromised.

CONCLUSION

Our study concludes that there is a positive effect when clonidine (30 µg) is added as a supplement with adrenaline to 0.5% of bupivacaine with 2% of lignocaine. Both sensory block and motor block occurred more quickly and lasted longer than expected. In the first 24 hours following surgery, fewer rescue analgesics were required, and there was not much sedation. Hemodynamic measurements, including SPO_2, Heartbeat, and blood pressure (SBP&DBP), did not show any discernible variation.

LIMITATIONS

The findings of this study cannot be generalized because it was only one study with a somewhat tiny sample size. Results from related major research must be substantiated before generalization can be made.

ACKNOWLEDGMENTS

The Department of Anaesthesiology at VMKVMC, Salem, Vinayaka Mission's Research Foundation (Deemed to be University) and its administration are to be thanked by the authors for allowing them to conduct the research.

ETHICAL STATEMENT

VMKVMC Salem approved the study's Institutional Ethical Committee; the Institutional Human Ethics Committee accepted the study (Tracking No. VMKVMC&H/IEC/20/30). Dated: January 30, 2020. All study participants provided written informed consent, and only those prepared to sign it were allowed to participate in the research. Before giving their agreement, participants were advised about the benefits

and dangers of the study. The confidentiality of the research subjects was protected.

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