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Original Article

Anaesthesia Section

# Effectiveness of 0.5% Ropivacaine with Magnesium Sulfate versus 0.5% Ropivacaine Alone in Ultrasound-guided Supraclavicular Brachial Plexus Block: A Prospective Observational Study

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## ABSTRACT

**Introduction:** In regional anaesthesia, a rapid onset of analgesia was clinically important because it improved patient comfort and may reduce the need for rescue analgesics. Evaluating the efficacy of a drug as an adjuvant can help identify approaches to achieve faster, more effective postoperative pain control.

**Aim:** To assess the efficacy of 0.5% ropivacaine with magnesium sulfate versus 0.5% ropivacaine alone in ultrasound-guided supraclavicular brachial plexus block.

**Materials and Methods:** This prospective observational study was conducted in the main Operation Theatre (OT) of the Department of Anaesthesia, Kottayam Government Medical College, Kottayam, Kerala, India, from July 2023 to July 2024. The study included American Society of Anaesthesiologists (ASA) physical status I and II patients aged 18-65 years posted for upper limb surgeries under ultrasound-guided supraclavicular block. Patients having peripheral neuropathy, bleeding disorders, and allergies to local anaesthetics or magnesium sulfate were excluded. Consecutive sampling resulted in 52 patients receiving 0.5% ropivacaine with 150 mg magnesium sulfate (Group A) and another 52 receiving 0.5% ropivacaine alone (Group B). The primary outcome was the duration of postoperative analgesia. Secondary outcomes were the onset of sensory and motor block, postoperative pain using the Visual Analogue Scale (VAS), sedation (Ramsay) scores, rescue-analgesic requirements, and haemodynamic parameters. Demographic data were also recorded. Non normally distributed/ordinal outcomes were compared by Mann-Whitney U, categorical rescue analgesia by Fisher's-exact test, and haemodynamics by repeated-measures Greenhouse-Geisser; effect sizes and per-family Bonferroni correction reported throughout.

**Results:** A total of 104 patients (52 per group) were included. Baseline demographic characteristics were comparable between groups. The median duration of postoperative analgesia was similar in the magnesium and control groups {468.5 (IQR 155) vs 470.0 (IQR 129) min; p=0.610}. The magnesium group had a faster onset of sensory block {15.0 (IQR 10) vs 18.5 (IQR 5) min; p=0.042} and motor block {15.0 (IQR 10) vs 18.0 (IQR 5) min; p=0.042} and this difference remained significant after Bonferroni correction (VAS at postoperative 6 h was significantly lower in Group A than in Group B [p=0.007], $\alpha$=0.0083). Paracetamol consumption was comparable between groups, whereas fewer patients in the magnesium group required tramadol rescue analgesia (42.3% vs 75.0%; adjusted OR 3.92, 95% CI 1.66–9.25; p=0.002). Early postoperative sedation was higher in the magnesium group {0 h: 4.0 (IQR 0) vs 3.0 (IQR 1); p<0.001}, with no clinically significant haemodynamic differences.

**Conclusion:** Adding magnesium sulfate to 0.5% ropivacaine did not significantly prolong the duration of postoperative analgesia. However, it was associated with reduced postoperative tramadol requirements and increased early sedation, while maintaining haemodynamic stability.


**Keywords:** Analgesia, Nerve block, Pain, Ultrasonography

## INTRODUCTION

Brachial plexus block was first described by William Halsted and Richard Hall in the late 1800 using cocaine under direct vision, marking the beginning of regional anaesthesia for upper limb surgery [1]. Advances in regional anaesthesia, particularly the introduction of ultrasound guidance, have significantly improved the safety, accuracy, and success of brachial plexus blocks by enabling direct visualisation of neural structures and adjacent vessels [2]. Consequently, ultrasound-guided supraclavicular brachial plexus block has become a widely accepted technique for upper limb surgeries, providing effective surgical anaesthesia and prolonged postoperative analgesia while reducing complications associated with landmark-based techniques such as pneumothorax [2].

Ropivacaine is a long-acting aminoamide local anaesthetic that blocks by acting on voltage-dependent sodium channels. It is unique in being less lipophilic and less likely to penetrate large myelinated motor fibres [3]. It is also manufactured as a pure S (–) enantiomer, which exhibits significantly lower cardiotoxicity and neurotoxicity [3]. Therefore, ropivacaine has a favourable safety profile compared with bupivacaine. Adding adjuvants provides rapid onset, dense and prolonged analgesia. Magnesium sulfate has been investigated as an adjuvant to ropivacaine in brachial plexus blocks because of its potential to enhance block characteristics and improve postoperative analgesia. The antinociceptive effects of magnesium result from modulation of intracellular calcium influx and blockade of NMDA receptors [4,5]. Mukherjee K et al., demonstrated that the addition of magnesium to ropivacaine in supraclavicular brachial plexus block significantly prolonged sensory and motor block duration, increased the time to first analgesic request, and reduced rescue analgesic consumption, although no significant difference in block onset was observed [6]. Despite the reported benefits of magnesium sulfate, variations in findings regarding onset characteristics, duration of blockade, postoperative analgesia, rescue analgesic requirements,

sedation profile, and adverse effects, as well as differences in study design, magnesium dosage, and block techniques, indicate that the available evidence remains heterogeneous [6,7]. Therefore, further evaluation of magnesium sulfate as an adjuvant to ropivacaine in ultrasound-guided supraclavicular brachial plexus block was warranted. Hence, the study aimed to assess the efficacy of 0.5% ropivacaine with magnesium sulfate versus 0.5% ropivacaine alone in ultrasound-guided supraclavicular brachial plexus block. The primary objective was to compare the duration of postoperative analgesia, while the secondary objectives were to compare the onset of sensory and motor blockade, postoperative pain scores, rescue analgesic requirements, and sedation scores between patients receiving 0.5% ropivacaine with magnesium sulfate and those receiving 0.5% ropivacaine alone for ultrasound-guided supraclavicular brachial plexus block.

## MATERIALS AND METHODS

This prospective observational study was conducted in the main OT of the Department of Anaesthesia, Kottayam Government Medical College, Kottayam, Kerala, India, from July 2023 to July 2024. After obtaining approval from the Institutional Ethics Committee (CDSCO registration no: ECR/1677/Inst/KL/2022) and Institutional Review Board (IRB NO: 08/2023), the study was carried out over a period of 12 months from July 2023 to July 2024.

**Sample size calculation:** Sample size was calculated from the formula:

$$N = \frac{(Z\alpha + Z\beta)^2 \times SD^2 \times 2}{(M_1 - M_2)^2}$$

$$\text{Where } SD_2 = \frac{(SD1)^2 + (SD2)^2}{2},$$

$Z\alpha$=1.96, $Z\beta$=0.84, $SD_1$ =152, $SD_2$=145 , $M_1$= 461, $M_2$= 379 (mean and SD calculated from the 1st analgesic requirement)

$$\text{Sample size, } N = \frac{(1.96+0.84)^2 \times 22064 \times 2}{(461-379)2}$$

$$= \frac{345971}{6724} = 51.4 = 52$$

A total of 104 (52 in each group) patients underwent ultrasound-guided brachial plexus block for upper limb surgeries.

Standard deviations were derived from Mukherjee K et al., the only available study using an identical drug combination and dose (0.5% ropivacaine with 150 mg magnesium sulfate) [6]; no observational study with comparable methodology was available to provide an effect size from a non randomised design. The implications of using a randomised trial as the source for this calculation are addressed in the limitations.

**Inclusion criteria:** Patients aged between 18-65 years, patients categorised under ASA I, ASA II and patients undergoing upper limb surgeries were included.

**Exclusion criteria:** Pre-existing peripheral neuropathy, bleeding disease, infection at the injection site, allergy to local anaesthetics and magnesium sulfate, surgeries lasting more than three hours, and patients with a history suggestive of arrhythmias were excluded.

### Study Procedure

Patients were observed based on the anaesthetic technique and drug regimen used by the attending consultant anaesthesiologist as a part of routine clinical practice. Accordingly, patients were categorised into two groups:

- Group A: Patients who received 0.5% ropivacaine with 150 mg magnesium sulfate
- Group B: Patients who received 0.5% ropivacaine alone [6].

No randomisation or allocation was performed by the investigator; the attending anaesthesiologist independently selected the drug regimen as part of routine clinical care; the investigator observed and recorded outcomes only. All patients underwent detailed preanaesthetic evaluation and were informed about the anaesthetic procedure. Oral premedication with pantoprazole 40 mg was given on the morning of surgery. In the OT, standard anaesthesia monitoring was commenced. Intravenous access with an 18G cannula was secured, and Ringer's lactate infusion started. Patient positioned supine with the head turned to the opposite side. A high-frequency linear ultrasound probe was placed over the supraclavicular region to identify the brachial plexus. The brachial plexus was approached using a 22-G, 50-mm Braun Stimuplex needle through the lignocaine-infiltrated skin [6]. All patients received 20 mL of 0.5% ropivacaine for the block as part of standard care. Based on the anaesthetic regimen chosen by the attending anaesthesiologist, patients either received magnesium sulfate (150 mg in 1 mL normal saline) or 1 mL normal saline. Patients with unsuccessful brachial plexus block requiring conversion to general anaesthesia were predefined to be excluded from the final analysis. However, no block failures occurred, and all 104 enrolled patients completed the study.

The primary outcome was duration of postoperative analgesia. Postoperative pain was assessed using the Visual Analog Scale (VAS) at predetermined intervals of 0, 2, 4, 6, 12, and 24 hours. The duration of analgesia was recorded as the time from initiation of the block to the requirement of the first rescue analgesic. Initial treatment involved intravenous infusion of 1 g of paracetamol and 0.1 mg/kg of ondansetron when the VAS score exceeded 4. If further analgesia was required, intravenous tramadol was administered at 1.5 mg/kg (up to a maximum of 3 mg/kg).

**Secondary outcomes** were the onset of motor and sensory block and sedation levels. The onset time of sensory and motor blockade was defined as the interval between completion of local anaesthetic administration and the establishment of complete sensory or motor block. Sensory blockade was assessed using the pin-prick method along the distribution of the four major nerves and graded according to the Hollmen scale [8]. Complete sensory block was defined as anaesthesia involving all nerve territories (Hollmen score 4) [8], while complete motor block was defined as the absence of voluntary movement of the hand and forearm. Motor blockade was evaluated using thumb abduction (radial nerve), thumb adduction (ulnar nerve), thumb opposition (median nerve), and elbow flexion (musculocutaneous nerve) and graded using the Modified Bromage scale [9]. Sedation levels were assessed using the Ramsay Sedation Score [10].

## STATISTICAL ANALYSIS

Data analysis was performed using IBM Statistical Package for Social Sciences (SPSS) Statistics version 26.0. Data distribution was assessed using the Shapiro-Wilk test and normal Q-Q plots. Continuous and ordinal variables were compared between groups using the Mann-Whitney U test, while categorical variables were analysed using the Chi-square test or Fisher's-exact test, as appropriate. Serial haemodynamic variables were analysed using repeated-measures Analysis of Variance (ANOVA) with Greenhouse-Geisser correction. Data are presented as median (interquartile range) for non normally distributed variables, Mean ± Standard Deviation (SD) for normally distributed variables, and frequency (percentage) for categorical variables. A two-sided p-value<0.05 was considered statistically significant. Sensitivity analyses were performed by adjusting the principal outcomes for age, gender, and ASA physical status.

## RESULTS

A total of 104 patients were enrolled in the study, with 52 patients in each group. All enrolled patients completed the study and were

included in the final analysis. No patient experienced block failure or required conversion to general anaesthesia; therefore, no patients were excluded after enrollment.

Both groups were comparable in terms of age, gender, ASA physical status, mean weight, and mean height, with no statistical difference between them [Table/Fig-1].

| Characteristics | Group A, n (%) | Group B, n (%) | $\chi^2$-value | p-value |
|---|---|---|---|---|
| **Age group (years)** | | | | |
| 18-35 | 29 (55.8) | 22 (42.3) | 1.89 | 0.389 |
| 36-50 | 14 (26.9) | 18 (34.6) | | |
| 51-65 | 9 (17.3) | 12 (23.1) | | |
| **Gender** | | | | |
| Male | 35 (67.3) | 37 (71.2) | 0.18 | 0.671 |
| Female | 17 (32.7) | 15 (28.8) | | |
| **ASA physical status** | | | | |
| I | 30 (57.7) | 31 (59.6) | 0.04 | 0.842 |
| II | 22 (42.3) | 21 (40.4) | | |
| **Weight (kg)** | | | | |
| <50 | 3 (5.8) | 2 (3.8) | 2.31 | 0.315 |
| 50–70 | 45 (86.5) | 41 (78.8) | | |
| >70 | 4 (7.7) | 9 (17.3) | | |
| **Height (cm)** | | | | |
| <155 | 2 (3.8) | 0 | 2.20 | 0.332 |
| 155-165 | 23 (44.2) | 26 (50.0) | | |
| >165 | 27 (51.9) | 26 (50.0) | | |

**[Table/Fig-1]:** Demographic and baseline characteristics.
Pearson's Chi-square; height <155 cell sparse (collapse with 155-165 or use Fisher's-exact). All comparisons non significant - groups were comparable.

Regarding the primary outcome, the duration of postoperative analgesia (in minutes) was compared between group A and group B and showed no statistical difference, with a p-value of 0.6 [Table/Fig-2].

| Outcomes | Group A Median (IQR) | Group B Median (IQR) | p-value |
|---|---|---|---|
| Time to first rescue analgesic (min) | 468.5 (155) | 470.0 (129) | 0.610 |

**[Table/Fig-2]:** The duration of postoperative analgesia (primary outcome).
Mann-Whitney U test. No significant difference in duration of analgesia between groups (medians differ by 1.5 min).

With respect to the secondary outcome, group A showed faster sensory and motor block onset than group B; however, these differences did not remain statistically significant after Bonferroni correction, with p-values of 0.042 for sensory block and 0.042 for motor block in group A [Table/Fig-3].

| Outcomes | Group A Median (IQR) | Group B Median (IQR) | p-value | r-value |
|---|---|---|---|---|
| Sensory block onset (min) | 15.0 (10) | 18.5 (5) | 0.042 | 0.20 |
| Motor block onset (min) | 15.0 (10) | 18.0 (5) | 0.042 | 0.20 |

**[Table/Fig-3]:** Onset of sensory and motor block.
Mann-Whitney U test; r = effect size (small). Group A showed faster onset of both sensory and motor block, with a small effect size (r=0.20); neither difference survived Bonferroni correction for multiple comparisons. Means with bootstrapped 95% confidence intervals. Group A, ropivacaine + magnesium sulfate; Group B, ropivacaine alone.

The VAS at postoperative 0 hr, 2 hr, 4 hr, 12 hr, and 24 hr showed no statistical significance. However, VAS at postoperative 6 hr showed statistical significance with a p-value of 0.007 [Table/Fig-4]. Mann-Whitney result reflects a difference in the distributional spread (IQR 2 vs IQR 1) between groups rather than a difference in median values.

| Time | Group A Median (IQR) | Group B Median (IQR) | p-value | r-value |
|---|---|---|---|---|
| 0 h | 0 | 0 | 1.000 | — |
| 2 h | 0 | 0 | 0.155 | 0.14 |
| 4 h | 0 (1) | 0 | 0.462 | 0.007 |
| 6 h | 3.0 (2) | 3.0 (1) | 0.007 | 0.26 |
| 12 h | 4.0 (1) | 4.0 (0) | 0.736 | 0.03 |
| 24 h | 4.0 (0) | 4.0 (0) | 0.874 | 0.02 |

**[Table/Fig-4]:** Postoperative VAS pain scores.
Mann-Whitney U test. Significance interpreted against a Bonferroni-corrected threshold ($\alpha$=0.0083) for six time points. Surviving correction: VAS at 6 h (p=0.007); sedation at 0, 2, and 4 h (p≤0.001). Group A, ropivacaine + magnesium sulfate; Group B, ropivacaine alone.

Total paracetamol consumption was comparable between the groups (p=0.088). However, the magnesium group required significantly less tramadol rescue analgesia than the ropivacaine-alone group (42.3% vs 75.0%; adjusted OR 3.92, 95% CI 1.66-9.25; p=0.002). This difference remained significant at both 12 hours (adjusted OR 3.72, 95% CI 1.46-9.48; p=0.006) and 24 hours (adjusted OR 2.84, 95% CI 1.25-6.45; p=0.013) [Table/Fig-5].

| Analgesics | Group A n (%) | Group B n (%) | Adjusted OR (95% CI)* | p-value |
|---|---|---|---|---|
| **Paracetamol** | | | | |
| 1000 mg | 6 (11.5) | 7 (13.5) | - | 0.088 |
| 2000 mg | 41 (78.8) | 45 (86.5) | | |
| 3000 mg | 5 (9.6) | 0 | | |
| **Tramadol** | | | | |
| None | 30 (57.7) | 13 (25.0) | - | 0.002 |
| 50 mg | 18 (34.6) | 28 (53.8) | | |
| 100 mg | 4 (7.7) | 11 (21.2) | | |
| Any tramadol | 22 (42.3) | 39 (75.0) | 3.92 (1.66 - 9.25) | 0.002 |
| Any tramadol, 12 h | 14 (26.9) | 30 (57.7) | 3.72 (1.46 - 9.48) | 0.006 |
| Any tramadol, 24 h | 18 (34.6) | 28 (53.8) | 2.84 (1.25 – 6.45) | 0.013 |

**[Table/Fig-5]:** Rescue analgesic requirement.

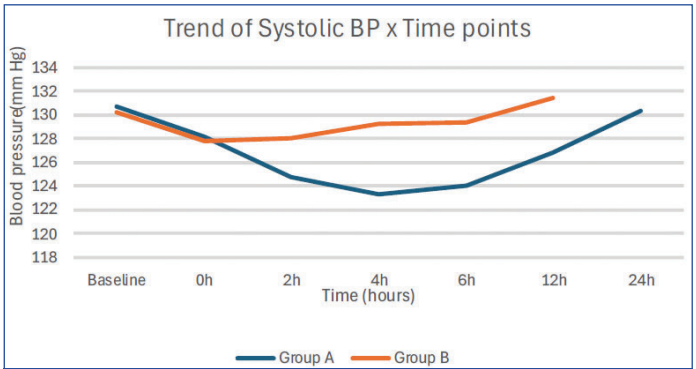
Postoperative sedation scores at postoperative periods of 0 hr, 2 hr, 4 hr, and 6 hr showed a statistical difference between the two groups. Sedation scores at postoperative 12 hr and 24 hr showed no statistical difference [Table/Fig-6].

| Time | Group A Median (IQR) | Group B Median (IQR) | p-value | r-value |
|---|---|---|---|---|
| 0 h | 4.0 (0) | 3.0 (1) | <0.001 | 0.49 |
| 2 h | 3.0 (1) | 3.0 (0) | 0.001 | 0.33 |
| 4 h | 3.0 (0) | 3.0 (1) | <0.001 | 0.35 |
| 6 h | 2.5 (1) | 2.0 (1) | 0.009 | 0.26 |
| 12 h | 2.0 (0) | 2.0 (0) | 0.222 | 0.12 |
| 24 h | 2.0 (0) | 2.0 (0) | 1.000 | — |

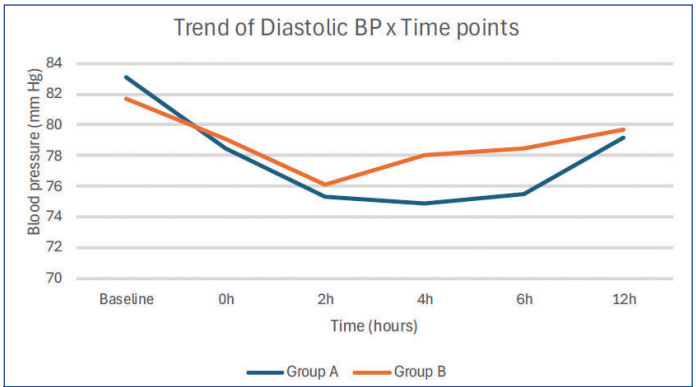
**[Table/Fig-6]:** Postoperative sedation scores (Ramsay).
Mann-Whitney U test. Magnesium produced significantly greater sedation through 0-6 h (large effect at 0 h), resolving by 12-24 h. Significant timepoints survive Bonferroni correction at 0-4 h. Sedation at 6 h (p=0.009) is nominally significant but does not survive correction.

Haemodynamic outcome comparison of group A and group B measured at timepoints 0 hr, 2 hr, 4 hr, 12 hr, and 24 hr showed no overall Blood Pressure (BP) difference; the significant interaction in mean systolic BP, Systolic Blood Pressure (SBP) reflects a transient mid-period (4-6 h) decline in the magnesium group, resolving by 24 hours. There was no overall between-group difference (p=0.090), but the group × time interaction was significant (p=0.030; repeated-measures ANOVA, Greenhouse-Geisser corrected). Values are means; n=52 per group. Also, the interaction in diastolic BP: the magnesium group showed a transient mid-period (4-6 h) reduction, resolving by 24 hours. No overall between-group difference was observed (p=0.520), with a significant group × time interaction (p=0.032; repeated-measures

Analysis of Variance (ANOVA), Greenhouse-Geisser corrected). Values are means; n=52 per group. No clinically significant hypotension [Table/Fig-7,8].



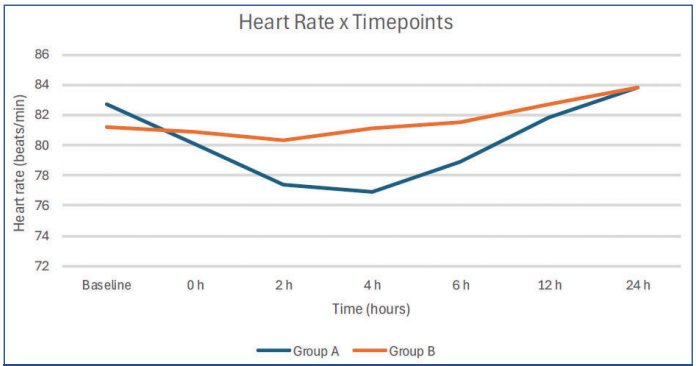

**[Table/Fig-7]:** Systolic blood pressure over time by group.




**[Table/Fig-8]:** Diastolic blood pressure over time by group.

Mean SBP (mmHg) at baseline and at 0, 2, 4, 6, 12, and 24 hours postoperatively in group A (ropivacaine + magnesium sulfate) and group B (ropivacaine alone). The magnesium group showed a transient mid-period (4–6 h) reduction that returned to baseline by 24 h.

Heart rate was compared between group A and group B at time points 0 hr, 2 hr, 4 hr, 12 hr, 24 hr. No overall difference, but a significant interaction reflecting a transient heart-rate reduction in the magnesium group A at 2-6 h, resolving by 24 h. There was no overall between-group difference (p=0.418), but the group × time interaction was significant (p<0.001; repeated-measures ANOVA, Greenhouse-Geisser corrected). Values are means; n=52 per group [Table/Fig-9].




**[Table/Fig-9]:** Heart rate over time by group.

Mean heart rate (beats/min) at baseline and at 0, 2, 4, 6, 12, and 24 hours postoperatively in group A (ropivacaine + magnesium sulfate) and group B (ropivacaine alone). The magnesium group showed a transient reduction at 2-6 h, returning to baseline by 24 hours.

## DISCUSSION

The present study demonstrated that the addition of 150 mg magnesium sulfate to 0.5% ropivacaine for ultrasound-guided supraclavicular brachial plexus block did not significantly prolong the duration of postoperative analgesia, as reflected by a comparable time to first rescue analgesic between the two groups. This finding differs from that of Mukherjee K et al., who reported a significantly prolonged duration of sensory and motor blockade, delayed first analgesic request, and reduced postoperative analgesic consumption with the same dose of perineural magnesium sulfate added to ropivacaine in supraclavicular brachial plexus block [6]. Similar findings have also been reported by Lee AR et al., in interscalene brachial plexus block and El Shamaa HA et al., in femoral nerve block, where magnesium sulfate prolonged postoperative analgesia when used as an adjuvant to local anaesthetics [10,11]. The discrepancy between the present study and previous reports may be attributed to differences in study design, patient population, type of surgery, local anaesthetic regimen, postoperative analgesic protocols, and methodological variations. Unlike the previous randomised controlled trials, the present study was observational, allowing anaesthetic management to follow routine clinical practice, which may have reduced the ability to detect modest differences in analgesic duration. Nevertheless, the findings suggest that although perineural magnesium may not consistently prolong the time to first rescue analgesic, its analgesic benefits should be interpreted alongside other clinically relevant outcomes rather than duration alone.

The present study demonstrated a faster onset of both sensory and motor blockade in patients receiving magnesium sulfate as an adjuvant to 0.5% ropivacaine, although the effect size was small and the differences did not remain statistically significant after correction for multiple comparisons. These findings are consistent with those of Verma V et al., who demonstrated a faster onset of sensory and motor blockade and prolonged block duration following the addition of magnesium sulfate to ropivacaine for ultrasound-guided supraclavicular brachial plexus block [12]. Similar observations were reported by Kaur S et al., who demonstrated improved onset of blockade and postoperative analgesia with magnesium as an adjuvant to ropivacaine [13]. In contrast, Singh P et al., found that although magnesium sulfate improved block characteristics, dexmedetomidine was superior in hastening block onset and prolonging postoperative analgesia, suggesting that the choice of adjuvant also influences block quality [14]. The favourable effects of magnesium are attributed to peripheral NMDA receptor antagonism and modulation of calcium influx, which potentiate local anaesthetic action and attenuate nociceptive transmission. However, the improvement observed in the present study was modest and did not remain significant after adjustment for multiple comparisons, indicating that the clinical benefit of magnesium on block onset may vary according to magnesium dose, local anaesthetic concentration, block technique, patient population, and study methodology. Further adequately powered randomised controlled trials are warranted to confirm these findings.

The current study also demonstrated comparable postoperative pain scores between the two groups at most time points, with a significantly lower VAS score at 6 hours in the magnesium group. Although total paracetamol consumption was similar, patients receiving magnesium sulfate required significantly less postoperative tramadol, indicating an opioid-sparing effect despite the absence of a significant prolongation in the duration of postoperative analgesia. Similarly, Sun J et al., demonstrated lower postoperative pain scores and reduced rescue analgesic consumption after perineural magnesium administration in ultrasound-guided sciatic nerve block, while El Sherif FA et al., observed significantly reduced opioid requirements and improved postoperative analgesia when magnesium sulfate was used as an adjuvant to levobupivacaine in erector spinae plane block [15,16]. In addition, the randomised trial by George S and Karthick Raj A reported reduced postoperative analgesic requirements with magnesium compared with ropivacaine

alone, further supporting its analgesic benefits [17]. The observed reduction in tramadol requirement in the present study, despite comparable overall analgesic duration, suggests that magnesium may improve the quality of postoperative analgesia rather than simply prolong its duration. This observation is supported by the systematic review and meta-analysis by de Oliveira GS et al., which concluded that perioperative magnesium administration reduces postoperative pain intensity and opioid consumption through NMDA receptor antagonism and modulation of central sensitisation [18]. The differences in analgesic duration reported among studies may reflect variations in magnesium dose, type of local anaesthetic, block technique, postoperative analgesic protocols, and surgical procedures.

From a safety perspective, magnesium sulfate was associated with transient early sedation without clinically significant haemodynamic instability. During the first 4 hours, higher sedation scores were noted although it became comparable by 12 and 24 hours. In addition, transient reductions in heart rate and blood pressure were observed in patients receiving magnesium sulfate; however, these changes were not clinically significant, and haemodynamic stability was maintained throughout the study period. These findings are consistent with those reported by Hussien RM and Ibrahim DA, who observed mild-to-moderate sedation associated with perioperative magnesium administration without clinically relevant adverse effects [19]. Comparable haemodynamic findings have also been described by Silva Filho SE et al., who demonstrated that magnesium administration may produce modest reductions in heart rate and blood pressure without causing clinically significant cardiovascular instability [20]. Likewise, Aref FAM et al., reported stable perioperative haemodynamic parameters following the use of magnesium sulfate as an adjuvant to regional anaesthesia [21]. The transient sedative and haemodynamic effects observed in the present study are likely attributable to the calcium channel-blocking and sympatholytic properties of magnesium sulfate, which reduce catecholamine release and attenuate sympathetic responses. Importantly, these effects resolved spontaneously without requiring clinical intervention, suggesting that 150 mg perineural magnesium sulfate was not associated with clinically significant haemodynamic instability in the present study.

Overall, the findings of this study suggest that the addition of 150 mg magnesium sulfate to 0.5% ropivacaine may enhance the quality of postoperative analgesia without significantly prolonging the duration of analgesia. Although the primary outcome was not improved, patients receiving magnesium sulfate experienced faster block onset, reduced postoperative tramadol requirements, lower pain scores at six hours, and transient early sedation without clinically significant haemodynamic instability. Collectively, these findings suggest that perineural magnesium sulfate may improve the quality of postoperative analgesia and reduce opioid requirements without compromising haemodynamic stability. These results support its potential role as part of a multimodal analgesic strategy; however, larger multicentre randomised controlled trials are required to establish the optimal dose and confirm its clinical effectiveness.

### Limitation(s)

The present study has several limitations. First, as a prospective observational study, treatment allocation was not randomised and was based on the attending anaesthesiologist's choice of drug regimen. Because treatment allocation was determined by the attending anaesthesiologist rather than by randomisation, confounding by treatment selection and residual confounding from unmeasured variables cannot be excluded.

Second, the sample size was derived from previously published data and may have been insufficient to detect smaller between-group differences. Furthermore, some statistically significant findings were observed in secondary outcomes and should therefore be interpreted with caution. The lack of blinding may also have introduced observer bias, particularly for subjective outcomes such as pain and sedation scores.

Finally, this was a single-centre study involving ASA I-II patients undergoing elective upper-limb surgery, with follow-up limited to 24 hours. Therefore, the findings may not be generalisable to higher-risk patients, paediatric or geriatric populations, emergency procedures, or longer-term postoperative outcomes. Further large-scale randomised controlled trials are required to confirm these findings. Future research directions would be compared based on the location of surgery.

## CONCLUSION(S)

The addition of 150 mg magnesium sulfate to 0.5% ropivacaine for ultrasound-guided supraclavicular brachial plexus block did not significantly prolong the duration of postoperative analgesia. However, magnesium sulfate was associated with reduced postoperative tramadol requirements, lower pain scores at six hours, and increased early postoperative sedation without clinically significant haemodynamic instability. These findings suggest that magnesium sulfate may serve as a useful adjuvant for enhancing the quality of postoperative analgesia and reducing opioid consumption, although its effect on prolonging analgesia remains uncertain. Further large-scale randomised controlled trials are required to clarify its role and determine the optimal dose in peripheral nerve blocks.

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