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Clonidine as an Adjuvant to 0.5% Ropivacaine for Ultrasound-Guided Supraclavicular Brachial Plexus Block in Upper-Limb Surgeries: A Randomised Prospective Study

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ABSTRACT

Background and Aims; Ultrasound-guided supraclavicular brachial plexus block provides effective anaesthesia and postoperative analgesia for upper-limb surgeries. Ropivacaine is favoured due to its safer pharmacological profile, and adjuvants such as clonidine may enhance block characteristics. This study aimed to compare the efficacy of 0.5% ropivacaine alone with 0.5% ropivacaine plus clonidine (1 µg/kg) for ultrasound-guided supraclavicular brachial plexus block.
Methods; This prospective, randomised controlled study included 80 adult patients (ASA I–II), aged 18–60 years, scheduled for elective upper-limb surgeries. Patients were allocated into two groups: Group R (n=40) received 20 mL of 0.5% ropivacaine, and Group RC (n=40) received 20 mL of 0.5% ropivacaine with clonidine 1 µg/kg. Blocks were performed under ultrasound guidance. Primary outcomes were onset and duration of sensory and motor block and duration of postoperative analgesia. Secondary outcomes included visual analogue scale (VAS) scores, haemodynamic parameters, rescue analgesic requirement, and adverse effects.
Results; Demographic variables and baseline haemodynamic parameters were comparable between groups. The onset of sensory (6.3±1.5 vs. 7.5±1.1 min) and motor block (10.9±1.5 vs. 13.2±1.8 min) was significantly faster in Group RC ($p<0.001$). Duration of sensory block (11.3±1.1 vs. 5.0±0.4 h), motor block (9.7±1.1 vs. 4.5±0.3 h), and analgesia (12.8±1.3 vs. 5.4±0.6 h) were significantly prolonged in Group RC ($p<0.001$). VAS scores were significantly lower at 4 and 8 hours, and rescue analgesic requirement was reduced in Group RC ($p<0.001$). No significant adverse effects were observed.
Conclusion; Clonidine (1 µg/kg) added to 0.5% ropivacaine significantly improves block quality and prolongs postoperative analgesia without added adverse effects.

Keywords: *Ropivacaine; Clonidine; Supraclavicular brachial plexus block; Ultrasound guidance; Analgesia.*

INTRODUCTION

Supraclavicular brachial plexus block (SCBPB) is an effective regional anaesthetic technique widely used for upper-limb surgeries, owing to its ability to provide dense sensory and motor blockade with superior perioperative analgesia. Regional anaesthesia offers several advantages over general anaesthesia, including reduced opioid consumption, lower incidence of postoperative nausea and vomiting, improved haemodynamic stability, and enhanced patient satisfaction.[1] SCBPB is

particularly advantageous due to the compact anatomical arrangement of the brachial plexus at this level, facilitating reliable blockade of the major nerves of the upper limb.[2]

Ropivacaine, a long-acting amide local anaesthetic, has gained widespread acceptance for peripheral nerve blocks because of its favourable safety profile, with reduced cardio toxicity and neurotoxicity compared with bupivacaine.[3] Its lower lipophilicity results in preferential sensory blockade with relative sparing of motor function, making it suitable for both intraoperative anaesthesia and prolonged postoperative analgesia. Consequently, ropivacaine is among the most commonly used local anaesthetics for brachial plexus blocks.[4]

The addition of adjuvants to local anaesthetics is an established strategy to enhance block characteristics by hastening onset, prolonging sensory and motor blockade, and extending postoperative analgesia. α_2-Adrenergic agonists such as clonidine have been shown to potentiate peripheral nerve blocks through synergistic action on neuronal transmission and local vasoconstriction, thereby reducing systemic absorption of local anaesthetics and prolonging their effect. [5] recent clinical studies continue to support clonidine as an effective adjuvant in SCBPB, demonstrating faster onset and prolonged duration of sensory and motor blockade along with improved postoperative analgesia. [6]

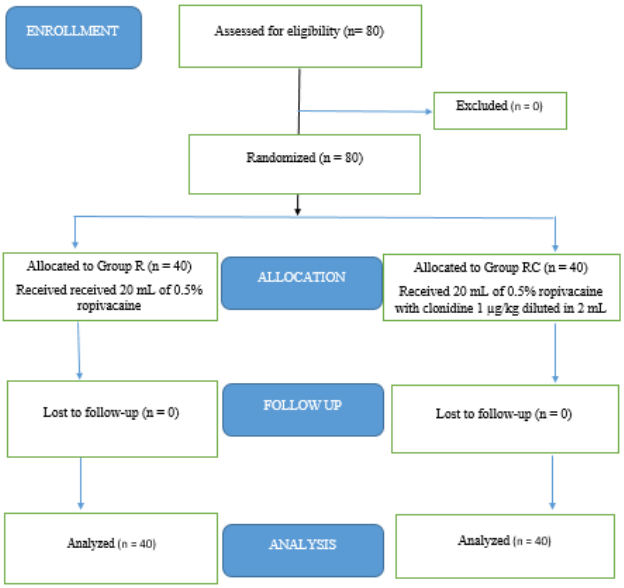
Ultrasound guidance has become the standard of care for SCBPB, allowing real-time visualisation of neural structures, needle trajectory, and local anaesthetic spread. This technique improves block success rates, permits the use of lower local anaesthetic volumes, and significantly reduces complications such as pneumothorax, vascular puncture, and nerve injury. [1, 2]

Despite growing evidence supporting the use of clonidine as an adjuvant in peripheral nerve blocks, there remains a need for high-quality randomised studies comparing ropivacaine alone with ropivacaine combined with clonidine under ultrasound guidance for upper-limb surgeries. The present study was therefore designed to evaluate the onset and duration of sensory and motor blockade and postoperative analgesia following ultrasound-guided supraclavicular brachial plexus block using 0.5% ropivacaine with and without clonidine.

METHODS

This prospective randomised controlled study was conducted at PES Institute of Medical Sciences and Research, Kuppam, from February 2021 to June 2022 after obtaining approval from the Institutional Human Ethical Committee (Approval No: PESIMSR/IHEC/C-05/2021 dated 01/02/2021). Written informed consent was obtained from all participants. Eighty adult patients aged 18–60 years, belonging to American Society of Anaesthesiologists (ASA) physical status I and II scheduled for elective upper-limb surgery were included. Patients with infection at the injection site or sepsis, pre-existing neurological deficit in the operative limb, patient refusal, pregnancy, coagulopathy or anticoagulant therapy, known hypersensitivity to clonidine or local anaesthetics, and ASA physical status III–IV were excluded. Patients were randomly allocated into two equal groups (n=40 each):

- **Group R:** 20 mL of 0.5% ropivacaine
- **Group RC:** 20 mL of 0.5% ropivacaine with clonidine 1 µg/kg diluted in 2 mL normal saline



The Consolidated Standards of Reporting Trials **(CONSORT)** flow chart

No premedication was administered. Standard ASA monitors were applied, baseline vital parameters were recorded, and intravenous access was secured in the contralateral limb. Ultrasound-guided supraclavicular brachial plexus block was

performed using a high-frequency (>10 MHz) linear probe and a 22-G needle with an in-plane technique. After confirming negative aspiration, the study drug was injected incrementally to achieve circumferential spread around the plexus. Block failure within 20 minutes was excluded from analysis and managed with general anaesthesia.

- **Sensory block:** Assessed every minute using a spirit-soaked cotton swab in ulnar, median, and radial nerve distributions
- **Motor block:** Evaluated using modified Lovett's scale (0–6)
- **Pain assessment:** Visual Analogue Scale (VAS) postoperatively
- **Rescue analgesia:** IV Paracetamol 15 mg/kg on demand

Data were analysed using SPSS version 20. Continuous variables were expressed as mean ± SD and analysed using Student's t-test. Categorical variables were analysed using the Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 80 patients undergoing upper limb surgeries under ultrasound-guided supraclavicular brachial plexus block were enrolled and randomly allocated into two equal groups: Group R (0.5% ropivacaine, 20 ml) and Group RC (0.5% ropivacaine, 20 ml + clonidine 1 µg/kg).

Demographic variables including age, sex distribution, height, weight, and ASA physical status were comparable between the groups (p>0.05). The mean age was 34.4±13.9 years in Group R and 39.8±13.2 years in Group RC. Both groups had similar proportions of male and female patients as well as similar distribution of ASA I and II patients.

Haemodynamic parameters:

Baseline heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), respiratory rate (RR), and SpO_2 were comparable in both groups (p>0.05).

Heart rate values were significantly lower in Group RC between 20 minutes and 8 hours post-block (p<0.05), although the changes were not clinically significant and no intervention was required. There was no significant intergroup difference in SBP, DBP, MAP, RR, or SpO_2 at any time point (p>0.05).

Block Characteristics:

The onset of sensory block was significantly faster in Group RC (6.3±1.5 min) compared with Group R (7.5±1.1 min) (p<0.001). Similarly, the onset of motor blockade was significantly earlier in Group RC (10.9±1.5 min) than in Group R (13.2±1.8 min) (p<0.001). (Table 1)

Table 1. Comparison of onset of sensory and motor block

Variable	Group R (Mean ± SD)	Group RC (Mean ± SD)	t-value	p-value
Onset of sensory block (min)	7.5 ± 1.1	6.3 ± 1.5	4.03	0.0001*
Onset of motor block (min)	13.2 ± 1.8	10.9 ± 1.5	5.99	<0.001*

*Statistically significant

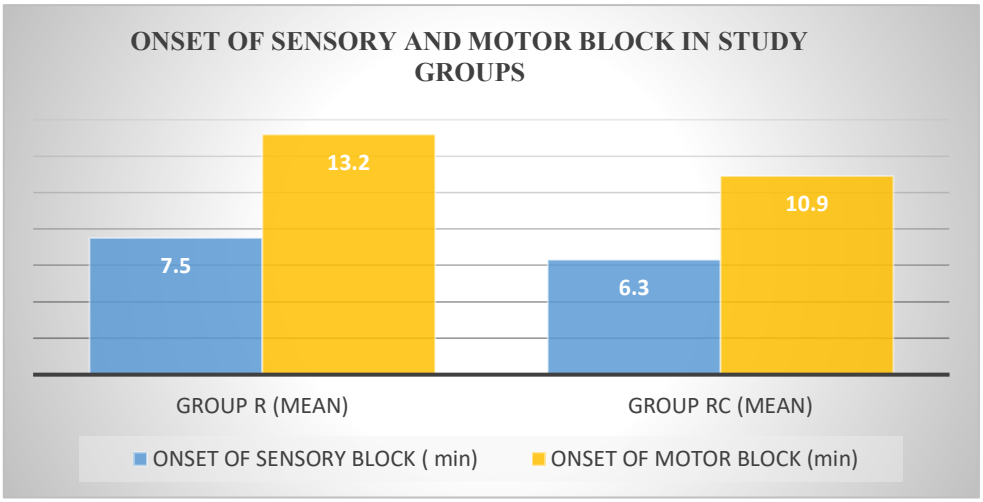


Figure 1: Comparison of onset of sensory and motor block between the study groups

The duration of sensory block was significantly prolonged in Group RC (11.3±1.1 hours) compared with Group R (5.0±0.4 hours) (p<0.001). The duration of motor block was also longer in Group RC (9.7±1.1 hours) compared with Group R (4.5±0.3 hours) (p<0.001). (Table 2)

Table 2. Comparison of duration of sensory and motor blockade

Variable	Group R (Mean ± SD)	Group RC (Mean ± SD)	t-value	p-value
Duration of sensory block (h)	5.0 ± 0.4	11.3 ± 1.1	33.47	<0.001*
Duration of motor block (h)	4.5 ± 0.3	9.7 ± 1.1	28.14	<0.001*

*Statistically significant

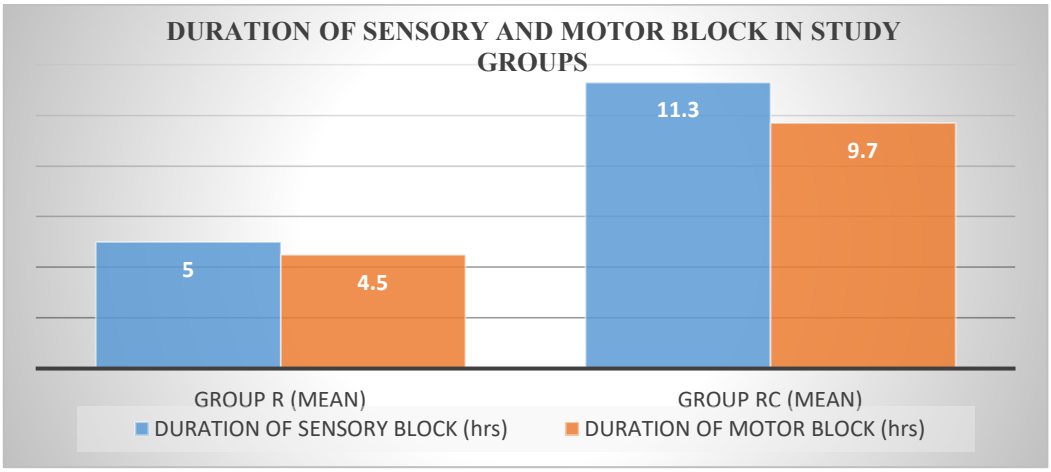


Figure 2: Comparison of duration of sensory and motor block

Postoperative analgesia was significantly prolonged in Group RC (12.8±1.3 hours) compared with Group R (5.4±0.6 hours) (p<0.001). (Table 3)

Table 3. Comparison of duration of postoperative analgesia

Variable	Group R (Mean ± SD)	Group RC (Mean ± SD)	t-value	p-value
Duration of analgesia (hours)	5.4 ± 0.6	12.8 ± 1.3	31.99	<0.001*

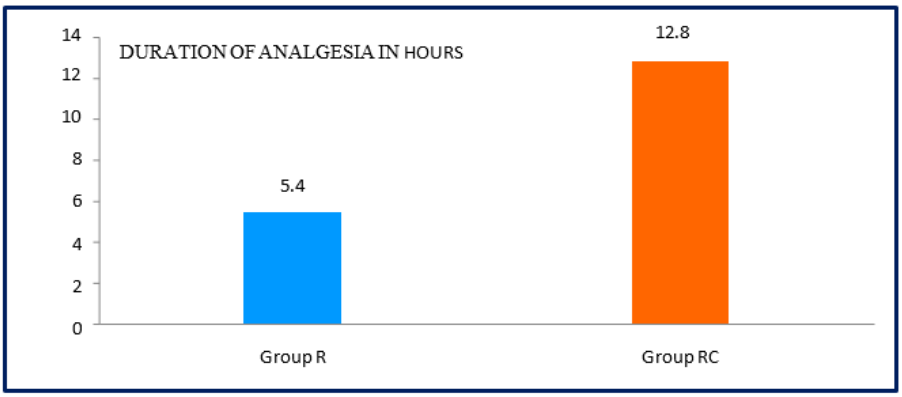


Figure 3: Comparison of duration of postoperative analgesia

Pain scores and Analgesic requirement:
There was no difference in VAS scores at baseline and up to 2 hours after block administration. At 4 hours and 8 hours, Group RC demonstrated significantly lower VAS scores (p<0.001). At 16 and 24 hours, VAS scores were comparable between the groups (p>0.05). (Table 4)

Table 4. Comparison of VAS scores

Time	Group R (Mean ± SD)	Group RC (Mean ± SD)	p-value
Baseline	0 ± 0	0 ± 0	NS
2 h	0 ± 0	0 ± 0	NS
4 h	0.5 ± 0.6	0 ± 0	<0.001*
8 h	2.9 ± 0.7	0.4 ± 0.5	<0.001*
16 h	3.2 ± 0.6	3.1 ± 0.8	NS
24 h	3.7 ± 0.4	3.6 ± 0.5	NS

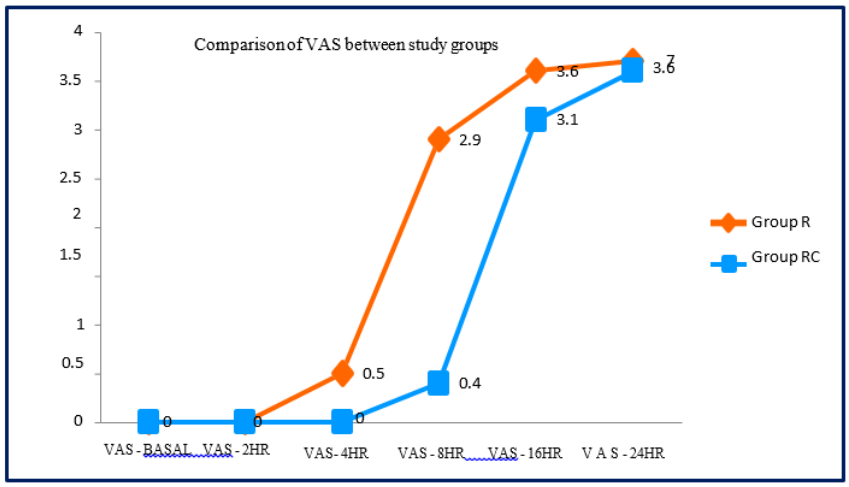


Figure 4: Comparison of postoperative VAS scores

The time to first rescue analgesia (Injection Paracetamol 15 mg/ kg IV) was significantly longer in Group RC (13.1±1.0 hours) compared to Group R (7.1±0.8 hours) ($p<0.001$). (Table 5) All patients in Group R required two doses of rescue analgesia in the first 24 hours, whereas all patients in Group RC required only one dose **(**$p<0.001$). (Table 6)

Table 5. Time to first rescue analgesia

Variable	Group R (Mean ± SD)	Group RC (Mean ± SD)	t-value	p-value
Time to first rescue analgesia (hours)	7.1 ± 0.8	13.1 ± 1.0	29.21	<0.001*

Table 6. Total rescue analgesic requirement in 24 hours

Number of doses	Group R n (%)	Group RC n (%)	χ^2	p-value
One dose	0 (0)	40 (100)	80.0	<0.001*
Two doses	40 (100)	0 (0)		

*Statistically significant

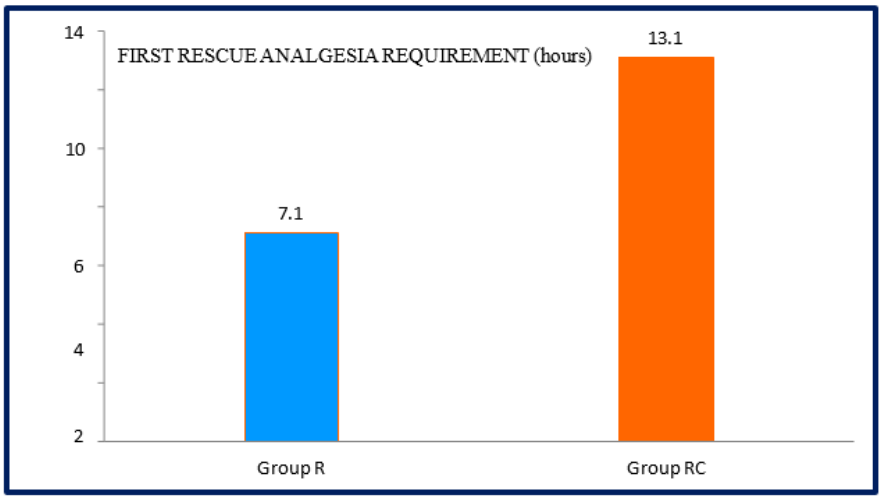


Figure 5: Comparison of time to first rescue analgesic requirement

Complications:
No adverse effects such as hypotension, bradycardia requiring treatment, sedation, respiratory depression, nausea, vomiting, or other complications were observed in either group during the study period.

DISCUSSION
Ultrasound-guided supraclavicular brachial plexus block is an established technique for upper-limb surgeries, offering rapid onset, dense anaesthesia, and prolonged postoperative analgesia with improved safety compared to landmark-based approaches. The present study evaluated the effect of adding clonidine (1 µg/kg) to 0.5% ropivacaine and demonstrated improved block characteristics and prolonged postoperative analgesia without significant adverse effects.

Ropivacaine, a pure S (–) enantiomer, is preferred for peripheral nerve blocks due to its lower cardio toxicity and greater sensory–motor differentiation compared with bupivacaine. However, its duration of analgesia may be insufficient for prolonged postoperative pain control, prompting the use of adjuvants. α_2-adrenergic agonists such as clonidine prolong nerve block duration by inhibiting hyperpolarisation-activated cataion currents, increasing potassium conductance, and producing local vasoconstriction that delays systemic absorption of the local anaesthetic.[7,8]

In the present study, the onset of sensory and motor blockade was significantly faster with clonidine supplementation. Similar findings have been reported by Priyadarshi et al. [9] and Patil and Singh [10], who observed a shorter onset time when clonidine was added to ropivacaine for supraclavicular brachial plexus block. The accelerated onset may be due to the synergistic action of clonidine on peripheral nerves and its facilitation of local anaesthetic diffusion. [8, 11]

The duration of sensory and motor block was significantly prolonged in the clonidine group. This observation is consistent with studies by Bafna et al. [12], Kelika and Arun [13], and Nazir et al. [6], all of whom demonstrated prolonged block duration with clonidine as an adjuvant to ropivacaine. Although dexmedetomidine has been reported to produce longer analgesia, clonidine remains a valuable alternative due to its favourable haemodynamic profile, lower incidence of sedation, and cost-effectiveness. [6, 14]

Postoperative analgesia was significantly enhanced with clonidine, as evidenced by lower VAS scores during the early postoperative period, delayed first rescue analgesic requirement, and reduced total analgesic consumption over 24 hours. These findings are in agreement with earlier and contemporary studies that reported reduced postoperative analgesic requirements with clonidine in brachial plexus blocks.[6,12,15] Improved early postoperative analgesia is clinically beneficial, facilitating early mobilisation and improving patient comfort.

Haemodynamic parameters remained stable in both groups throughout the study period. Although a mild reduction in heart rate was observed in the clonidine group, it was not clinically significant and required no intervention. Similar haemodynamic stability has been reported in previous studies using low-dose clonidine (≤1 μg/kg) as an adjuvant in peripheral nerve blocks.[6,10,13] No adverse effects such as hypotension, excessive sedation, respiratory depression, or neurological complications were observed, reinforcing the safety of clonidine at the studied dose.

Overall, the findings of the present study are consistent with existing literature and support the use of clonidine as a safe and effective adjuvant to ropivacaine in ultrasound-guided supraclavicular brachial plexus block, particularly in settings where cost-effectiveness and haemodynamic stability are important considerations.

CONCLUSION

The present study demonstrates that the addition of clonidine (1 μg/kg) to 0.5% ropivacaine for ultrasound-guided supraclavicular brachial plexus block significantly hastens the onset of sensory and motor blockade and markedly prolongs their duration. Postoperative analgesia was superior, with lower pain scores, delayed first rescue analgesic requirement, and reduced total analgesic consumption over 24 hours. These benefits were achieved without clinically significant haemodynamic instability or adverse effects. Clonidine is therefore a safe, effective, and economical adjuvant to ropivacaine for supraclavicular brachial plexus block in upper-limb surgeries.

Limitations of the Study

This was a single-centre study with a limited sample size, which may restrict generalisability. Sedation scores were not formally assessed, and plasma drug concentrations were not measured. Long-term neurological follow-up was not undertaken. Only one dose of clonidine was evaluated, and comparisons with other α_2-agonists such as dexmedetomidine were not performed.

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