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Effect Of Verapamil as An Adjuvant To 0.5% Ropivacaine in Ultrasound-Guided Supraclavicular Brachial Plexus Block for Upper Limb Surgeries: A Randomized Controlled Study

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ABSTRACT

Background: Ultrasound-guided supraclavicular brachial plexus block is widely used for upper limb surgeries. Verapamil, a calcium channel blocker, has been investigated as an adjuvant to local anesthetics to improve block characteristics and prolong postoperative analgesia. This study evaluated the effect of adding verapamil to 0.5% ropivacaine in supraclavicular brachial plexus block.

Methods: In this prospective randomized double-blind controlled study, 70 ASA I–II patients undergoing elective upper limb surgeries were allocated into two groups (n=35 each). Group R received 30 mL of 0.5% ropivacaine, while Group RV received 30 mL of 0.5% ropivacaine with verapamil 2.5 mg. Onset and duration of sensory and motor block, duration of analgesia, rescue analgesic consumption, postoperative pain scores, hemodynamic parameters, and adverse effects were compared.

Results: Baseline demographic and surgical characteristics were comparable between groups. Group RV demonstrated significantly faster onset of sensory block (9.94±1.41 vs. 12.74±1.40 min) and motor block (12.37±0.88 vs. 15.94±1.47 min) ($p<0.001$). Duration of sensory block (398.86±26.52 vs. 308.57±23.72 min), motor block (327.14±23.05 vs. 297.43±19.68 min), and postoperative analgesia (436.29±23.62 vs. 379.71±22.98 min) were significantly prolonged in Group RV ($p<0.001$). Rescue analgesic requirements and postoperative VAS pain scores were significantly lower in the verapamil group. Hemodynamic parameters remained stable, and adverse effects were comparable between groups.

Conclusion: Addition of verapamil (2.5 mg) to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block significantly hastens block onset, prolongs sensory and motor blockade, enhances postoperative analgesia, and reduces analgesic requirements without increasing adverse effects. Verapamil appears to be a safe and effective adjuvant for upper limb surgeries.

Keywords*: Ultrasound-guided supraclavicular brachial plexus block, Verapamil, Ropivacaine, Regional anesthesia, Postoperative analgesia.*

INTRODUCTION

Regional anesthesia has become an integral component of modern perioperative care owing to its ability to provide effective analgesia, reduce perioperative opioid requirements, facilitate early mobilization, and improve patient satisfaction. Among the various regional anesthetic techniques employed for upper limb surgeries, the supraclavicular brachial plexus block is widely regarded as the "spinal anesthesia of the upper extremity" because of its ability to provide dense sensory and motor blockade of the upper limb distal to the shoulder. The advent of ultrasound guidance has significantly improved the success rate of supraclavicular brachial plexus blocks by enabling direct visualization of neural structures, adjacent vessels, and needle trajectory while minimizing procedure-related complications such as vascular puncture and pneumothorax.[1,2] Local anesthetics remain the cornerstone of peripheral nerve blocks. Ropivacaine, a long-acting amide local anesthetic, is

commonly preferred for brachial plexus blockade because of its favorable safety profile, reduced cardiotoxicity, and lower propensity for motor blockade compared with bupivacaine.[3] The pure S-enantiomer structure of ropivacaine contributes to its lower potential for central nervous system and cardiovascular toxicity while maintaining excellent sensory analgesia. Consequently, ropivacaine has gained widespread acceptance for upper limb surgeries requiring prolonged intraoperative anesthesia and postoperative pain control.[4] Despite the effectiveness of ropivacaine, achieving a rapid onset of blockade and prolonged postoperative analgesia remains a clinical challenge. To overcome these limitations, various adjuvants such as clonidine, dexmedetomidine, dexamethasone, magnesium sulfate, and opioids have been combined with local anesthetics in peripheral nerve blocks. These agents have demonstrated varying degrees of success in improving block quality and extending analgesic duration; however, concerns regarding adverse effects such as sedation, hypotension, bradycardia, nausea, and neurotoxicity continue to exist.[5,6] Therefore, the search for an ideal adjuvant that enhances block characteristics without increasing complications remains an area of active research. Verapamil, a phenylalkylamine calcium channel blocker commonly used in the treatment of hypertension, angina, and cardiac arrhythmias, has emerged as a potential adjuvant in regional anesthesia. Experimental studies suggest that calcium ions play an important role in nociceptive transmission and neuronal excitability. By inhibiting calcium influx through voltage-gated calcium channels, verapamil may potentiate the action of local anesthetics and prolong neural blockade. Additionally, verapamil has been shown to possess membrane-stabilizing properties and may exert local anesthetic-like effects by modulating sodium channel activity.[7,8] Several studies have evaluated the addition of verapamil to local anesthetic solutions in peripheral nerve blocks and neuraxial anesthesia. The results indicate that verapamil may accelerate the onset of sensory and motor blockade, prolong the duration of analgesia, and reduce postoperative analgesic consumption without causing significant adverse hemodynamic effects when used in appropriate doses.[9,10] However, evidence regarding its efficacy as an adjuvant to ropivacaine in ultrasound-guided supraclavicular brachial plexus block remains limited, and further well-designed randomized controlled studies are needed to establish its clinical utility.

Therefore, the present randomized controlled study was undertaken to evaluate the effect of verapamil as an adjuvant to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block for upper limb surgeries.

The study aimed to compare the onset and duration of sensory and motor blockade, duration of postoperative analgesia, analgesic requirements, hemodynamic parameters, and adverse effects between patients receiving ropivacaine alone and those receiving ropivacaine combined with verapamil.

MATERIALS AND METHODS

Study design & setting: This prospective, randomized, double-blind, controlled study was conducted in the Department of Anaesthesiology, Pacific Medical College and Hospital, Udaipur, Rajasthan, from May 2023 to May 2025 after obtaining Institutional Ethics Committee approval and written informed consent from all participants.

Study subjects: A total of 70 adult patients aged 18–60 years, belonging to American Society of Anesthesiologists (ASA) physical status I–II and scheduled for elective upper limb surgeries under ultrasound-guided supraclavicular brachial plexus block, were enrolled in the study.

Patients were randomly allocated into two equal groups (n = 35 each) using a computer-generated randomization sequence. Group R received 30 mL of 0.5% ropivacaine, whereas Group RV received 30 mL of 0.5% ropivacaine combined with verapamil 2.5 mg. Both the patient and the observer assessing outcomes were blinded to group allocation.

Data collections: Standard monitoring including electrocardiography, non-invasive blood pressure, pulse rate, and oxygen saturation was instituted. Under strict aseptic precautions, ultrasound-guided supraclavicular brachial plexus block was performed using a high-frequency linear probe. Following drug administration, sensory blockade was assessed by pinprick testing and motor blockade using standard motor function assessment at regular intervals.

Outcome measures: The primary outcome measures were onset and duration of sensory and motor blockade. Secondary outcomes included duration of postoperative analgesia, time to first rescue analgesic requirement, total rescue analgesic consumption during the first 24 hours, hemodynamic parameters, visual analogue scale (VAS) pain scores, and adverse events or complications.

Statistical analysis: Data were analyzed using appropriate statistical tests. Continuous variables were expressed as mean ± standard deviation and compared using the independent Student's t-test, while categorical variables were analyzed using the Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

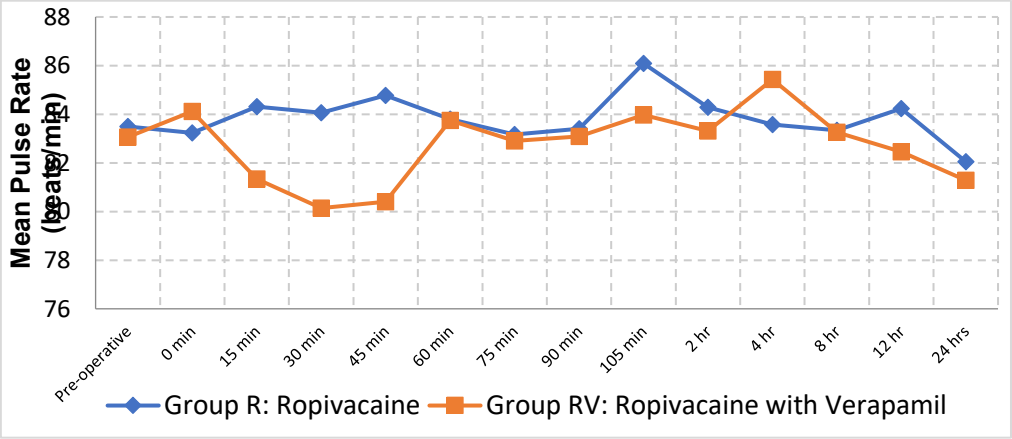
The demographic and clinical characteristics were comparable between the two groups. No statistically significant differences were observed regarding age, gender distribution, body weight, ASA physical status, or duration of surgery ($p>0.05$), indicating homogeneity of the study population.

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants

Variable	Group R (Ropivacaine) (n=35)	Group RV (Ropivacaine + Verapamil) (n=35)	p-value
Age (years), Mean ± SD	46.49 ± 11.55	45.80 ± 11.93	0.448
Age Group, n (%)			
21–30	4 (11.4)	3 (8.6)	
31–40	8 (22.9)	12 (34.3)	
41–50	7 (20.0)	7 (20.0)	
51–60	17 (48.6)	9 (25.7)	
>60	2 (5.7)	4 (11.4)	
Gender, n (%)			
Male	18 (51.4)	17 (48.6)	0.811
Female	17 (48.6)	18 (51.4)	
Weight (kg), Mean ± SD	59.89 ± 5.59	61.80 ± 8.24	0.259
ASA Grade, n (%)			
Grade I	17 (48.6)	24 (68.6)	0.089
Grade II	18 (51.4)	11 (31.4)	
Duration of Surgery (min), Mean ± SD	103.20 ± 9.78	102.77 ± 8.24	0.394

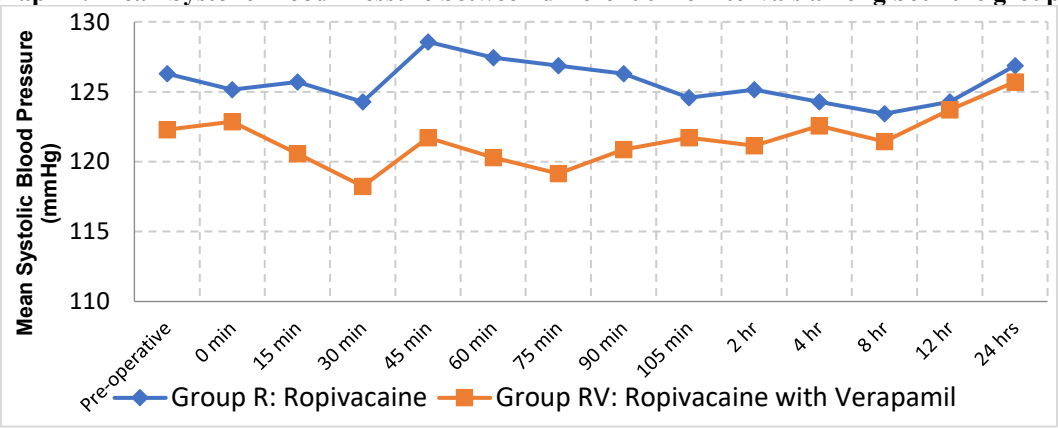
Mean pulse rate remained stable throughout the perioperative and postoperative periods in both groups. No clinically significant fluctuations were observed, suggesting that the addition of verapamil did not adversely affect heart rate.

Graph 1: Mean Pulse Rate between different time intervals among both the groups



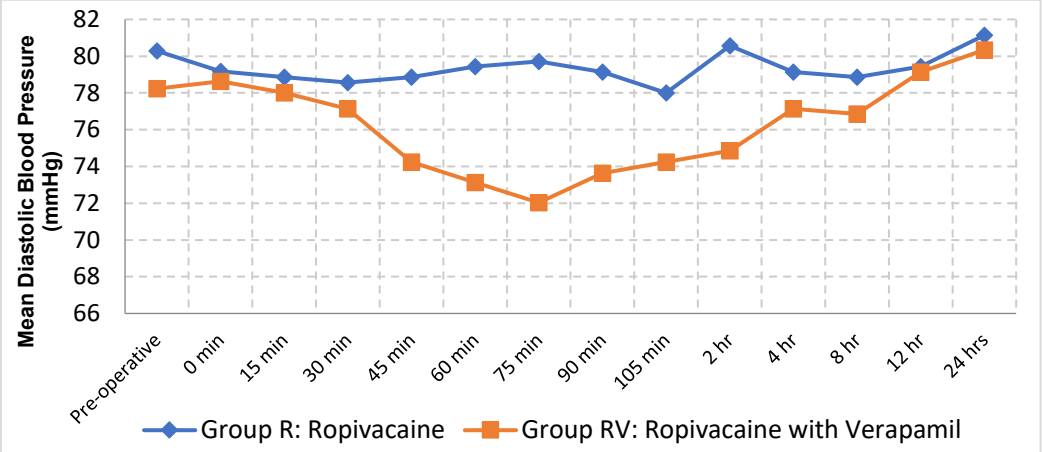
Systolic blood pressure values remained within normal physiological limits in both groups during the study period. Hemodynamic stability was maintained, with no significant differences observed between the groups.

Graph 2: Mean Systolic Blood Pressure between different time intervals among both the groups



Diastolic blood pressure showed minimal variations over time in both groups and remained hemodynamically stable throughout the observation period, indicating the cardiovascular safety of verapamil as an adjuvant.

Graph 3: Mean Diastolic Blood Pressure between different time intervals among both the groups



Patients receiving verapamil with ropivacaine demonstrated a significantly faster onset of sensory and motor blockade and a significantly prolonged duration of both sensory and motor blockade compared to ropivacaine alone ($p<0.001$).

Table 2: Comparison of Onset and Duration of Sensory and Motor Blockade between Both Groups

Parameter	Group R (Mean ± SD)	Group RV (Mean ± SD)	p-value
Onset of Sensory Block (min)	12.74 ± 1.40	9.94 ± 1.41	<0.001*
Onset of Motor Block (min)	15.94 ± 1.47	12.37 ± 0.88	<0.001*
Duration of Sensory Block (min)	308.57 ± 23.72	398.86 ± 26.52	<0.001*
Duration of Motor Block (min)	297.43 ± 19.68	327.14 ± 23.05	<0.001*

The addition of verapamil significantly prolonged postoperative analgesia and reduced rescue analgesic requirements during the first 24 hours. More than half of the patients in the verapamil group required only one rescue analgesic dose, whereas the majority of patients in the ropivacaine group required more than three doses ($p<0.001$).

Table 3: Comparison of Postoperative Analgesia Characteristics between the Groups References

Parameter	Group R: (n=35)	Group RV: (n=35)	p-value
Duration of Rescue Analgesia (min), Mean ± SD	379.71 ± 22.98	436.29 ± 23.62	**<0.001***
Rescue Analgesic Doses in First 24 Hours			
≤ 1 Dose, n (%)	0 (0.0)	18 (51.4)	**<0.001***
2 Doses, n (%)	4 (11.4)	15 (42.9)	
3 Doses, n (%)	9 (25.7)	2 (5.7)	
> 3 Doses, n (%)	22 (62.9)	0 (0.0)	

Postoperative pain scores were significantly lower in the verapamil group at all assessed time intervals compared with the ropivacaine group, indicating superior and prolonged analgesic efficacy ($p<0.05$).

Table 4: Comparison of Postoperative VAS Pain Scores between Study Groups

Time Interval	Group R (Mean ± SD)	Group RV 9Mean ± SD)	p-value
2 h	5.97 ± 0.62	4.34 ± 0.48	<0.001*
4 h	5.03 ± 0.71	3.31 ± 0.47	<0.001*
6 h	5.00 ± 0.49	3.29 ± 0.46	<0.001*
8 h	4.69 ± 0.72	2.74 ± 0.44	<0.001*
10 h	3.20 ± 0.53	2.40 ± 0.55	<0.001*
12 h	2.06 ± 0.64	1.51 ± 0.98	0.008*

Time Interval	Group R (Mean ± SD)	Group RV 9Mean ± SD)	p-value
18 h	0.57 ± 0.74	0.09 ± 0.37	0.001*
24 h	0.14 ± 0.43	0.03 ± 0.17	0.007*

The incidence of postoperative complications was low and comparable between the groups. Although nausea, vomiting, dizziness, and other adverse effects were numerically less frequent in the verapamil group, no statistically significant difference was observed (p>0.05).

Table 5: Comparison of Postoperative Complications between study Groups

Complication	Group R (n=35) n (%)	Group RV (n=35) n (%)	p-value
Nausea	8 (22.9)	6 (17.1)	>0.05
Vomiting	7 (20.0)	2 (5.7)	
Dizziness	3 (8.6)	0 (0.0)	
Other adverse effects	2 (5.7)	0 (0.0)	

DISCUSSION

The present findings demonstrated that the addition of verapamil significantly accelerated the onset of sensory and motor blockade, prolonged block duration, extended postoperative analgesia, reduced analgesic consumption, and lowered postoperative pain scores without causing clinically significant hemodynamic instability or adverse effects.

In the present study, sensory and motor block onset times were significantly shorter in the verapamil group. Calcium channel blockade by verapamil may enhance local anesthetic action through inhibition of calcium-dependent neurotransmitter release and stabilization of neuronal membranes, thereby facilitating rapid nerve conduction blockade. Similar findings were reported by Bansal et al., who observed faster onset of brachial plexus blockade with the addition of verapamil to local anesthetics during peripheral nerve block procedures [11]

A major finding of the present study was the significant prolongation of sensory and motor block duration in patients receiving verapamil. The prolonged blockade may be attributed to synergistic interaction between verapamil and ropivacaine at the neuronal membrane, resulting in enhanced inhibition of impulse propagation. Comparable results have been documented by Kothari et al., who reported prolonged neural blockade and improved block quality when verapamil was used as an adjunct in regional anesthesia techniques [12]

Postoperative analgesia was significantly enhanced in the verapamil group, with a longer duration before first rescue analgesic requirement and reduced analgesic consumption during the first 24 hours. These findings are clinically relevant because prolonged analgesia improves patient comfort and reduces dependence on systemic analgesics. A meta-analysis by Sun et al. demonstrated that calcium-channel blockers used as adjuvants in regional anesthesia significantly prolong postoperative analgesia and decrease rescue analgesic requirements [13]

Pain assessment using VAS scores showed significantly lower scores at all postoperative time intervals in the verapamil group. This observation further supports the analgesia-enhancing effect of verapamil and is consistent with previous studies suggesting that calcium-channel blockade modulates nociceptive transmission and attenuates postoperative pain perception [14]

Hemodynamic parameters remained stable throughout the study period, and the incidence of adverse effects was low and comparable between the groups. These findings suggest that low-dose verapamil can be safely administered as a perineural adjuvant without significant cardiovascular compromise. Similar safety profiles have been reported by El-Boghdadly et al. and Hussain et al. in studies evaluating adjuncts for peripheral nerve blocks [15, 16]

CONCLUSION

The addition of verapamil (2.5 mg) to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block significantly hastened the onset and prolonged the duration of sensory and motor blockade. It also provided longer postoperative analgesia, reduced rescue analgesic requirements, and resulted in lower postoperative pain scores without causing significant hemodynamic instability or adverse effects. Therefore, verapamil appears to be a safe and effective adjuvant to ropivacaine for enhancing the quality and duration of brachial plexus blockade in upper limb surgeries.

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