**ORIGINAL RESEARCH**

# A Comparative Analysis of Two Different Doses of Clonidine as an Adjuvant to Supraclavicular Brachial Plexus Block in Upper Limb Surgeries

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**ABSTRACT**

**Background:** Acute postoperative pain arises from a complex physiological response to tissue injury. The present study was conducted to compare supraclavicular brachial plexus block with clonidine as adjuvant in upper limb surgery. **Materials & Methods:** 60 patients scheduled for upper limb surgery of both genders were randomly divided into 3 groups of 20 each. Group I received 15 mL of 2% lignocaine with adrenaline (1 in 200000) and 15 mL of 0.5% bupivacaine with 0.6 mL of normal, group II received 45 µg of clonidine and group III received 90 µg of clonidine along with the local anaesthetics. Until 24 hours after the operation, the duration of sensory and motor blocks as well as the time to onset were recorded. **Results:** The mean age was 35.1 years, 34.2 years and 35.0 years, weight was 63.8 kgs, 65.2 kgs and 65.7 kgs, and height was 159.2 cms, 158.2 cms and 157.2 cms in group I, II and III respectively. The difference was non- significant (P> 0.05). Rescue analgesia duration was significantly prolonged in Groups II and III, with the longest duration observed in Group III (11.6 ± 1.7 hours). Sensory onset time was faster in the clonidine groups, especially in Group III (5.3 ± 1.6 minutes), indicating a quicker block onset. Sensory duration was longest in Group III (8.5 ± 1.2 hours), suggesting a dose-dependent prolongation. The difference was significant (P< 0.05). **Conclusion:** Clonidine presents a promising option as an adjunct in the ultrasound-guided supraclavicular block for upper limb surgical procedures, particularly for those requiring extended duration with minimal side effects and high-quality postoperative analgesia.

**Keywords:** Clonidine, Supraclavicular block, Sensory onset time, Motor onset time



## INTRODUCTION

Acute postoperative pain arises from a complex physiological response to tissue injury. The dorsal horn of the spinal cord serves as the termination point for primary afferents, where intricate interactions occur among these afferent fibers, intrinsic spinal neurons, descending pain-modulating fibers, and a variety of associated neurotransmitters including serotonin, norepinephrine, acetylcholine, adenosine, and glutamate.[1] Kumar A et al. *observed that* Fentanyl led to a faster onset of both sensory and motor block. Clonidine provided a longer duration of analgesia and motor blockade. Both drugs were associated with stable hemodynamic profiles and no serious adverse effects. Clonidine showed slightly higher sedation scores, but this did not lead to clinical complications.[2]

Clonidine, which is a selective alpha adrenergic receptor agonist, has been utilized as an adjunct

to LA in various dosages.[3] It certainly decreases the onset time and extends the duration of anaesthesia. Nevertheless, elevated doses have shown a range of side effects, including hypotension, bradycardia, sedation, and so on.[4] Clonidine leads to membrane hyperpolarization by opening potassium channels, which enhances the sodium channel blockade effect of local anesthetics. The cell does not respond to excitatory inputs in this state. When given through different methods (like oral, intravenous, or epidural), clonidine has been demonstrated to improve the efficacy of local anesthetics. Clonidine, when utilized as an adjuvant, can extend the duration of regional anesthesia and offer extra pain relief.[5]

In the case of surgeries on the upper limb, clonidine can be included in the local anesthetic solution for regional anesthesia methods such as brachial plexus blocks.[6] It aids in decreasing intraoperative and postoperative pain, which may enable the use of smaller amounts of local anesthetics and reduce the necessity for extra analgesics.[7]

## AIM AND OBJECTIVES

The present study was conducted to compare supraclavicular brachial plexus block with clonidine as a**n a**djuvant in upper limb surgery.

## MATERIALS AND METHODS

### Study Design

This was a prospective, randomized, double-blind, comparative clinical study conducted to evaluate the efficacy of clonidine as an adjuvant to local anaesthetics in ultrasound-guided supraclavicular brachial plexus block for upper limb surgeries.

### Study Population

A total of 60 adult patients, of both genders, scheduled to undergo elective upper limb surgery under supraclavicular brachial plexus block were included in the study. All patients provided written informed consent prior to participation.

### Study Place

The study was conducted in the Department of Anaesthesiology, Department of Anaesthesia, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar, India.

### Study Duration

The study was carried out over a period of one year from January 2018 to December 2018.

### Inclusion Criteria

- Patients aged 18–60 years.
- ASA physical status I or II.
- Scheduled for elective upper limb surgery under regional anaesthesia.
- Provided informed consent.

### Exclusion Criteria

- Patient refusal.
- Known allergy to local anaesthetics or clonidine.
- Coagulopathy or anticoagulant therapy.
- Local infection at the block site.
- Pre-existing neurological deficits or neuropathies in the operative limb.
- History of significant cardiac, hepatic, renal, or respiratory disorders.
- Pregnancy or lactation.

### Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee. Written informed consent was obtained from all patients after a detailed explanation of the study procedures, potential risks, and benefits. Patient confidentiality and adherence to the Declaration of Helsinki were maintained throughout the study.

### Study Procedure

Patients were randomly divided into three equal groups (n = 20) using computer-generated random numbers:

- **Group I (Control):** Received 15 mL of 2% lignocaine with adrenaline (1:200000) + 15 mL of 0.5% bupivacaine + 0.6 mL normal saline without clonidine.
- **Group II (Clonidine 45 µg):** Received the same mixture of local anaesthetics with 45 µg clonidine (diluted appropriately).
- **Group III (Clonidine 90 µg):** Received the same mixture local anaesthetics with 90 µg clonidine.

The total drug volume was 30.6 mL in all groups. An ultrasound-guided supraclavicular brachial plexus block was performed under sterile conditions using a high-frequency linear ultrasound probe. After identifying the brachial plexus in the supraclavicular region, the drug mixture was injected incrementally following negative aspiration for blood.

### Surgical Technique

Standard operative procedures were performed according to the type of upper limb surgery. All surgeries were performed under tourniquet control where required, and all patients were monitored intraoperatively by an anaesthesiologist not involved in the block procedure.

**Outcome Measures**

1. Primary Outcomes:
   - Time to onset of sensory and motor block.
   - Duration of sensory and motor block.
   - Duration of analgesia (time to first rescue analgesic).
2. Secondary Outcomes:
   - VAS pain scores (measured at regular intervals postoperatively).
   - Sedation scores.
   - Haemodynamic parameters (heart rate, blood pressure, oxygen saturation) recorded before, during, and after the procedure at fixed intervals.
   - Any complications or adverse effects (e.g., bradycardia, hypotension, sedation, nausea).

**Statistical Analysis**

- Data were entered and analyzed using SPSS version 21.0.
- Descriptive statistics were used for demographic data. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies or percentages.
- ANOVA was used for comparison between the three groups for parametric data.
- Chi-square test was used for categorical variables.
- A p-value < 0.05 was considered statistically significant.

## RESULTS

**Table 1: Baseline Characteristics of the Study Groups**

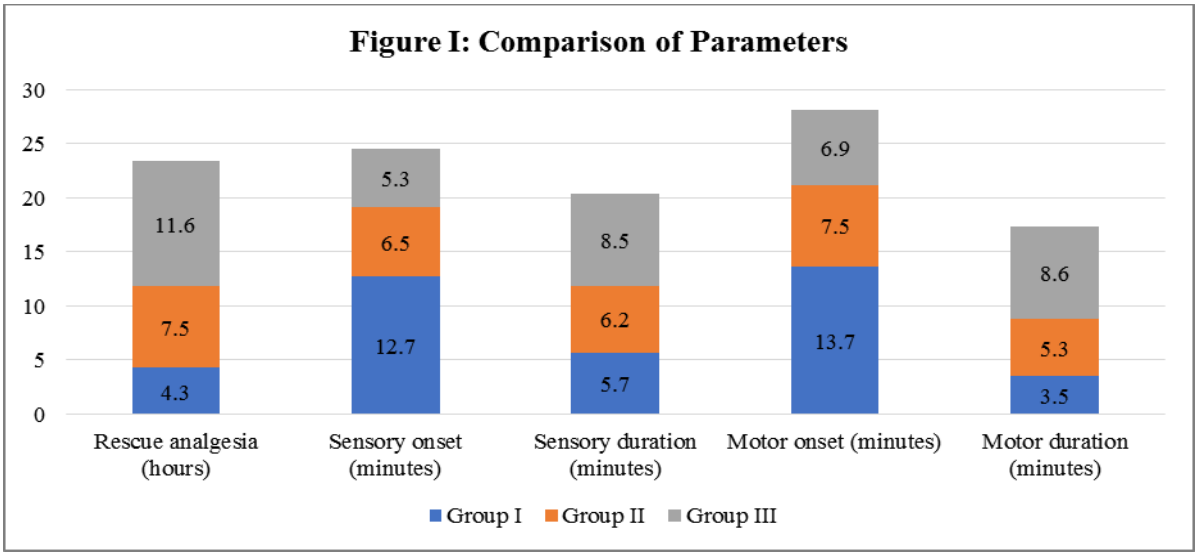
| Characteristics | Group I: (Control), n=20 | Group II: (Clonidine 45 µg), n=20 | Group III: (Clonidine 90 µg), n=20 | P value |
|---|---|---|---|---|
| Age (years) | 35.1 ± 6.2 | 34.2 ± 5.9 | 35.0 ± 6.0 | 0.91 |
| Weight (kg) | 63.8 ± 7.1 | 65.2 ± 6.8 | 65.7 ± 7.4 | 0.83 |
| Height (cm) | 159.2 ± 5.3 | 158.2 ± 5.5 | 157.2 ± 5.1 | 0.75 |

Table 1 shows that mean age was 35.1 years, 34.2 years and 35.0 years, weight was 63.8 kgs, 65.2 kgs and 65.7 kgs, and height was 159.2 cms, 158.2 cms and 157.2 cms in group I, II and III respectively. All p-values were >0.05**,** indicating no statistically significant differences among the groups for any baseline parameter. This suggests the three groups were well-matched demographically, ensuring that the observed effects on block characteristics and analgesia are likely due to the intervention (clonidine) and not due to baseline differences.

**Table 2: Comparison of Parameters with Standard Deviations (SDs)**

| Parameters | Group I (Mean ± SD) | Group II (Mean ± SD) | Group III (Mean ± SD) | P value |
|---|---|---|---|---|
| Rescue analgesia (hours) | 4.3 ± 1.1 | 7.5 ± 1.4 | 11.6 ± 1.7 | 0.03 |
| Sensory onset (minutes) | 12.7 ± 2.2 | 6.5 ± 1.8 | 5.3 ± 1.6 | 0.01 |
| Sensory duration (hours) | 5.7 ± 0.8 | 6.2 ± 0.9 | 8.5 ± 1.2 | 0.02 |
| Motor onset (minutes) | 13.7 ± 2.3 | 7.5 ± 2.0 | 6.9 ± 1.8 | 0.04 |
| Motor duration (hours) | 3.5 ± 0.6 | 5.3 ± 0.9 | 8.6 ± 1.3 | 0.05 |

Table 2, figure I shows that mean Rescue analgesia duration was significantly prolonged in Groups II and III, with the longest duration observed in Group III (11.6 ± 1.7 hours). Sensory onset time was faster in the clonidine groups, especially in Group III (5.3 ± 1.6 minutes), indicating a quicker block onset. Sensory duration was longest in Group III (8.5 ± 1.2 hours), suggesting a dose-dependent prolongation. Similarly, clonidine shortened the motor block onset time and prolonged its duration, with Group III showing the most favorable results. *P* values < 0.05 across all parameters indicate statistically significant differences.




## DISCUSSION

Clonidine has sedative properties that can be advantageous for upper limb surgeries conducted under local anesthesia or regional blocks.[8] Clonidine can assist in keeping patients calm and relaxed during the procedure by promoting sedation, which may reduce anxiety and enhance patient comfort. The calming effects of clonidine can be especially beneficial in cases where patients wish to remain awake during surgery or when general anesthesia is not recommended.[9] As with any medication, the decision to use clonidine in upper limb surgeries should be made by the healthcare provider, taking into account the unique characteristics of the patient, their medical history, and the details of the surgical procedure.[10]

We found that mean age was 35.1 years, 34.2 years and 35.0 years, weight was 63.8 kgs, 65.2 kgs and 65.7 kgs, and height was 159.2 cms, 158.2 cms and 157.2 cms in group I, II and III respectively. Clonidine, an α2-adrenergic agonist, is known to enhance the quality and duration of peripheral nerve blocks when used as an adjuvant. Its use is associated with prolonged duration of sensory and motor block, enhanced postoperative analgesia, and reduced need for rescue analgesics.[11,12]

The use of 45 µg and 90 µg clonidine demonstrated dose-dependent improvements in block characteristics and analgesic duration. Previous studies have similarly reported that clonidine prolongs both sensory and motor block durations without significantly increasing adverse effects when used in low to moderate doses.[13]

In a study by Duma et al., the addition of clonidine to bupivacaine significantly prolonged the duration of analgesia in brachial plexus blocks without significant haemodynamic instability.[14] Similarly, Singelyn et al. demonstrated improved block quality with clonidine as an adjuvant to mepivacaine in brachial plexus blocks.[15]

Importantly, our study found no significant differences in baseline characteristics, indicating that the observed benefits in the clonidine groups can be attributed to the pharmacological effect of clonidine rather than demographic variability. The incidence of clonidine-related side effects such as sedation or bradycardia was low, supporting its safety profile at the tested doses. Nevertheless, caution should be exercised with higher doses (≥90 µg), as some studies have reported an increased risk of hypotension and sedation at higher clonidine concentrations.[16]

The impact of this combination on supraclavicular brachial plexus block for upper limb orthopaedic procedures was assessed by Chakroborty et al.[17] Patients in Group A (n = 35) received a supraclavicular brachial plexus block with 25 ml of 0.5% bupivacaine and 0.2 ml (30 mcg) clonidine, while those in Group B (n = 35) received the same volume of bupivacaine but with 0.2 ml normal saline instead. Vital parameters were noted 10 minutes before the block was placed and subsequently every 3 minutes until the procedure was completed. The onset and duration of sensory and motor blocks, as well as the sedation score, were documented. All patients were monitored in the post-

anesthesia care unit and received a tramadol injection as soon as they reported pain, serving as rescue analgesia. The time interval from the block's placement to the injection of rescue analgesic was considered the duration of analgesia. The duration of analgesia in Group A (clonidine) was 415.4 ± 38.18 min, whereas in Group B (control), it was 194.2 ± 28.74 min. No clinically important difference was noted in heart rate, blood pressure, and oxygen saturation levels. The clonidine group exhibited a higher sedation score.

We found that mean rescue analgesia (hours) was 4.3, 7.5 and 11.6, sensory onset (minutes) was 12.7, 6.5 and 5.3, sensory duration (minutes) was 5.7, 6.2 and 8.5, motor onset (minutes) was 13.7, 7.5 and 6.9, motor duration (minutes) was 3.5, 5.3 and 8.6 and in group I, group II and group III, respectively. The faster onset of sensory and motor block observed in the clonidine groups (particularly Group III) may be attributed to the α2-adrenergic agonist action of clonidine, which enhances the effects of local anaesthetics by hyperpolarizing nerve tissues and reducing the firing of pain signals .[18] Clonidine has also been reported to cause vasoconstriction, reducing systemic absorption of local anaesthetics and thereby prolonging their action.[19]

The duration of analgesia was notably longer in the group receiving 90 µg clonidine. Similar findings were reported by Gaumann et al., where clonidine enhanced both the quality and duration of regional blocks.[13] Our results are also consistent with studies by Duma et al. and El Saied et al., which demonstrated improved block characteristics and prolonged analgesia without significant haemodynamic instability at doses up to 150 µg.[11,14]

Using a USG guided method, Adhikari et al.[20] assessed the effectiveness of two moderate doses of clonidine as an adjunct to the combination of lignocaine and bupivacaine in supraclavicular brachial plexus block. In Group N, the average time (in minutes) for motor block onset was 14.6±3.024, while in Group C1 it was 7.567±1.0726 and in Group C2 it was 6.033±1.756. In group N, the mean duration of motor block was 3.8±0.6967 hours, in Group C1 it was 5.65±1.1533 hours, and in Group C2 it was 8.05±0.9035 hours. In Group N, the average onset time (measured in minutes) for sensory block is 14.9±3.1442, whereas in Group C1 it is 6.8±1.0635 and in Group C2 it is 5.4±2.4403. The mean duration (in hours) of sensory block was 4.233±0.6915 in Group N, 5.833±1.0367 in Group C1 and 8.417±0.8914 in Group C2.

## LIMITATIONS OF THE STUDY

- Sample Size: The study was limited to 60 patients, which may affect the generalizability of the findings.
- Short Follow-Up Duration: Postoperative analgesia was assessed for only 24 hours; long-term effects of clonidine could not be evaluated.
- Single-Centre Study: Being a single-institution study, results may not be generalizable to other settings.
- Lack of Biochemical Monitoring: No serum clonidine or anaesthetic drug levels were measured to correlate with clinical outcomes.
- Sedation Assessment Subjectivity: Sedation scores are subjective and could vary between assessors.
- Exclusion of High-Risk Patients: Patients with ASA status III and IV were excluded, limiting applicability in higher-risk surgical populations.

## CONCLUSION

Authors found that clonidine presents a promising option as an adjunct in the ultrasound-guided supraclavicular block for upper limb surgical procedures, particularly for those requiring extended duration with minimal side effects and high-quality postoperative analgesia. Clonidine, particularly at a dose of 90 µg, is a valuable adjuvant in supraclavicular brachial plexus blocks for upper limb surgeries. It provides faster onset, longer duration of sensory and motor blocks, and prolonged postoperative analgesia, making it a preferred choice in regional anaesthesia with minimal side effects.

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