Section: Anesthesia

Original Research Article

COMPARISON OF $MGSO_4$ AND DEXAMETHASONE AS ADJUVANTS TO 0.75% ROPIVACAINE FOR POSTOPERATIVE PAIN MANAGEMENT IN UPPER LIMB SURGERIES USING SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK UNDER ULTRASOUND GUIDANCE

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ABSTRACT

Background: Peripheral nerve blockade is a widely used regional anesthesia technique that reduces postoperative pain, minimizes the need for analgesics, and improves patient recovery. The supraclavicular brachial plexus block (SCBPB) is commonly used for upper limb surgeries due to its high success rate, rapid onset, and dense anesthesia. Various adjuvants are added to local anesthetics to enhance block characteristics. Magnesium sulfate ($MgSO_4$) and dexamethasone are among the most studied adjuvants, but limited data exist on their comparative efficacy when used with ropivacaine in SCBPB. **Objective:** This study aimed to compare the efficacy of Magnesium Sulfate -$MgSO_4$ and dexamethasone as adjuvants to 0.75% ropivacaine in supraclavicular brachial plexus block for upper limb surgeries. The primary objective was to evaluate postoperative analgesia duration. Secondary objectives included sensory and motor block onset and duration, quality of analgesia assessed by the Visual Analog Scale (VAS), total analgesic consumption, and hemodynamic stability.
Materials and Methods: A prospective, randomized, double-blinded study was conducted on 100 patients (ASA I & II) scheduled for elective upper limb surgery under supraclavicular brachial plexus block. Patients were randomized into two groups: Group RD (n=50): Received 20 ml 0.75% ropivacaine + 2 ml (8 mg) dexamethasone + 8 ml normal saline (total 30 ml).Group RM (n=50): Received 20 ml 0.75% ropivacaine + 2 ml (200 mg) Magnesium Sulfate - $MgSO_4$ + 8 ml normal saline (total 30 ml). Block characteristics, postoperative pain scores, and rescue analgesia requirements were assessed over 24 hours.
Results: Onset of sensory block was faster in Group RD (13.15 ± 1.90 min) compared to Group RM (15.44 ± 2.26 min, $P < 0.001$).Onset of motor block was also faster in Group RD (17.12 ± 2.12 min) than in Group RM (19.26 ± 2.28 min, $P = 0.001$).Duration of sensory block was significantly longer in Group RD (1168.2 ± 111.88 min) compared to Group RM (468.60 ± 62.14 min, $P < 0.001$).Duration of motor block was longer in Group RD (1088.6 ± 91.15 min) than in Group RM (385.80 ± 45.39 min, $P < 0.001$).Time to first rescue analgesic requirement was significantly prolonged in Group RD (1208.4 ± 111.08 min) compared to Group RM (498.18 ± 64.22 min, $P < 0.001$).Total analgesic consumption was significantly lower in Group RD (87.4 ± 22.2 mg) than in Group RM (185 ± 36.2 mg, $P < 0.001$).
Hemodynamic parameters were stable in both groups, though Group RM showed transient hypotension at 30 minutes ($P = 0.013$).

Conclusion: Dexamethasone (8 mg) proved to be a more effective adjuvant than $MgSO_4$ (200 mg) when combined with 0.75% ropivacaine for supraclavicular brachial plexus block, as it resulted in faster onset, prolonged sensory and motor block duration, extended analgesia, and reduced postoperative analgesic requirement. While $MgSO_4$ remains a viable adjuvant, it is less effective than dexamethasone for optimizing nerve block characteristics. Future studies should investigate optimal dosing and potential synergistic effects of combining adjuvants.
Keywords: Supraclavicular brachial plexus block, Ropivacaine, Dexamethasone, Magnesium sulfate, Postoperative analgesia, Peripheral nerve block, Regional anesthesia, Ultrasound-guided nerve block.

INTRODUCTION

Peripheral nerve blockade is a widely used technique in regional anesthesia that significantly reduces postoperative pain, nausea, and the requirement for analgesics, thereby enhancing patient satisfaction and overall recovery outcomes.[1] The brachial plexus block can be performed at various levels, from nerve roots to terminal branches, to provide surgical anesthesia for upper extremity and shoulder procedures.[2] Among these techniques, the supraclavicular brachial plexus block (SCBPB) is preferred due to its ease of administration, high success rate, and reliable anesthesia coverage.[3]

The supraclavicular block is typically performed using a peripheral nerve stimulator with an insulated needle, delivering a low-frequency current (0.05–1 ms) to elicit a defined muscle twitch response that confirms correct placement.[4]

Advantages and Clinical Importance of Supraclavicular Brachial Plexus Block

Supraclavicular brachial plexus block (SCBPB) has become a preferred regional anesthesia technique due to its ability to provide rapid-onset, dense anesthesia for upper limb surgeries. It effectively anesthetizes the trunks and divisions of the brachial plexus, resulting in uniform sensory and motor blockade for the entire upper limb. Compared to other approaches, such as axillary or interscalene blocks, the supraclavicular approach has a higher success rate, requires a lower anesthetic volume, and is associated with a more predictable and complete blockade of the upper limb. The minimal patient discomfort, prolonged postoperative analgesia, and reduced opioid requirement contribute to improved clinical outcomes and faster recovery.[5]

Ultrasound-Guided vs. Nerve Stimulator Technique

Traditionally, the peripheral nerve stimulator (PNS) technique has been widely used to identify the brachial plexus by eliciting a muscle twitch response, ensuring precise needle placement before anesthetic injection. However, ultrasound (US)-guided supraclavicular blocks have gained popularity due to improved visualization of neural structures, real-time needle guidance, reduced risk of vascular puncture, and enhanced success rates.[6] Studies have demonstrated that ultrasound guidance reduces the time to block onset, minimizes local anesthetic dosage requirements, and decreases complications such as pneumothorax or vascular injury. While PNS remains a valuable technique, ultrasound guidance is becoming the gold standard for performing supraclavicular blocks.[7]

Complications and Risk Factors

Although SCBPB is highly effective, it is not without risks. One of the most concerning complications is phrenic nerve palsy, which can result in hemidiaphragmatic paralysis, particularly in patients with pre-existing pulmonary conditions.[8] Additionally, inadvertent intravascular injection may lead to local anesthetic systemic toxicity (LAST), presenting as neurological (seizures, confusion) and cardiovascular (arrhythmias, hypotension) manifestations. The risk of pneumothorax is also a concern, especially in landmark-based techniques where the pleura is in close proximity to the brachial plexus. Proper technique, aspiration before injection, fractionated dosing, and real-time ultrasound guidance help mitigate these risks, ensuring safer and more effective regional anesthesia for upper limb procedures.[9]

Local Anesthetic and Adjuvants

Ropivacaine, an aminoamide local anesthetic, acts by blocking voltage-dependent sodium channels in peripheral nerves. It is less cardiotoxic and neurotoxic than bupivacaine, while providing a similar duration of action with a more motor-sparing effect, making it an ideal choice for regional anesthesia.[5,6]

To enhance the efficacy, density, and duration of nerve blocks, various adjuvants have been incorporated with local anesthetics, including dexamethasone, α-2 adrenergic agonists, opioids, magnesium sulfate ($MgSO_4$), epinephrine, and midazolam.[7-9]

- Dexamethasone is a highly potent and selective glucocorticoid that improves nerve block characteristics by blocking nociceptive transmission along unmyelinated C-fibers and exerting anti-inflammatory effects.[10,11]
- Magnesium sulfate ($MgSO_4$) is another commonly used adjuvant, known for its anti-nociceptive effects mediated by calcium channel regulation and N-methyl D-aspartate (NMDA) receptor antagonism, which prevents central sensitization and extends the duration of nerve block action.[12]

Rationale for the Study

While previous studies have assessed the role of $MgSO_4$ and dexamethasone as adjuvants in bupivacaine-based peripheral nerve blocks, limited research has focused on their comparative efficacy when used with ropivacaine in supraclavicular brachial plexus blocks. No study has comprehensively evaluated $MgSO_4$ versus dexamethasone as additives to ropivacaine specifically for SCBPB, highlighting the need for further investigation.

Study Objectives

The primary objective of this study was to compare the clinical efficacy of $MgSO_4$ and dexamethasone as adjuvants to ropivacaine in supraclavicular brachial plexus block for upper limb surgeries, with a focus on:

✓ Postoperative analgesia duration (time to first analgesic request)

The secondary objectives included:

✓ Onset and duration of sensory and motor blocks

✓ Quality of analgesia, assessed using the Visual Analog Scale (VAS)

✓ Total analgesic consumption over 24 hours

✓ Hemodynamic stability and changes in vital parameters

This study aimed to provide new insights into the optimal adjuvant choice for improving the quality and longevity of supraclavicular brachial plexus block with ropivacaine in clinical practice.

MATERIALS AND METHODS

This prospective, randomized, double-blinded, comparative study was conducted over a period of one year, from April ---- to March ----, at a tertiary care teaching institute in India. Ethical clearance was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants for their inclusion in the study and for the use of their data for research and academic purposes. A total of 100 adult patients aged 18–65 years, of either gender, classified under the American Society of Anesthesiologists (ASA) physical status I and II, scheduled for elective upper limb surgery under supraclavicular brachial plexus block, were enrolled in the study after obtaining written informed consent. Patients with a known allergy to local anesthetics, diabetes mellitus, neuromuscular disorders, psychiatric or neurological conditions, coagulopathy, severe cardiac disease, local infection at the injection site, and pregnant women were excluded from the study.

The selected patients were randomly assigned into two groups, each comprising 50 participants:

- Group RD: Received a mixture of 20 ml 0.75% ropivacaine, 2 ml (8 mg) dexamethasone, and 8 ml 0.9% normal saline (NS), making a total volume of 30 ml.
- Group RM: Received a mixture of 20 ml 0.75% ropivacaine, 2 ml (200 mg) 10% magnesium sulfate ($MgSO_4$), and 8 ml 0.9% NS, making a total volume of 30 ml.

Randomization was achieved using a computer-generated random number table, ensuring equal allocation (1:1) between the two groups. Allocation concealment was maintained using sequentially numbered, sealed, opaque envelopes, which were opened on the day of surgery before drug administration. The drug preparation was carried out by an independent anesthesiologist not involved in the study. The supraclavicular brachial plexus blocks were administered by experienced anesthesiologists using a peripheral nerve stimulator (B-Braun Stimuplex HNS 12). As this was a double-blinded study, neither the patients nor the resident anesthesiologists responsible for intraoperative and postoperative data collection were aware of the group assignments.

Preoperative Evaluation and Block Procedure

All patients underwent a detailed pre-anesthetic assessment before surgery. The procedure was explained to them, and their familiarity with the Visual Analog Scale (VAS) for pain assessment was ensured. On the day of surgery, an 18G or 20G intravenous cannula was secured in the contralateral arm. Standard monitoring, including electrocardiography (ECG), pulse oximetry (SpO_2), and non-invasive blood pressure (NIBP), was applied in the operating room, and baseline vital parameters were recorded.

For the supraclavicular brachial plexus block, patients were positioned supine with the affected limb placed by their side, the elbow flexed at 90° resting on the chest, and the head turned slightly away from the side of the block. A towel roll was placed under the ipsilateral shoulder for better access to the supraclavicular region. A 22G, 5 cm insulated nerve-stimulating needle (Stimuplex A Insulated Needle) was used to locate the brachial plexus using a peripheral nerve stimulator (B-Braun Stimuplex HNS 12). The stimulation frequency was set at 1 Hz, and the stimulating current was initially 2 mA, which was gradually reduced. The needle was advanced until a distal motor response in the forearm or hand was elicited at ≤0.5 mA, confirming appropriate placement. The total 30 ml local anesthetic solution was administered incrementally in 10 ml aliquots after aspiration to prevent accidental intravascular injection.

Assessment of Sensory and Motor Block

The sensory block was assessed by pinprick testing over the C5–T1 dermatomes using a three-point scale:

- Score 2: Anesthesia (No pain, no touch sensation)
- Score 1: Analgesia (No pain, but touch sensation present)
- Score 0: Pain present

Motor block was evaluated by testing movements associated with the following nerves:

- Radial nerve: Thumb abduction
- Ulnar nerve: Thumb adduction
- Median nerve: Thumb opposition
- Musculocutaneous nerve: Elbow flexion

Motor block was graded using the Modified Bromage Scale for Upper Limbs:

- Score 0: No motor block (full arm and forearm movement)
- Score 1: Partial block (full forearm movement, partial arm movement)
- Score 2: Almost complete block (unable to move arm, reduced forearm movement)
- Score 3: Complete block (unable to move arm and forearm)

Sensory and motor blocks were assessed every minute for the first 30 minutes post-injection and subsequently every 30 minutes until recovery.

Definitions of Block Characteristics

- Onset of sensory block: Time from local anesthetic administration to the achievement of score 2 in all nerve territories.
- Duration of sensory block: Time from administration to complete sensory recovery (score 0).
- Onset of motor block: Time from administration to score 3 on the Bromage scale.
- Duration of motor block: Time from administration to full motor recovery (score 0).
- Duration of analgesia: Time from administration to VAS ≥4, marking the first request for rescue analgesia.

A block was considered inadequate if sensory anesthesia was not achieved within 30 minutes. Such patients were excluded from the study. If a patient experienced VAS >4 intraoperatively, they were given general anesthesia, and the block was classified as failed and excluded.

Postoperative Pain and Rescue Analgesia

Pain assessment using VAS (0–10) was conducted:

- Every hour for the first 8 hours
- Every 4 hours until 24 hours postoperatively

Patients reporting VAS >4 received intravenous diclofenac sodium 75 mg as rescue analgesia. If pain persisted or recurred, the same dose was repeated.

Hemodynamic Monitoring

Vital parameters, including systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), arterial oxygen saturation (SpO_2), and heart rate (HR), were monitored at:

- Baseline (0 min)
- 5 min, 15 min, 30 min post-block
- Every 30 minutes up to 5 hours
- Hourly up to 12 hours postoperatively

Sample Size and Statistical Analysis

Based on a previous study by Raghavan and Ashraf, a sample size of 50 patients per group was determined, maintaining an alpha error of 0.05 and a study power of 80%. (4)

- Categorical data were summarized as percentages and proportions (%).
- Continuous data were expressed as mean ± standard deviation (SD).
- Statistical analysis was performed using:
  - Chi-square test for categorical variables
  - Unpaired Student's t-test for quantitative variables

A P-value <0.05 was considered statistically significant.

RESULTS

Table 1: Comparison of Demographic and Baseline Characteristics between the Two Study Groups

Characteristic	Group RD (n=50), mean±SD	Group RM (n=50), mean±SD	Statistical Significance
Age	32.1 ±11.3	32.5 ±11.2	t = -0.311, P = 0.712
Sex, n (%)			χ^2 = 0.039, P = 0.812
Male	32 (64%)	31 (62%)	
Female	18 (36%)	19 (38%)	
BMI (kg/m²)	20.5 ±1.44	20.68 ±1.47	t = 0.428, P = 0.655
ASA, n (%)			χ^2 = 1.000, P = 0.317
I	22 (44%)	27 (54%)	
II	28 (56%)	23 (46%)	
Surgery Performed, n (%)			χ^2 = 4.688, P = 0.565
Close reduction internal fixation + K wire	11 (22%)	4 (8%)	
Debridement + K wire	0 (0%)	1 (2%)	
Dual plating	1 (2%)	0 (0%)	
Implant removal	1 (2%)	1 (2%)	
Open reduction internal fixation + K wire	1 (2%)	1 (2%)	
Open reduction internal fixation + nailing	2 (4%)	7 (14%)	
Open reduction internal fixation + plating	33 (66%)	34 (68%)	
Radius + ulna	5 (10%)	5 (10%)	
Radius	17 (34%)	16 (32%)	
Ulna	0 (0%)	1 (2%)	
The mean duration of surgery (min)	99.6 ±28.2	100.8 ±30.1	t = 0.322, P = 0.755

Abbreviations: BMI: Body mass index, ASA: American Society of Anesthesiologists, SD: Standard deviation, RD: Ropivacaine-Dexamethasone, RM: Ropivacaine-Magnesium Sulphate.

The demographic and baseline characteristics were comparable between the two groups, indicating that randomization was effective in balancing potential confounding variables.

- Age & BMI: The mean age and BMI were similar between Group RD (32.1 ± 11.3 years, 20.5 ± 1.44 kg/m²) and Group RM (32.5 ± 11.2 years, 20.68 ± 1.47 kg/m²), with no statistically significant difference (P = 0.712 for age, P = 0.655 for BMI).
- Sex Distribution: The proportion of males (64% in RD, 62% in RM) and females (36% in RD, 38% in RM) was well-matched (P = 0.812).
- ASA Classification: Both groups had a comparable distribution of ASA physical status I and II (P = 0.317), ensuring similar baseline health conditions.
- Surgical Procedures: The type of surgeries performed was similar between the two groups (P = 0.565), suggesting that surgical complexity did not influence the outcomes.
- Mean Duration of Surgery: The mean surgical time was 99.6 ± 28.2 min (RD) vs. 100.8 ± 30.1 min (RM), showing no significant difference (P = 0.755).

These results confirm that both groups were homogeneous at baseline, allowing for a fair comparison of the effects of dexamethasone and magnesium sulfate as adjuvants.

Table 2: Comparison of Block Characteristics between Study Groups

Characteristic	Group RD (n=50), Mean ± SD	Group RM (n=50), Mean ± SD	t	P
Time taken for onset of sensory block (min)	13.15 ± 1.90	15.44 ± 2.26	6.120	<0.001
Time taken for onset of motor block (min)	17.12 ± 2.12	19.26 ± 2.28	3.512	0.001
Duration of sensory block (min)	1168.2 ± 111.88	468.60 ± 62.14	39.456	<0.001
Duration of motor block (min)	1088.6 ± 91.15	385.80 ± 45.39	48.75	<0.001
Time to first rescue analgesic need (min)	1208.4 ± 111.08	498.18 ± 64.22	39.102	<0.001

The addition of dexamethasone (RD group) significantly improved block characteristics compared to magnesium sulfate (RM group).

- Onset of Sensory Block:
  - Interpretation: Sensory block was faster in the dexamethasone group by approximately 2.3 minutes (P < 0.001), making dexamethasone a more rapid-acting adjuvant.
  - Group RD: 13.15 ± 1.90 min
  - Group RM: 15.44 ± 2.26 min
- Onset of Motor Block:
  - Group RD: 17.12 ± 2.12 min
  - Group RM: 19.26 ± 2.28 min
  - Interpretation: Motor block also developed faster in the dexamethasone group by about 2 minutes (P = 0.001).
- Duration of Sensory Block:
  - Group RD: 1168.2 ± 111.88 min
  - Group RM: 468.60 ± 62.14 min
  - Interpretation: The sensory block lasted significantly longer in the dexamethasone group by almost 2.5 times (P < 0.001), indicating its superior prolongation effect.
- Duration of Motor Block:
  - Group RD: 1088.6 ± 91.15 min
  - Group RM: 385.80 ± 45.39 min
  - Interpretation: Motor block was significantly prolonged in the dexamethasone group (P < 0.001), which is beneficial in prolonged surgeries.
- Time to First Rescue Analgesic Need:
  - Group RD: 1208.4 ± 111.08 min
  - Group RM: 498.18 ± 64.22 min
  - Interpretation: Patients in the dexamethasone group experienced much longer pain relief before requiring rescue analgesia, with a duration of 20 hours vs. 8 hours in the magnesium sulfate group (P < 0.001).

These findings highlight that dexamethasone significantly enhances the onset, duration, and analgesic efficacy of ropivacaine compared to magnesium sulfate, making it the more effective adjuvant for supraclavicular brachial plexus block.

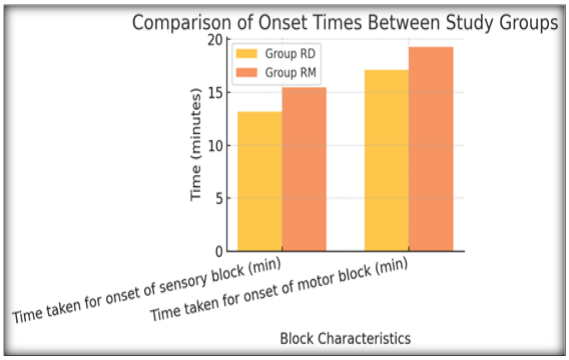

Figure 1: Comparison of Onset Times between Study Groups

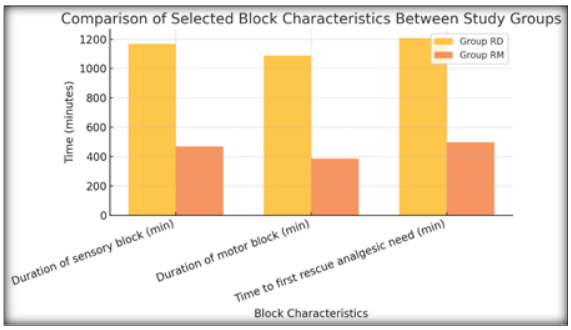

Figure 2: Comparison of Selected Block Characteristics between Study Groups

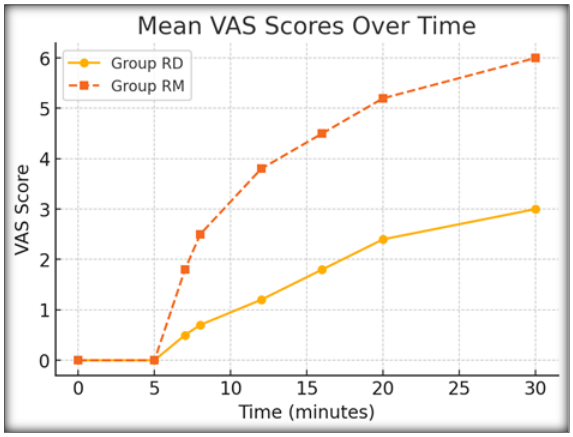

Figure 3: Mean VAS Scores over Time – Comparison of pain scores between Group RD and Group RM at different follow-up intervals

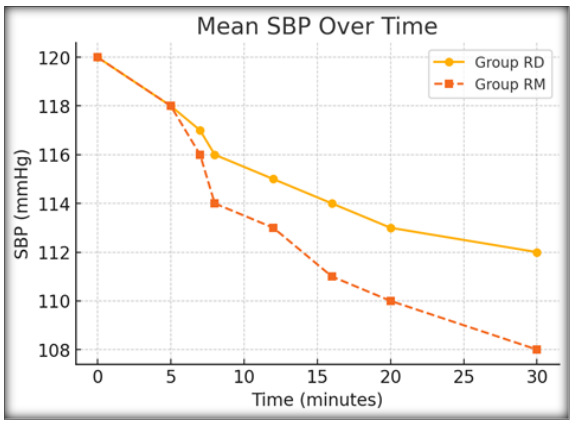

Figure 4: Mean SBP over Time – Comparison of systolic blood pressure changes over time in both groups.

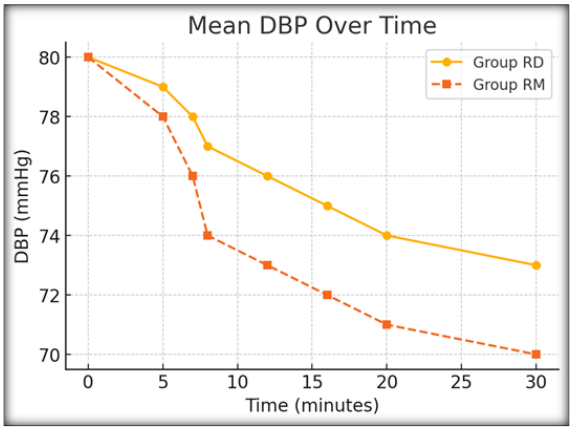

Figure 5: Mean DBP over Time – Comparison of diastolic blood pressure trends between the two groups

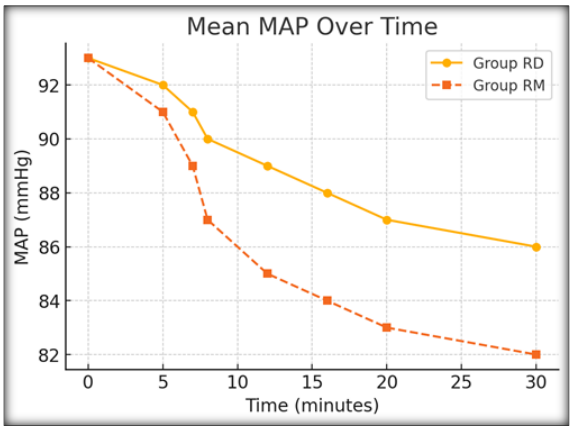

Figure 6: Mean MAP over Time – Mean arterial pressure (MAP) variations between Group RD and Group RM

Table 3: Comparison of the Number of Rescue Analgesic Dosages Used During the First 24-Hour Follow-Up

Number of Rescue Analgesic Dosages	Group RD (n=50), n (%)	Group RM (n=50), n (%)
1	41 (82%)	0 (0%)
2	9 (18%)	22 (44%)
3	0 (0%)	28 (56%)
χ^2; P	**75; <0.001**	
Mean rescue analgesia used ± SD (mg)	**87.4 ± 22.2**	**185 ± 36.2**
t; P	**14.88; <0.001**	

Abbreviations: SD: Standard deviation, RD: Ropivacaine-Dexamethasone, RM: Ropivacaine-Magnesium Sulphate.

The requirement for postoperative analgesia was markedly lower in the dexamethasone group compared to the magnesium sulfate group.

- Number of Rescue Analgesic Doses:
  - 1 dose: 41 patients (82%) in RD vs. 0 patients in RM
  - 2 doses: 9 patients (18%) in RD vs. 22 patients (44%) in RM
  - 3 doses: 0 patients (0%) in RD vs. 28 patients (56%) in RM
  - Interpretation: All patients in Group RM required multiple analgesic doses, whereas most patients in Group RD needed only one dose ($P < 0.001$). This confirms that dexamethasone provided superior prolonged analgesia.
- Total Analgesic Consumption (mg) Over 24 Hours:
  - Group RD: 87.4 ± 22.2 mg
  - Group RM: 185 ± 36.2 mg

Interpretation: Total analgesic consumption was significantly lower in the dexamethasone group ($P < 0.001$), supporting its greater opioid-sparing effect.

DISCUSSION

The present study was designed as a comparative, randomized, prospective clinical study to evaluate the effects of 0.75% ropivacaine combined with either 8 mg dexamethasone or 200 mg magnesium sulfate ($MgSO_4$) as adjuvants for supraclavicular brachial plexus block in upper limb surgeries. Our findings demonstrate that dexamethasone is a superior adjuvant compared to $MgSO_4$ in terms of faster onset,

prolonged sensory and motor block duration, and extended analgesic effects.

Our study findings align with those of Raghavan and Ashraf (2019),[4] who compared 0.25% bupivacaine with 8 mg dexamethasone or 150 mg $MgSO_4$ as adjuvants. While they used a lower concentration of local anesthetic (bupivacaine 0.25%), we opted for 0.75% ropivacaine, which has a longer duration of action and reduced cardiotoxicity. Similarly, Shridevi and Asokan (2020),[6] used 0.75% ropivacaine but at a lower $MgSO_4$ dose of 150 mg, while we used 200 mg $MgSO_4$ to assess any dose-dependent effects.

Onset of Sensory and Motor Block

- Our study showed that the onset of sensory and motor blocks was significantly faster in the dexamethasone group than in the $MgSO_4$ group.
- Sensory block onset was 1.2 times faster, and motor block onset was 1.1 times faster with dexamethasone.
- This is comparable to Raghavan and Ashraf's (2019) study, where sensory and motor block onsets were 1.28 and 1.09 times faster, respectively, in the dexamethasone group.[4]
- The faster onset in the dexamethasone group can be attributed to its ability to enhance potassium channel-mediated inhibition of nociceptive C-fibers, which transmit pain signals.

Duration of Sensory and Motor Block

- The duration of both sensory and motor blocks was significantly longer in the dexamethasone group than in the $MgSO_4$ group ($P < 0.001$).
- In our study, the duration of sensory block in the dexamethasone group was 1168.2 ± 111.88 min, whereas in the $MgSO_4$ group, it was 468.6 ± 62.14 min ($P < 0.001$).
- The motor block duration was 1088.6 ± 91.15 min in the dexamethasone group compared to 385.8 ± 45.39 min in the $MgSO_4$ group ($P < 0.001$).
- Dexamethasone prolonged block duration 2.4 times longer than $MgSO_4$, which is consistent with previous findings by El Azzazi et al., Ghali et al., and Shaikh et al.[16]

Analgesic Duration and Rescue Analgesia Requirement

- The time to first rescue analgesic need was significantly longer in the dexamethasone group (1208.4 ± 111.08 min) compared to the $MgSO_4$ group (498.18 ± 64.22 min, $P < 0.001$).
- In line with our results, Shridevi and Asokan (2020),[6] also found that dexamethasone significantly extended analgesic duration compared to $MgSO_4$.
- In our study, none of the patients in Group RD required analgesia up to 12 hours, whereas patients in Group RM required their first analgesic dose after 5 hours.
- The total number of rescue analgesic doses was significantly higher in Group RM than in Group RD ($P < 0.001$), which correlates with the findings of Dudhat and Kantharia (2021).[15]

Hemodynamic Stability

- Our study found that both groups were hemodynamically stable for most of the study period.
- However, SBP was significantly lower in the $MgSO_4$ group at 30 minutes ($P = 0.013$) compared to the dexamethasone group.
- Similarly, diastolic BP and MAP were significantly lower in Group RM at 15 and 30 min ($P < 0.05$), which aligns with the results of Yousef Metias et al., who reported transient hypotension in the $MgSO_4$ group.

Heart rate changes were comparable between both groups ($P > 0.05$).

Table 4: Comparison Table of Studies on Magnesium Sulfate and Dexamethasone in Supraclavicular Brachial Plexus Block

Study	Sample Size	Local Anesthetic Used	Adjuvants Compared	Onset Time (Sensory)	Onset Time (Motor)	Duration of Sensory Block (min)	Duration of Motor Block (min)	Time to First Analgesic Need (h)
Akhondzade et al. (18)	52	Lidocaine 1% (4mg/kg)	$MgSO_4$ 20% (5mL) vs. Normal Saline	Longer in $MgSO_4$ group ($P<0.0001$)	Longer in $MgSO_4$ group ($P<0.0001$)	8.00 ± 0.00 ($MgSO_4$) vs. 4.26 ± 1.88 (Control)	Significantly prolonged in $MgSO_4$ group ($P<0.0001$)	8.00 ($MgSO_4$) vs. 4.26 (Control)
Jalili et al. (19)	55	Ropivacaine 0.5% (24 mL)	200mg $MgSO_4$ vs. 4mg Dexamethasone vs. Normal Saline	Faster in $MgSO_4$ group ($P<0.05$)	Faster in $MgSO_4$ group ($P<0.05$)	Longer in LDD group than $MgSO_4$ group	Longer in LDD group ($P<0.05$)	Longer in LDD group ($P<0.05$)
Ramegowda et al. (20)	50	Ropivacaine 0.75% (20 mL)	IV $MgSO_4$ 150mg vs. Perineural $MgSO_4$ 150mg	Shorter in Perineural Mg group ($P<0.001$)	Shorter in Perineural Mg group ($P<0.001$)	Longer in Perineural Mg group ($P<0.001$)	Longer in Perineural Mg group ($P<0.001$)	Longer in Perineural Mg group ($P<0.001$)
Verma et al. (14)	90	Bupivacaine	125mg $MgSO_4$ vs. 250mg	Shorter in 250mg $MgSO_4$	Shorter in 250mg $MgSO_4$	665.13 ± 97.87 (250mg $MgSO_4$) vs.	475.10 ± 53.29 (125mg $MgSO_4$) vs.	665.13 min (250mg $MgSO_4$) vs.

		0.5% (20 mL)	$MgSO_4$ vs. Normal Saline	group (P<0.001)	group (P<0.001)	272.03 ± 40.40 (NS)	272.03 ± 40.40 (NS)	272.03 min (NS)
Elmaleh et al. (21)	60	Lidocaine 2% (20 mL)	100mg $MgSO_4$ vs. 100mcg Dexmedetomidine	Longer in $MgSO_4$ group compared to Dexmedetomidine	Longer in $MgSO_4$ group compared to Dexmedetomidine	482.50 ± 72.75 (Dexmedetomidine) vs. 277.17 ± 54.34 ($MgSO_4$)	482.50 ± 72.75 (Dexmedetomidine) vs. 277.17 ± 54.34 ($MgSO_4$)	8.70 ± 3.38h (Dexmedetomidine) vs. 5.10 ± 1.56h ($MgSO_4$)

CONCLUSION

Our study confirms that dexamethasone (8 mg) is a superior adjuvant to $MgSO_4$ (200 mg) for supraclavicular brachial plexus block with 0.75% ropivacaine. Dexamethasone resulted in:

✓Faster onset of sensory and motor block

✓ Significantly prolonged sensory and motor block duration

✓ Longer duration of analgesia

✓ Reduced need for rescue analgesia

✓ Greater hemodynamic stability

While $MgSO_4$ remains a viable adjuvant, it is less effective than dexamethasone in prolonging analgesia and block duration. Future studies should explore optimal dosing strategies and evaluate combination adjuvant therapy to enhance block efficacy.

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