Original Article

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Comparative Study of 20ml of 0.5% Ropivacaine with 250mg Magnesium Sulphate and 20ml of 0.5% Ropivacaine with 500mg of Magnesium Sulphate in Supraclavicular Approach to Brachial Plexus Block under Ultrasound Guidance

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Abstract

Context: Available evidence on efficacy of adjuvants to local anesthetics (LAs) in supraclavicular BPB is of varying strengths and levels. Several studies have been conducted in which Magnesium Sulphate ($MgSO_4$) was administered (with placebos and other drugs) as adjunct to LAs in supraclavicular BPB, and they revealed varying degrees of efficacy with or without side effects

Aim: To study efficacy of 20ml 0.5% ropivacaine with 250mg $MgSO_4$ and 20ml 0.5% Ropivacaine with 500mg of $MgSO_4$ in supraclavicular approach to brachial plexus block under ultrasound guidance

Settings and design: Prospective Randomized Controlled Comparative Interventional study was conducted at KIMS Hospital, Kondapur, Hyderabad.

Methods: 80 patients undergoing upper limb surgeries were included. They were randomly assigned in two groups of 40 each; with one group receiving MgSO4 250mg and the other MgSO4 500mg. two groups were compared for different parameters.

Statistical Analysis: Chi Square Test was applied for categorical data and t test for the continuous data.

Results: Baseline parameters, pre-anesthesia vital parameters were comparable in two groups ($p>0.05$). Duration of onset of sensory and motor block and completeness of block was similar in two groups ($p>0.05$). But duration of block was significantly more both for sensory and motor in Mg-500 compared to Mg-250 group ($p<0.05$). Heart rate, Mean Arterial Pressure (mmHg) were comparable in two group at all durations from pre-operative to 24 hours ($p>0.05$).

Conclusion: Duration of sensory and motor blockade is prolonged by addition of MgSO4 in two doses (500mg and 250mg) to Ropivacaine in USG-guided supraclavicular BPB. Action of MgSO4 is dependent on the dose, more the dose longer the action.

Keywords: Ropivacaine; Magnesium sulphate; Supraclavicular; Brachial plexus; Ultrasound.

Key messages: 20ml of 0.5% ropivacaine with 500mg of magnesium sulphate in supraclavicular approach to brachial plexus block under ultrasound guidance can be used instead of 250mg magnesium sulphate.

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Introduction

Regional Anesthesia (RA) limits the physiological side effects and stress associated with surgery. The advantages include, but limited to, the reduction of blood loss of 20-50% in many procedures; less interference with immuno-competence; avoids polypharmacy; provides better hemodynamic stability; excellent post-operative analgesia; less interference with normal metabolic process and vital functions of most patients and reduction in hospital stay.[1,2]

As the Ultrasonography (USG) guided techniques developed, there has been enormous increase in the use of local Anesthetic peripheral nerve blocks for surgical Anesthesia and postoperative pain management.[3]

With regard to upper extremity surgeries, brachial plexus blockade (BPB) has been significantly and widely used as an alternative to GA. BPB is a simple, safe and reliable method. Patients can also enjoy postoperative period free from nausea, vomiting, cerebral depression and immediate postoperative pain.[4] Therefore, BPB is flexible and improves patient satisfaction.[5] The USG guided BPB has remarkably improved precision.[3]

The most common technique for regional anesthesia is Interscalene BPB. It is effective in alleviating pain in cases of surgery of the shoulder. But it is associated with the complications like "hoarseness, ipsilateral hemi diaphragmatic paresis and Horner's syndrome." Hence research was carried out and from Meta analysis, it was concluded that supraclavicular approach is more effective and also has lesser side effects.[6] Now, among all BPBs, supraclavicular BPB is most commonly used technique. Supraclavicular approach gives the most effective block for all portions of upper extremity and is carried out at the level of trunks of brachial plexus. The plexus is blocked where it is most compact i.e. at the middle of brachial plexus, resulting in homogeneous spread of Anesthetic throughout the plexus with a fast onset and complete block.[7]

Dureja J et al[8] compared the three techniques (Conventional Blind (CB), Nerve Stimulator (NS) Guided, and USG Guided) of supraclavicular BPB in a prospective, randomized clinical trial and concluded that the success rate and effective quality of the block were more satisfactory with USG technique than the NS or CB technique.

So, USG guided supraclavicular BPB has been the technique of choice and has been widely and significantly used for the upper limb surgeries. BPB also minimizes the local Anesthetic volume, thereby reducing the incidences of their systemic toxicity.[1]

Topical anesthetics are used commonly used for nerve blocks. They not only have less adverse effects but also help in the control of pain after surgery. The BPB in particular is a widely used option in upper extremity surgeries. While the procedure of BPB, along with the local anesthetics, a variety of drugs have been used with the objective of reducing the effect onset time, to increase the period of anesthesia and to increase the success rates. With regard to this, hundreds of studies have been conducted, with varying results.[9] Presence of additives to LAs has the advantages of improving onset and duration of blockade, gaining patient satisfaction, maintaining proper hemodynamic, together with reducing the need to postoperative analgesics.[10]

The available evidence11-14 with regard to the efficacy of adjuvants to LAs in supraclavicular BPB is of varying strengths and levels. Several studies have been conducted in which Magnesium Sulphate ($MgSO_4$) has been administered (with placebos and other drugs) as adjunct to LAs in supraclavicular BPB, and those studies have revealed varying degrees of efficacy with or without side effects.

"$MgSO_4$ has N-methyl-D-aspartate (NMDA) receptors antagonist property and is a calcium channel blocker.[15,16] it stimulates the peripheral nociceptive and thus prevents the central sensitization. Thus it is a useful adjuvant to the LAs. But there is lack of degree of evidence of $MgSO_4$ in surgeries of upper limbs using BPB along with LAs. Also knowledge on dose of $MgSO_4$ is conflicting.

We therefore studied the efficacy of $MgSO_4$ in two doses (250mg and 500mg) as an adjuvant to Ropivacaine in USG guided supraclavicular BPB.

Methods

The Prospective Randomized Controlled Comparative Interventional study was conducted from August 2019–June 2021; on either gender, patients age group 20-70 years, ASA physical status I & II, posted for elective upper arm surgeries at KIMS Hospital, Kondapur, Hyderabad.

The permission of ethical committee was taken. Written informed consent was taken from all patients on a separate "Patient Consent Form".

Sample Size Calculation

Sample size was determined (based on the previously

conducted study) 17 for the two independent study groups for continuous variable for this comparative prospective randomized controlled study. In that study by Verma V et al[17] mean time to first request for rescue analgesic medication was 450±50 min and 517±125.01 min in the 125 mg and 250 mg Magnesium Groups respectively when compared with the Control (Bupivacaine) Group which was 399±97 min. We calculated a minimum sample size assuming alpha (type 1) error (two-tailed) of 0.05, beta error as 0.2, and power as 80% i.e. total sample size of 8 (4 in each arm) is required, however we have considered a total sample size of 80 i.e. 40 in each arm.

Inclusion Criteria

- Age group 20-70 years
- ASA Grade I and II
- Admitted into hospital for elective upper limb surgeries

Exclusion Criteria

- Patient refusal
- Infection at the site of injection
- ASA Grade III and IV
- Known allergy to local anesthetic agents
- Coagulation disorders (including patients on anticoagulants)
- Patients with neurological deficits and musculoskeletal disease
- Pregnant and lactating women
- Emergency upper limb surgery
- Pneumothorax or previous Pneumectomy on the opposite side

Methodology

Pre-Anesthesia (Pre-Block Preparation)

- Patients of ASA I - II aged between 20 and 70 years undergoing upper limb surgeries were taken.
- Procedure was explained to the patients during pre-operative visits.
- A thorough preoperative evaluation was done with written informed consent (complete medical history and physical examination was done for all the patients).
- Basic hematological and laboratory investigations like complete hemogram, blood sugar, renal function test, etc. were reviewed. Where indicated ECG and Chest X-RAY were also reviewed.
- All patients were made to fast (NBM) for a minimum of 2 hours prior to anesthesia for liquids and overnight for solids.
- On the day of surgery, an appropriately sized IV cannula was secured.
- On arrival at the operating theatre, a 5 lead ECG monitor, pulse oximeter and an automated non-invasive arterial blood pressure monitor were applied.
- Pre-operative Heart Rate, Blood Pressure, and Saturation (SPO2) were noted in the Operating Room and those were considered as baseline Heart Rate, Blood Pressure, and Saturation.
- Ensured that there were no contraindications for the procedure.
- Correct side of the block was confirmed (through 'Time Out Process').

Practical Conduct of the Block was ensure by appropriate Scanning Technique using the ultrasound probe. Nerve Localization was done by Anatomic Correlation. Appropriate technique was followed for Needle Insertion. Test Drug Injection was injected as per the study protocol.

Randomization

1. Through computer generated random sampling method, patients were randomly divided into following two groups:

Group Mg250 (Magnesium Sulphate 250 mg Group) (n=40)

Group Mg500 (Magnesium Sulphate 500 mg Group) (n=40)

Test Drugs

Group Mg250 (n=40): Inj Ropivacaine (0.5%) 19 ml + Inj Magnesium Sulphate 250 mg (0.5 ml MgSo4 plus 0.5ml NS).

Group Mg500 (n=40): Inj Ropivacaine (0.5%) 19 ml + Inj Magnesium Sulphate 500 mg (1 ml).

Intra-Operative Assessment

1. Every patient of each group was assessed for the following parameters, in the minimum, intra-operatively:

a. Onset of sensory and motor block

b. Quality of block

i. Complete

ii. Incomplete

iii. Failed

c. Total duration of sensory and motor bock

d. Complications (Adverse Events) like vascular puncture, hematoma, pneumothorax, and drug toxicity were noted

2. Incomplete blocks were supplemented with propofol.

3. Failed blocks were supplemented with full GA with intubation.

Post-Operative Assessment

Postoperatively, all the patients were followed-up for 24 hours in the wards, and the following parameters were assessed (in both the groups).

Pain severity on 10mm Visual Analogue Scale (VAS) scores of 0 being no pain, and 10 as the worst imaginable pain. VAS Score was assessed and recorded at 2h, 4h, 8h, 12h, and 24h. Patient with VAS score more than 4 was given Inj. Paracetamol 1gm IV as a rescue analgesia. Total Paracetamol consumption in the first 24 hours in both the groups was noted for comparison.

Hemodynamic changes (Heart Rate, Mean Arterial Pressure, SpO_2) at 0 Minutes, 5 Minutes, 10 Minutes, 20 Minutes, 30 Minutes, 60 Minutes, 2 hours, 4 hours, and at 6 hours post-operatively as secondary outcomes. Overall patient satisfaction was also assessed.

Sensory Blockade Assessment and Scoring

Onset of Sensory Blockade

- Onset time is the time from the completion of injection of the local anesthetic to first loss of pinprick sensation in any of the dermatomes C5-T1

Duration of Sensory Blockade (Duration of Analgesia)

- Duration of sensory blockade is the time from the onset of the sensory blockade till the patient complaints of pain at the site of surgery (wound site).

Grading for Sensory Block by Pin Prick

- 0 = No pain
- 1 – 3 = Annoying (Mild Pain)
- 4 – 6 = Uncomfortable (Moderate Pain)
- 7 – 10 – Dreadful (Severe Pain)

Method of Sensory Block Assessment

Pin-prick with 23G Needle in an area innervated by:

- Musculocutaneous nerve: Lateral side of forearm
- Medial cutaneous nerve: Medial side of forearm
- Median nerve: Thenar eminence
- Radial nerve: Dorsum of hand over 2nd metacarpophalangeal joint
- Ulnar nerve: Little finger

Pain Score

Visual Analogue Score was explained to patients preoperatively (VAS: 0-10, 0=No pain, 10=worst pain possible), presented as a 10 cm horizontal line with verbal anchors at each end of 'no pain' and 'worst pain possible'. Post-operative VAS scores were recorded at 3h, 6h, 12h, 18h and 24h. Patient with VAS score more than 4 were given Inj. Paracetamol (1gm IV TID) as rescue analgesia.

Motor Blockade Assessment and Scoring

Onset of Motor Blockade

- The total time required to achieve complete paralysis of the upper limb
- Duration of Motor Blockade

1. Duration of motor blockade is the interval between the onsets of motor blockade to the time patient first experiences movement of the blocked limb

- Grading for Motor Block by Modified Lovett's Scoring.
- Grade 6 = Normal
- Grade 5 = Slightly reduced muscular force
- Grade 4 = Pronounced reduction
- Grade 3 = Slightly impaired mobility
- Grade 2 = Pronounced mobility impairment
- Grade 1 = Almost complete paralysis
- Grade 0 = Complete paralysis

Method of Motor Block Assessment

It is evaluated by examining the following response:

- Musculocutaneous nerve: Elbow flexion
- Median nerve: Third finger flexion
- Radial nerve: Thumb abduction
- Ulnar nerve: Little finger flexion

Block Performance Time (BPT – Time Taken for the Procedure).

This is defined as the interval between preparations of the injection site to the administration of total dose of local anesthetic.

Quality of Block (Scoring)

Quality of block assessed as scale for sensory and motor blockage:

- Complete block – 2
- Incomplete – 1
- Failed – 0

Total Duration of Analgesia

Duration of Analgesia is the time from the onset of the sensory blockade till the patient complaints of pain at the site of surgery (wound site). Rescue analgesia is given after that only.

Method of Data Collection

Upon assessment, the pre-operative, intra-operative, and post-operative data was recorded on the pre-designed and structured patient proforma

Statistical Analysis

Data was entered into Microsoft Excel and statistical analysis was done. Level of significance was set at $p<0.05$. P value <0.05 was considered to be significant. P value <0.0001 was considered to be highly significant. Chi Square Test was applied for categorical data and t test for the continuous data.

Results

The baseline parameters were comparable in two groups ($p>0.05$). (Table 1). The pre-anesthesia vital parameters were comparable in two groups ($p>0.05$). (Table 2).

Duration of onset of sensory and motor block and completeness of block was similar in two groups ($p>0.05$). But the duration of block was significantly more both for sensory and motor in the Mg-500 compared to Mg-250 group ($p<0.05$). (Table 3).

The heart rate was comparable in two group at all durations from pre-operative to 24 hours ($p>0.05$). (Table 4). The Mean Arterial Pressure (mmHg) was comparable in two group at all durations from pre-operative to 24 hours ($p>0.05$). (Table 5).

The SpO2 was comparable in two group at all durations from pre-operative to 24 hours ($p>0.05$). (Table 6). The duration of analgesia was significantly more in Mg-500 group compared to Mg-250 group ($p<0.05$). (Table 7).

Table 1: Comparison of baseline parameters in two groups.

Variable		Mg-250 (n=40)	Mg-500 (n=40)	Chi square	t value	p value
Age (years)	Mean±SD	39.45±12.86	44.85±12.01	--	0.9527	0.1718
ASA grades	ASA grade I [N (%)]	34 (85%)	35 (87.5%)	0.1054	--	0.7454
Sex	Male [N (%)]	23 (57.5%)	25 (62.5%)	0.2083	--	0.6481
Weight (kg)	Mean±SD	57.97±9.15	53.93±8.22	--	1.3019	0.0979
Duration of surgery (min)	Mean±SD	103.88±26.97	107.0±30.50	--	0.48538	0.314

Table 2: Comparison of pre-anesthesia vital parameters in two groups.

Variables	Mg-250 (n=40)	Mg-500 (n=40)	t value	p value
Heart rate (min)	79.98+9.36	79.30+10.01	0.098	0.46
Systolic blood pressure (mmHg)	134.34+11.33	132.352+13.61	0.142	0.44
Diastolic blood pressure (mmHg)	80.20+8.73	80.66+8.94	0.743	0.23
Mean arterial pressure(mmHg)	97.95+9.40	98.25+8.77	0.836	0.31
SPO_2	99.66+0.56	99.60+0.57	0.648	0.26

Table 3: Comparison of sensory & motor block parameters in two groups.

Variables		Mg-250 (n=40)	Mg-500 (n=40)	t/chi square	p value
Duration of onset	Sensory block onset (min)	5.16±0.49	5.14±0.43	0.167	0.434
	Motor block onset (min)	10.72±0.43	10.62±0.52	0.924	0.179
Duration of block	Sensory (hours)	7.16±0.92	8.92±0.42	**12.08**	**< 0.001**
	Motor (hours)	6.5±0.63	8.63±0.50	**16.82**	**< 0.001**
Quality of block	Complete	37 (92.5%)	38 (95%)	0.213	0.644

Table 4: Comparison of Heart Rate in two groups.

Heart Rate (per min)	Mg-250 (n=40)	Mg-500 (n=40)	t value	p value
Pre-operative	79.30±10.01	79.98±9.36	0.031	0.97
0 min	78.52±11.36	79.66±10.63	0.83	0.41
5 min	77.68±10.60	78.94±10.73	0.10	0.92
10 min	77.38±10.88	78.32±11.14	0.40	0.691
20 min	77.80±9.98	77.42±9.42	0.67	0.51
30 min	77.26±9.81	77.22±9.23	0.43	0.67
60 min	76.74±9.93	79.22±10.10	0.06	0.95
2 hours	76.48±10.651	79.21±10.91	1.74	0.09
4 hours	76.72±10.96	79.21±10.0	4.62	0.12
6 hours	76.46±10.58	79.3±10.81	1.79	0.08
12 hours	76.69±9.48	78.69±9.95	0.76	0.45
24 hours	76.12±9.90	79.1±9.73	0.03	0.05

Table 5: Comparison of Mean Arterial Pressure (MAP) in two groups.

Mean Arterial Pressure (mmHg)	Mg-250 (n=40)	Mg-500 (n=40)	t value	p value
Pre-operative	97.95±9.40	98.25±8.77	0.201	0.841
0 min	93.83±9.26	93.81±9.59	1.05	0.301
5 min	91.53±9.11	92.47±9.66	0.251	0.803
10 min	90.32±8.56	92.36±9.27	1.125	0.269
20 min	89.18±7.36	91.60±9.20	0.489	0.628
30 min	89.00±7.31	91.45±9.25	0.138	0.891
60 min	87.08±6.28	90.46±8.19	0.952	0.348
2 hours	93.82±8.33	96.96±7.58	0.742	0.278
4 hours	93.75±6.56	95.16±7.11	0.711	0.318
6 hours	92.37±6.05	94.88±6.88	0.47	0.567
12 hours	91.47±5.55	93.35±7.33	0.832	0.711
24 hours	91.17±5.34	89.87±7.39	0.592	0.375

Table 6: Comparison of post brachial plexus block SpO_2 in two groups.

SpO_2	Mg-250 (n=40)	Mg-500 (n=40)	t value	p value
Pre-operative	99.60±0.57	99.66±0.56	1.139	0.263
0 min	99.58±0.54	99.68±0.51	0.51	0.102
5 min	99.74±0.49	99.72±0.54	0.465	0.645
10 min	99.80±0.45	99.70±0.51	0	1
20 min	99.64±0.56	99.74±0.44	0.238	0.813
30 min	99.60±0.57	99.74±0.56	0.441	0.662
60 min	99.68±0.55	99.70±0.46	0.827	0.414
2 hours	99.70±0.46	99.66±0.48	0.911	0.534
4 hours	99.56±0.58	99.66±0.48	0.876	0.458
6 hours	99.60±0.57	99.74±0.53	0.569	0.576
12 hours	99.64±0.53	99.70±0.51	0	1
24 hours	99.66±0.48	99.64±0.53	0.511	0.732

Table 7: Post brachial plexus block: duration of analgesia.

Duration of analgesia	Mg-250 (n=40)	Mg-500 (n=40)	t value	p value
(in minutes)	529.68±53.32	699.36±45.99	12.05	< 0.0001

Discussion

In our study the mean age was 39.45±12.86 for the Mg-250 group and 44.85±12.01 for the Mg-500 group (p=0.1718). Our age distribution was comparable to other similar studies.[18,19]

The gender distribution in both the groups was also comparable (p=0.839). In all the studies that made a mention of gender, the groups were comparable. The weight distribution too, in both the groups, was comparable (p=0979). Not many studies mentioned about the weight distribution. Weight distribution, in the studies which mentioned, was however comparable. The mean duration of surgery, in our study, was 103.88±26.97 minutes and 107.02±30.50 minutes in Mg-250 and Mg-500 Groups respectively. There was no statistically significant difference between the groups. (p=0.314). Similar comparable groups were seen in all the studies.[16,18,19]

The mean HR was 79.98±9.36 and 79.30±10.01 (p=0.46); the mean SBP was 134.34±11.33 and 132.52±13.61 (p=0.44); the mean DBP was 80.20±8.73 and 80.66±8.94 (p=0.23); the MAP was 97.95±9.40 and 98.25±8.77 (p=0.31) and; the mean SPO_2 was 99.66±0.56 and 99.60±0.57 in the Mg-250 group and the Mg-500 group (p=0.26) respectively. All the relevant similar studies[16,18,19] ensured that the pre-block vital parameters are comparable in their study groups.

The dosages in our study were in accordance with other studies. Verma V et al[17] used doses of 125mg and 250mg of $MgSO_4$ (Group Mg250 (n=40) received Inj Ropivacaine (0.5%) 19 ml + Inj Magnesium Sulphate 250 mg (0.5 ml MgSo4 plus 0.5ml NS) and Group Mg500 (n=40) received Inj Ropivacaine (0.5%) 19 ml + Inj Magnesium Sulphate 500 mg (1 ml); in Goyal et al[20] study, Group I patients received 20 ml of 0.5% $MgSO_4$ given in axillary sheath, Group II patients received 20ml of 1.0 % $MgSO_4$ given in axillary sheath, and Group III patients received intramuscular diclofenac sodium 1mg/kg.

In our study, the mean duration of onset of sensory block in Mg-250 Group was 5.16±0.49 min and in Mg-500 Group was 5.14±0.43 min (p=0.434). Mean duration of onset of motor block was 10.72±0.43 min in Mg-250 Group and was 10.62±0.52 min (p=0.179) in Mg-500 Group. There was no statistically significant difference between the groups–both in the onset of sensory block as well as the motor block. Similar findings were reported by Verma V et al[17] and Bansal et al[21] Rao LN 22 observed the mean onset of sensory block in case Group M (0.5% bupivacaine (1.5 mg/kg) with $MgSO_4$ 20% (3ml)) was 15.5±2.16 and the onset block in control Group P (0.5% bupivacaine (1.5 mg/kg) with normal saline (3 ml) as a placebo) was 12.73±1.18 (p<0.49); statistically not significant). The mean onset of motor block in case Group M was 23.5±1.1 and the onset block in control Group P was 41±3 (p<0.53; statistically not significant). Reza Akhondzade 23 observed that Sensory and Motor blocks onset and duration were statistically longer in group M than group N (P<0.0001) [group M (Lidocaine 1% (4 mg/kg) plus Fentanyl 50µg and MgSO4 20%) than group N (Lidocaine 1% (4 mg/kg) plus Fentanyl 50µg and Normal Saline (5ml))].

In this study, the duration of sensory block was 7.16±0.92 hours in the Mg-250 Group and it was 8.92±0.42 hours in the Mg-500 Group (p<0.00001). The duration of motor block was 6.50±0.63 hours in the Mg-250 Group and it was 8.63±0.50 hours in the Mg-500 Group (p<0.00001). We found statistically significant difference between the two groups – both in the duration of sensory block as well as motor block. Gunduz A et al[24] observed that the mean duration of sensory block in both of the perineural magnesium groups was statistically different than in groups I and II (P<.001). Mukherjee K et al[25] too concluded that adding $MgSO_4$ to supraclavicular BPB may increase the sensory and motor block.

None of the previously conducted studies made a specific mention about failed blocks in their studies. In our study, hemodynamically (HR, MAP, SPO_2) there were no statistically significant differences intra-operatively and post-operatively in both the Mg-250 Group and Mg-500 Group. In almost all the studies 17-44, 46, 48-54, we found no statistically significant between the groups hemodynamically.

We found the mean duration of analgesia in the Mg-250 group was found to be 8.83±0.89 hours while those in the Mg-500 group found to be 11.66±0.72 hours – a statistically significant difference between the performance of both the drugs (p<0.00001). Similar findings were reported by Verma V et al, 17 and Mukherjee K et al.[25] Goyal P et al 20 concluded that, for the first-time magnesium was used independently in a small dose in axillary sheath which results in good analgesia as determined by decreased uses of rescue analgesia without producing any major side effects.

None of the studies except Verma V et al[17] mentioned about the requirement of supplementation to block. Although the authors made a mention of supplementation to block, no specific objective information with regard to supplementation was detailed in the study. We did

not observe any kind of significant perioperative adverse events in either of the Group. The findings of study was in agreement with several other studies (Verma V et al[17], Mukherjee et al[25], Goyal P et al[20]).

Conclusion

Duration of sensory and motor blockade is prolonged by addition of $MgSO_4$ in two doses (500mg and 250mg) to Ropivacaine in USG-guided supraclavicular BPB. Action of $MgSO_4$ is dependent on the dose, more the dose longer the action.

The limitations of the study include, but not limited to the following:

- All types of surgeries were not included in the study.
- The sample size of study Groups was very limited, so cannot generalize this study results to the entire population.
- We did not use placebo group.
- A lower volume of local anesthetic could have been used, especially under USG guidance.
- Systemic absorption of magnesium may have contributed to the beneficial effects.

Therefore, further studies are required in this regard.

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