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Comparison Of Dexamethasone And Magnesium Sulphate As Adjuvants To 0.5% Ropivacaine In Ultrasound Guided Supraclavicular Brachial Plexus Block- A Prospective, Randomized, Double Blind Study

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Abstract
Background: *Ultrasound-guided supraclavicular brachial plexus block is a widely used regional anaesthesia technique for upper limb surgeries because it provides effective intraoperative anaesthesia and postoperative analgesia while avoiding the adverse effects of general anaesthesia. Various adjuvants have been added to local anaesthetics to improve the quality and duration of blockade. Dexamethasone, a potent glucocorticoid, prolongs analgesia through anti-inflammatory and local vasoconstrictive effects, whereas Magnesium sulphate, an N-methyl-D-aspartate (NMDA) receptor antagonist, reduces nociceptive transmission and central sensitization. However, evidence comparing these two adjuvants with ropivacaine in supraclavicular brachial plexus block remains limited.*
Objective: *To compare the efficacy of dexamethasone and magnesium sulphate as adjuvants to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block with respect to onset and duration of sensory and motor blockade, and duration of postoperative analgesia in patients undergoing upper limb surgeries.*
Methods: *This prospective, randomized, double-blind study included 40 ASA physical status I and II patients aged 18–60 years undergoing elective or emergency upper limb surgeries. Patients were randomly allocated into two groups (n=20 each) using the sequentially numbered opaque sealed envelope (SNOSE) method. Group RD received 30 ml of 0.5% ropivacaine with 4 mg dexamethasone (1 ml), while Group RM received 30 ml of 0.5% ropivacaine with 150 mg magnesium sulphate (1 ml). Ultrasound-guided supraclavicular brachial plexus block was performed in all patients. Sensory and motor block characteristics, duration of analgesia, haemodynamic parameters, and adverse effects were recorded and analysed using the Chi-square test and unpaired t-test. A p-value <0.05 was considered statistically significant.*
Results: *The demographic characteristics were comparable between the two groups. Group RM demonstrated a significantly faster onset of sensory block (8.83 vs. 9.93 minutes; p=0.024) and motor block (11.57 vs. 13.37 minutes; p=0.048) compared with Group RD. Magnesium sulphate also significantly prolonged the duration of sensory block (526.3 vs. 386.6 minutes; p<0.001), motor block (436.97 vs. 323.73 minutes; p<0.001), and postoperative analgesia (596.8 vs. 446.6 minutes; p<0.001). Haemodynamic parameters remained stable in both groups, and no block failures or significant adverse effects were observed.*
Conclusion: *Magnesium sulphate (150 mg) is a superior adjuvant to dexamethasone (4 mg) when combined with 0.5% ropivacaine for ultrasound-guided supraclavicular brachial plexus block. It provides a faster onset of sensory and motor blockade, significantly prolongs the duration of anaesthesia and postoperative analgesia, and is not associated with increased adverse effects. Magnesium sulphate may therefore be considered an effective and safe adjuvant for upper limb surgeries performed under supraclavicular brachial plexus block.*
Keywords: *ASA- American Society of Anaesthesiologists.*
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I. Introduction:

Peripheral nerve blocks have become an integral component of anaesthetic management for upper limb surgeries because they provide excellent intraoperative anaesthesia, prolonged postoperative analgesia, reduced opioid requirement, and early recovery while avoiding the complications associated with general anaesthesia. Among the various approaches, the **ultrasound-guided supraclavicular brachial plexus block** is widely preferred due to its rapid onset, dense blockade, and high success rate for surgeries involving the elbow, forearm, and hand. Ropivacaine, a long-acting amide local anaesthetic with lower cardiotoxicity and better sensorimotor differentiation than bupivacaine, is commonly used for this block[1]. However, its duration of analgesia remains limited, prompting the use of adjuvants to enhance block quality and prolong postoperative pain relief.

Among the commonly used adjuvants, **Dexamethasone** prolongs analgesia through its anti-inflammatory and local vasoconstrictive effects, whereas **Magnesium sulphate**, a non-competitive N-methyl-D-aspartate (NMDA) receptor antagonist, reduces nociceptive transmission and central sensitization, thereby enhancing the analgesic effect of local anaesthetics[2]. Although both agents have shown promising results in peripheral nerve blocks, evidence directly comparing their efficacy as adjuvants to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block is limited. Therefore, the present prospective, randomized, double-blind study was undertaken to compare dexamethasone and magnesium sulphate with respect to the onset and duration of sensory and motor blockade and the duration of postoperative analgesia in patients undergoing upper limb surgeries.

II. Methodology

Study Design and Population

Study Design- Prospective, double blinded and randomized study.
Study setting- Major operation theatre, Department of Anaesthesiology, Akash Institute Of Medical Sciences and Research centre, Bangalore rural.
Study Population- Patients undergoing upper limb surgeries.
Study Duration- 6 months
Study Outcome- Sensory and motor blockade with postoperative analgesia.
Sample Size- Based on the study by Shambavi T et al[4] , 19 per group and total sample size was 40

Inclusion Criteria

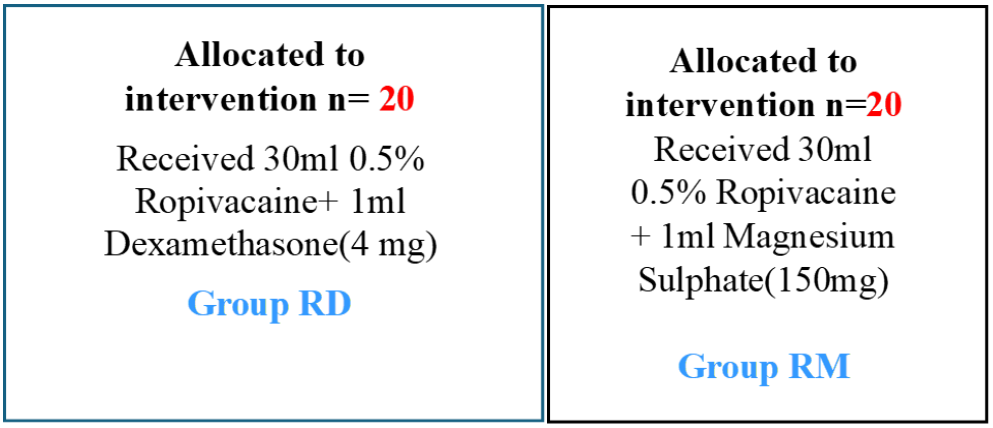
- Aged 18-60years
- ASA I and II
- Patients posted for elective and emergency upper limb surgeries.
- Willing for informed and written consent
- Adequate nil per oral status

Exclusion Criteria

- Allergy to study drugs
- ASA III and IV
- Patients with neuropathies

Anesthetic and Surgical Technique

Approval from Institutional ethical committee was obtained. Patients fulfilling the inclusion criteria, was allocated into 2 groups randomly by sequentially numbered, opaque, sealed envelope (SNOSE) method.



Pre-anaesthetic evaluation was done, informed and written consent was taken. All the patients were kept 6 hours nil per oral prior to surgery. On arrival to the operation theatre, baseline vitals were recorded and intravenous infusion of Ringer lactate started using 18G cannula. Under USG guidance, brachial plexus block performed through supraclavicular approach.
Group RD - 30ml 0.5% Ropivacaine+ 1ml Dexamethasone (4 mg).
Group RM - 30ml 0.5% Ropivacaine+ 1ml Magnesium Sulphate (150mg).

Sensory block was assessed using 3-points scale over C5-T1 dermatomes every 5 minutes till the loss of sensation to pinprick, using 22-guage hypodermic needle.

- sharp pain,
- dull pain (analgesia),
- No pain (anesthesia).

Motor block was assessed using modified bromage scale.
Grade 1 – ability to flex or extend the forearm
Grade 2 – ability to flex or extend only wrist or fingers
Grade 3 - ability to flex or extend only fingers Grade 4- inability to move the forearm, wrist or fingers.
Recovery from sensory block - Time to return of complete sensation.
Recovery from motor block - Time when patient regains strength to move the relevant muscle group against gravity.
Duration of analgesia - till VAS score >3 and asked for rescue analgesia. (Inj. Diclofenac aqueous 75mg IV slow).

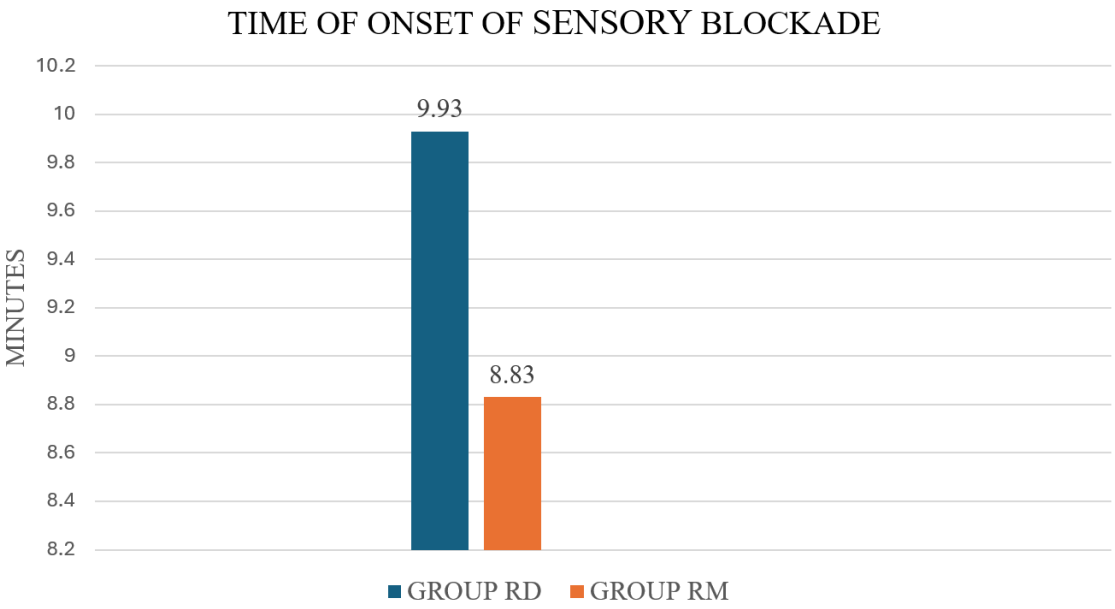
VAS score: 0-10 score 0-No pain
1, 2-Mild pain
3, 4, 5-Moderate pain
6, 7-Severe pain
8, 9-Very severe pain 10-Worst possible pain

Haemodynamic parameters and side effects were also recorded.

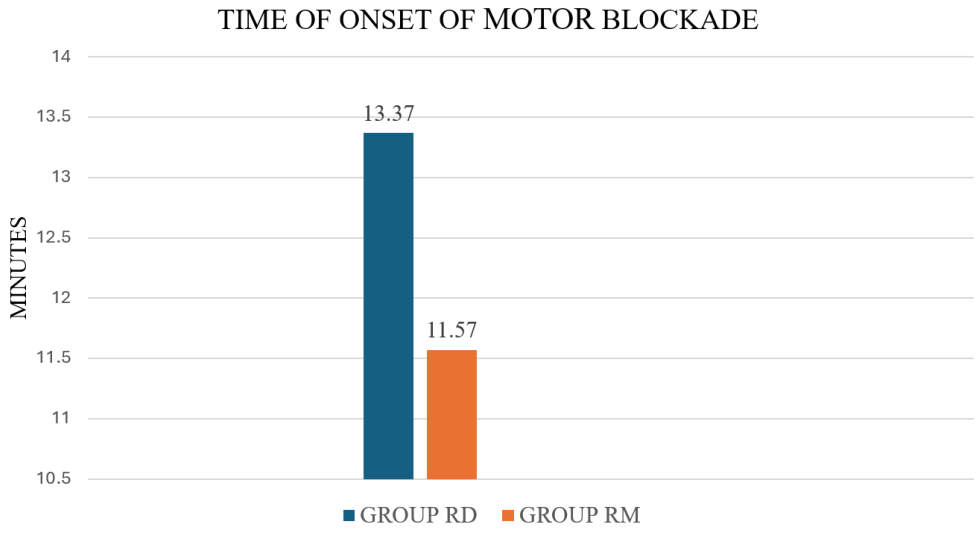
III. Results

Comparison of Demographic characteristics between Group RD and Group RM.

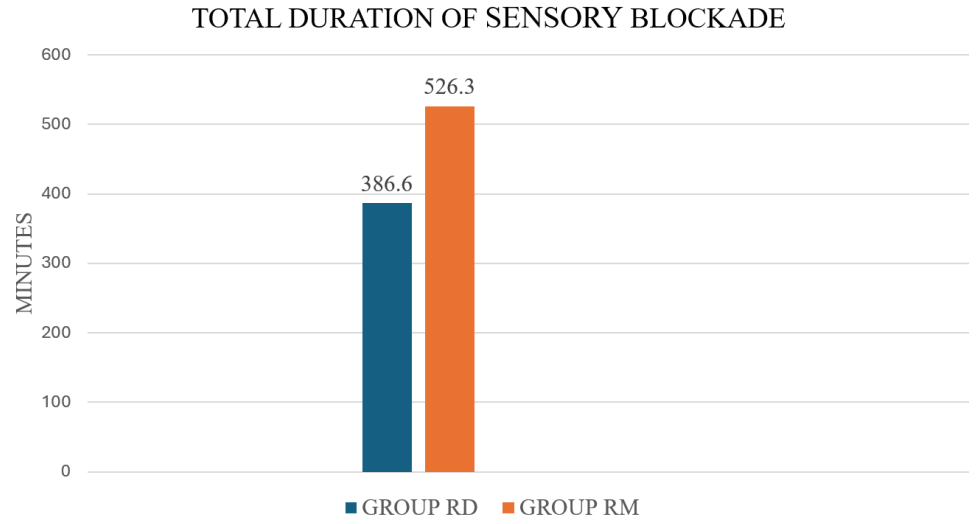
	Group RD (N=20)	Group RM (N=20)	p value
Age (years)	42.21 ± 3.8	44.35±4.08	0.87
Sex (M:F)	18:7	20:5	0.43
Height (cm)	158±1.3	156±1.8	0.80
Weight (kg)	65.13±13.4	64.42±9.6	0.83
ASA I : II	21:9	22:8	0.48



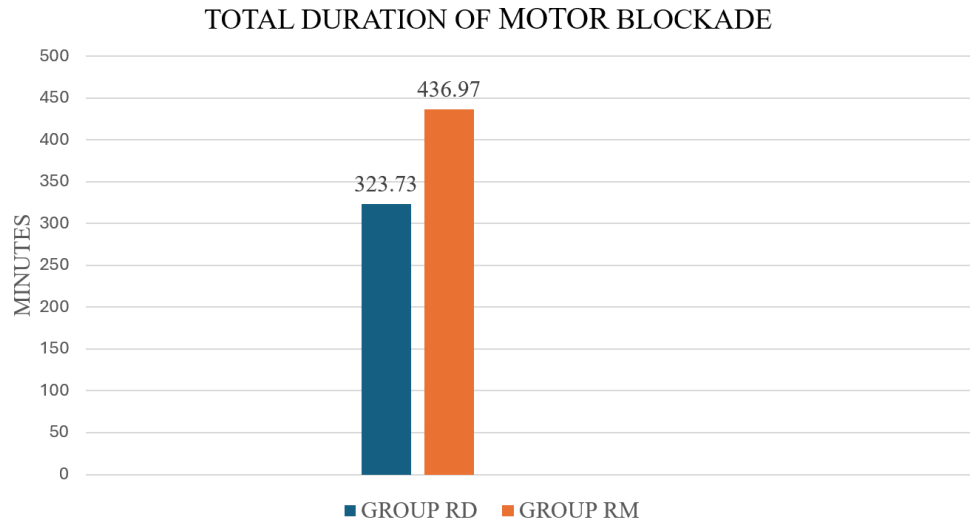
Onset of sensory block was faster in Group RM (8.83 mins) than Group RD (9.93 mins) p< 0.024.



Onset of motor block was faster in Group RM (11.57 mins) than Group RD (13.37 mins) p< 0.048.

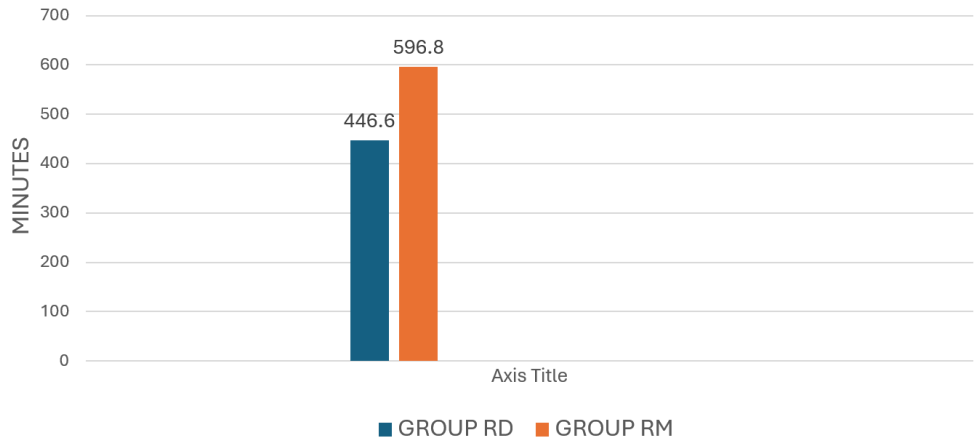


Total duration of sensory block was higher in Group RM (526.3 mins) than Group RD (386.6 mins), p< 0.001.



Total duration of motor block was higher in Group RM (436.97 mins) than Group RD (323.73) , p< 0.001.

TOTAL DURATION OF ANALGESIA



Total duration of analgesia was higher in Group RM (596.8 mins) than Group RD (446.6 mins) , p< 0.001.

IV. Discussion

The present prospective, randomized, double-blind study compared **150 mg magnesium sulphate** and **4 mg dexamethasone** as adjuvants to 0.5% ropivacaine for ultrasound-guided supraclavicular brachial plexus block in patients undergoing upper limb surgeries. Baseline demographic characteristics were comparable between the two groups, ensuring that differences in block characteristics and analgesic efficacy were attributable to the study drugs. The study demonstrated that magnesium sulphate produced a significantly faster onset of sensory and motor blockade and prolonged the duration of sensory block, motor block, and postoperative analgesia compared with dexamethasone.

The faster onset of sensory and motor blockade observed with magnesium sulphate is consistent with the findings of **Deshpande and Patil[1]** and **Shridevi et al[4].**, who also reported earlier onset of blockade when magnesium was added to ropivacaine in brachial plexus blocks. The beneficial effect of magnesium is attributed to its action as a non-competitive **N-methyl-D-aspartate (NMDA) receptor antagonist** and calcium channel blocker, which suppresses excitatory neurotransmitter release and enhances the action of local anaesthetics on peripheral nerves.

Magnesium sulphate also significantly prolonged the duration of sensory and motor blockade as well as postoperative analgesia compared with dexamethasone. These findings agree with studies by **Deshpande et al[1].**, and **Mukherjee et al[2].** which demonstrated prolonged block duration, delayed requirement for rescue analgesia, and improved postoperative pain control with magnesium sulphate. The prolonged analgesic effect is likely due to inhibition of central sensitization through NMDA receptor blockade, thereby reducing nociceptive transmission.

No block failures, haemodynamic instability, or significant adverse effects were observed in either group, indicating that both adjuvants were safe when administered under ultrasound guidance. The absence of complications may be attributed to accurate ultrasound-guided needle placement, careful aspiration before injection, and adherence to a standardized block technique. However, the study was limited by its relatively small sample size, inclusion of only ASA I and II patients, and lack of plasma drug level estimation, which may limit the generalizability of the findings.

In conclusion, the present study demonstrates that **150 mg Magnesium sulphate is a more effective adjuvant than 4 mg Dexamethasone** when combined with 0.5% ropivacaine for ultrasound-guided supraclavicular brachial plexus block. Magnesium sulphate provided faster onset of blockade, significantly prolonged sensory and motor blockade, and superior postoperative analgesia without increasing adverse effects. These findings support its routine clinical use as an effective and safe adjuvant for upper limb surgeries performed under supraclavicular brachial plexus block.

Limitations

- Plasma levels of drugs was not measured in the study.
- We have not included ASA III and IV patients and hence results cannot be applied to them.

V. Conclusion

We conclude that using Magnesium sulphate as an adjuvant to 0.5% Ropivacaine in supraclavicular brachial plexus block has faster onset and prolonged duration of sensory and motor blockade, as compared to Dexamethasone.

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