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A Comparative Clinical Study of Two Different Doses of Magnesium Sulphate Added as Adjuvant to Ropivacaine 0.5% Solution for Inducing Anaesthesia with Supraclavicular Brachial Plexus Block in Patients Undergoing Upper Limb Surgery

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Abstract: ***Background and Aims: Many studies have been conducted using magnesium sulphate as adjuvant to local anaesthetics in peripheral nerve blocks, but few studies compare the effect of different doses of magnesium sulphate. We aimed at comparing the clinical profile of different doses of magnesium sulphate as adjuvant to ropivacaine in supraclavicular brachial plexus block and finding out the dose which provides maximum improvement in block parameters with minimum undesirable effects. Methods: 90 patients belonging to ASA I and II, undergoing elective upper limb surgery were randomly allocated into three groups of 30 each. Ultrasound guided Supraclavicular brachial plexus blocks were performed in each group. Group D1 (Ropivacaine 0.5% + normal saline), Group D2 (Ropivacaine 0.5% + 100 mg MgSO4), and Group D3 (Ropivacaine 0.5% + 150 mg MgSO4). Sensory and motor block onset and duration were noted. Result: The demographic profile of all patients was statistically insignificant between the three groups. Groups D2 and D3 showed a significantly faster onset (p-value <0.001) and increased duration (p-value <0.001) of sensory and motor block compared to Group D1. Intraoperative hemodynamics were comparable among the groups throughout the study period. Conclusion: We conclude that the addition of both 100 mg and 150 mg Magnesium Sulphate as adjuvant in supraclavicular brachial plexus block significantly improves block characteristics while reducing the requirement for rescue analgesia.***

Keywords: Supraclavicular Block, Ultrasound, Ropivacaine, Magnesium Sulphate, Upper limb surgeries.

1. Introduction

In recent years, regional anaesthesia has become increasingly popular for upper limb procedures due to its targeted approach, quicker recovery times, and reduced systemic side effects compared to general anaesthesia. [1] One commonly used technique is the brachial plexus block (BPB), which provides comprehensive motor and sensory block for surgeries at or below the elbow. [2] The supraclavicular approach is particularly effective as it allows the anaesthetic to spread to almost all nerves of the brachial plexus, with the use of ultrasound enhancing precision and safety. [3]

Ropivacaine is often chosen for its favorable onset, duration of action, and safety profile, [4] although it may require adjuvants like Magnesium Sulphate to achieve adequate anaesthesia for certain procedures. Magnesium Sulphate, known for its calcium blocker and NMDA receptor antagonist properties, can potentiate the nerve block by prolonging the local anaesthetic effect and reducing nerve excitability. [5] This study aims to identify the most effective combination of Ropivacaine 0.5% and Magnesium Sulphate (either 100 mg or 150 mg) for supraclavicular brachial plexus blocks in adult patients undergoing upper limb surgery.

2. Aim and Objectives

We aim to find out a better combination of two drugs- Ropivacaine 0.5% solution (local anaesthesia) and Magnesium Sulphate (adjuvant drug) to be used for inducing anaesthesia in adult patients undergoing surgery of upper limb.

Primary Objectives:

1) Onset and duration of sensory block.
2) Onset and duration of motor block.

3. Material and Methods

The study was conducted in Swaroop Rani Nehru Hospital associated with Moti Lal Nehru Medical College, Prayagraj after approval from Institutional Ethical Committee and obtaining written and informed consent from all patients. After randomization and blinding, patients were divided into

three groups at random (using a sealed envelope procedure).

The patients were put in a supine position and instructed to tilt their heads away from the neutral position along their bodies in preparation for the supraclavicular plexus block. Skin above the clavicle was infiltrated with local anaesthetic, and then a 50 mm 22 G insulated short beveled stimulation needle (Stimuplex A, B. Braun Melsungen AG, Germany) was advanced toward the brachial plexus cluster under direct visualization using linear type ultrasonography probe (12 MHZ) in-plane technique, moving from lateral to medial.

A total of 21 mL of medication was administered to each of the three groups after the needle tip reached the brachial plexus cluster on the ultrasound image:
Group D1: Patients received 0.50% ropivacaine (20ml) + normal saline (1ml).
Group D2: Patients received 0.50% ropivacaine (20ml) + Magnesium Sulphate 100 mg in normal saline (1ml).
Group D3: Patients received 0.50% ropivacaine (20ml) + Magnesium Sulphate 150 mg in normal saline (1 ml)

4. Result

Table 1: Comparison of Onset of Sensory Block (in minutes) and Onset of Motor Block (in minutes) (N=90)

	Group D1 (n = 30)		Group D2 (n = 30)		Group D3 (n = 30)		F	p-Value
	Mean	± SD	Mean	± SD	Mean	± SD		
Onset of sensory block (min)	24.77	3.45	20.50	2.74	18.30	4.40	25.121	<0.001
Onset of motor block (min)	28.93	3.63	24.07	3.27	22.73	4.54	21.555	<0.001

Inference: The data shows the mean and standard deviation (SD) of the onset times for sensory block and motor block for each group. The mean time of onset for the sensory block was 24.77 ± 3.45 minutes in Group D1, 20.50 ± 2.74 minutes in Group D2, and 18.30 ± 4.40 minutes in Group D3. The difference in onset times among the groups was statistically significant (F = 25.121, p < 0.001).

Similarly, the mean onset time for the motor block was 28.93 ± 3.63 minutes in Group D1, 24.07 ± 3.27 minutes in Group D2, and 22.73 ± 4.54 minutes in Group D3. The difference in motor block onset times among the groups was also statistically significant (F = 21.555, p < 0.001).

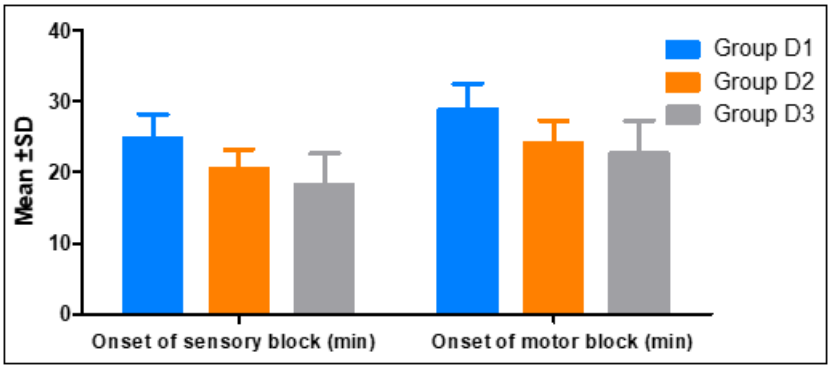

Figure 1: Comparison of Onset of Sensory Block and Onset of Motor Block (in minutes) (N=90)

Table 2: Comparison of Duration of Sensory Block (in minutes) and Duration of Motor Block (in minutes) (N=90)

	Group D1 (n = 30)		Group D2 (n = 30)		Group D3 (n = 30)		F	p-Value
	Mean	± SD	Mean	± SD	Mean	± SD		
Period of motor block (min)	368.70	56.41	508.87	56.77	509.73	49.35	67.086	<0.001
Period of sensory block	433.93	57.58	576.07	51.20	570.27	43.58	74.307	<0.001

Inference: The data shows the mean and standard deviation (SD) of the duration of both sensory block and motor block among each group. The mean duration was 368.70 ± 56.41 minutes in Group D1, 508.87 ± 56.77 minutes in Group D2, and 509.73 ± 49.35 minutes in Group D3. The difference in the duration of motor block among the groups was statistically significant (F = 67.086, p < 0.001). The mean duration was 433.93 ± 57.58 minutes in Group D1, 576.07 ± 51.20 minutes in Group D2, and 570.27 ± 43.58 minutes in Group D3. The difference in the duration of sensory block among the groups was also statistically significant (F = 74.307, p < 0.001). These results indicate that Group D1 had the shortest duration for both sensory and motor blocks, while Groups D2 and D3 had significantly longer durations. The significant p-values suggest that these differences are unlikely to be due to chance.

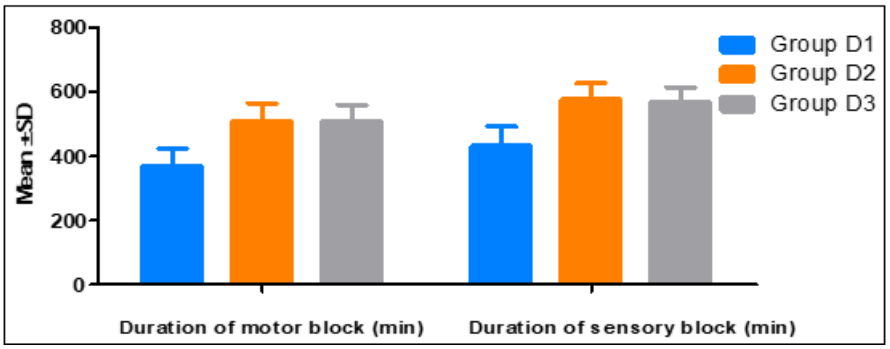

Figure 2: Comparison of Duration of Sensory Block (in minutes) and Duration of Motor Block (in minutes) (N=90)

5. Discussion

Our study's results revealed significant differences among the groups in terms of the onset and duration of sensory and motor blockade. Group D1, which received Ropivacaine 0.5% with normal saline, had the longest onset times and shortest durations for both sensory and motor blocks, with sensory blockade beginning after an average of 24.77 ± 3.45 minutes and motor block after 28.93 ± 3.63 minutes. The average period of motor blockade in this group was 368.70 ± 56.41 minutes, while the sensory block lasted 433.93 ± 57.58 minutes. In contrast, Group D2, which received Ropivacaine 0.5% with 100 mg Magnesium Sulphate, experienced a significantly faster onset of sensory blockade at 20.50 ± 2.74 minutes and motor block at 24.07 ± 3.27 minutes. The durations were also longer, with motor blockade lasting 508.87 ± 56.77 minutes and sensory block lasting 576.07 ± 51.20 minutes. Group D3, which received Ropivacaine 0.5% with 150 mg Magnesium Sulphate, showed similar results to Group D2, with sensory blockade beginning at 18.30 ± 4.40 minutes and motor block at 22.73 ± 4.54 minutes. The durations were comparable, with motor blockade lasting 509.73 ± 49.35 minutes and sensory block lasting 570.27 ± 43.58 minutes.

Overall, the addition of Magnesium Sulphate significantly improved the onset and duration of both sensory and motor blockades, with Groups D2 and D3 demonstrating faster and longer-lasting effects compared to Group D1. This finding is consistent with previous studies by Shridevi and Asokan (2020) [6], Haghighi et al. (2015) [7], George and Karthick (2024) [8], Mukherjee et al. (2014) and Verma et al. (2017) [9], providing a reliable framework for comparison. Overall, the addition of Magnesium Sulphate to Ropivacaine enhanced the efficacy of the block.

6. Conclusions

We found that the dose-dependent addition of Magnesium Sulphate to 0.50% ropivacaine hasten the onset while prolonging the duration of sensory and motor blockade. Group D2 with 100 mg Magnesium Sulphate had a good balance between onset and duration of blockade, while group D3 with 150 mg had the fastest onset and longest duration. These data suggest that Magnesium Sulphate can improve regional anaesthesia in clinical practice.

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