ORIGINAL ARTICLE

A Comparative Study of Adding Intrathecal Magnesium Sulphate to Bupivacaine Hydrochloride in Spinal Anaesthesia .

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ABSTRACT

Introduction : Recently the use of intrathecal adjuvants has gained popularity as they improve the quality of spinal anesthesia.MgSO4 mainly act as a non-competitive NMDA receptor antagonist by blocking ion channels and prolong the duration of spinal blockage. The present study is conducted to assess the effectiveness of adding magnesium sulphate intathecally to bupivacaine in spinal anaesthesia.

Material method : 100 adult patients of both genders, ASA grade I and II were divided randomly in to 2 groups (n=50). IN GROUP C Inj. Bupivacaine Hydrochloride (15mg) 3ml + 1ml Normal Saline and In GROUP M Inj. Bupivacaine Hydrochloride (15mg) 3ml + 1ml (50mg) Magnesium sulphate was administered intrathecally. Hemodynamic changes, Duration of sensory & motor blockade with duration of spinal anasthesia were noted.

Observation & result : Mean Duration of sensory and motor blockade with duration of spinal anesthesia is statistically highly significant in Group M($p<0.0001$) as compared to GROUP C. Adverse drug effects were also found to be significantly lower in GROUP M as compared to group C. No significant hemodynamic changes were observed on addition of MgSO4 intrathecally.

Conclusion : Administration of intrathecal MgSO4 to Bupivacaine significantly delays the onset of both sensory and motor blockade but also prolongs the period of spinal anesthesia without additional side effects.

INTRODUCTION

Regional Anaesthesia is a safe & inexpensive technique which is widely used for performing different surgical procedures. It reduces the risk of airway complication & avoids haemodynamic changes associated with laryngoscopy & intubation. Recently application of intrathecal adjuvants has gained popularity with aim of prolonging the duration of block, better success rate and patient satisfaction . Drugs like epinephrine, clonidine, ketamine, and neostigmine have also been used with opioids as an adjuvant to local anesthetic agents to prolong the duration of analgesia[1].

However, significant higher side effects of opioids such as pruritus, respiratory depression, urinary retention, hemodynamic instability and occasionally severe nausea and vomiting have limited their use intrathecally.

Magnesium sulphate acts as a noncompetitive N-Methyl-D-aspartate (NMDA) receptor antagonist, blocking ion channels in a voltage dependent manner. The addition of magnesium reduces the activation of C-fibers by inhibiting the slow excitatory postsynaptic currents which is produced by NMDA receptor activation. They also abolish hypersensitization by blocking NMDA receptor activation in the dorsal horn of spinal cord by excitatory amino acid transmitters like glutamate and aspartate. MgSO4 administered intrathecally prolongs the duration of spinal opioid analgesia given during labour.

The aim of this prospective randomised control study was to evaluate the effects of intrathecal addition of magnesium to bupivacaine in patients undergoing lower abdominal and lower extremity surgeries.

MATERIALS AND METHODS

A randomised controlled study was conducted after taking institutional ethical committee approval and informed written consent from all 100 adults patients undergoing surgeries. The procedure was explained to the patient in details and patient was informed to communicate about the perception of any discomfort or pain during surgery.

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Inclusion Criteria : 1) Age group-18 to 65 years, of either sex. 2) ASA grade 1 and 2. 3) Elective lower limb surgery, lower abdominal surgery.

Exclusion Criteria : 1) Patients with hepatic, renal, cardiac or respiratory problems. 2)Patients with localised site infections. 3) Haematological, bleeding disorders and coagulopathies. 4) Long term opioid use. 5) Patients with history of chronic pain. 6) History of neuropathy, myopathy and neuromuscular diseases. 7) Known allergy to magnesium sulphate or other study drugs. 8) Patients refusal, uncooperative patients or children.

Patients were randomly placed in two different groups (50 in each group).

Group C :

Inj. Bupivacaine hydrochloride (15 mg) 3ml + 1ml NS (normal saline) was administered to 50 patients.

Group M :

Inj.Bupivacaine hydrochloride (15 mg) 3ml +1 ml MgSO4 (50 mg) was administered to the other 50 patients.

Technique :

First, Peripheral IV line was taken and each patient was preloaded with 15ml/ kg of Ringer's lactate fluid before procedure. Pulse oximeter, non-invasive blood pressure monitoring and ECG were attached and base line reading was taken.

Under all strict aseptic and antiseptic precautions ,Lumber puncture was performed at L2-L3 intervertebral space with 23G Quincke needle and selected drug was given slowly after free flow of clear CSF.

After completion of procedure, patient was immediately turned to supine position. No tilt of the table is allowed till 20 mins after the administration of the drug at which the level of the blockade was noted as the highest level of block was achieved. Sensory level blockade was tested by pin prick method and the quality of block was noted.

Pulse, SBP, DBP, MAP and SpO2 and were recorded Preoperatively & every 5, 10, 15, 20, 25, 40, 55, 70, 85, 100 and 120 minutes after giving spinal anaesthesia and then every 20 minutes till the completion of surgery.The onset and duration of sensory blockade, time taken to reach the highest level of sensory blockade, time taken to achieve Bromage score 3,duration of sensory analgesia, time to complete motor block recovery and overall duration of spinal anaesthesia (post operative pain time onset)was recorded.

VAS scores were explained pre-operatively & were recorded before intrathecal injection & post operatively upto beyond 180 mins and analgesia in the form of Inj. Tramadol 1 mg/kg was given when VAS > 4 and the patient complained of pain.

Patients were watched for any intraoperative complications like bradycardia, hypotension, sedation, nausea, vomiting, dryness of mouth, pruritus and respiratory depression.

Master chart was prepared for all patients. Statistical analysis was prepared using Graphpad software and mean value was calculated for each parameter and P value < 0.05 was considered significant.

RESULTS, FIGURES & TABLES

There were no significant difference between the two groups in age, sex, weight but highly significant in total duration of surgery (Table 1)

Mean Heart rate does not change much in both the groups and is found to be statistically insignificant (p> 0.05) in maximum cases.(figure 1)

Mean Arterial Pressures statistically insignificant until about 40 -55 mins in both the groups after which the data becomes statistically significant indicating that magnesium sulphate plays a role in preventing the rise of MAP over the course of surgery which may be be deleterious for the patient and may result in excessive bleeding.(figure 2)

Parameters in Post Operative period suggest that the addition of Magnesium suphate intrathecally to bupiavcaine plays a larger role in maintaining the stability of heart rate post operatively (i.e. after 120 mins) and the difference is statistically significant as compared to the control group. Similarly, the rise of Mean Arterial pressure post operatively is also prevented by the addition of MgSO4 with the difference being statistically significant (p< 0.05).(Table 2)

Table 1: Demographic data for the two groups Characteristics of Spinal blockade

Parameters	Group C	Group M	P value	RESULT
AGE(years)	47.04±10.57	45.4±11.14	0.45	NS
WEIGHT(Kg)	53.56±9.35	54.26±10.33	0.72	NS
SEX(M/F)	20/30	36/14		
DURATION OF SURGERY	71.04±30.6	96.72±33.73	0.0001	HSS

Figure 1: Mean Heart rate in two groups

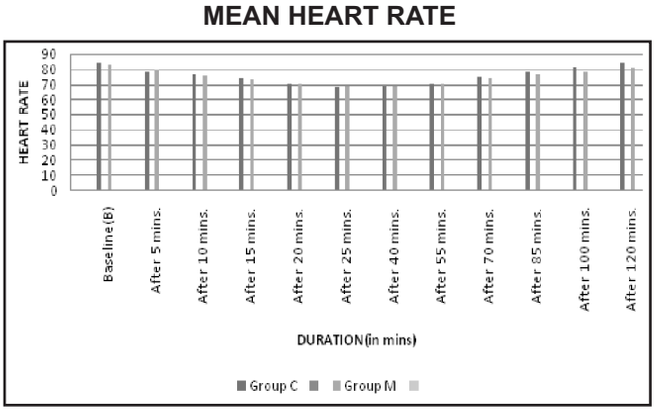

Figure 2 : Mean Arterial pressure in two groups

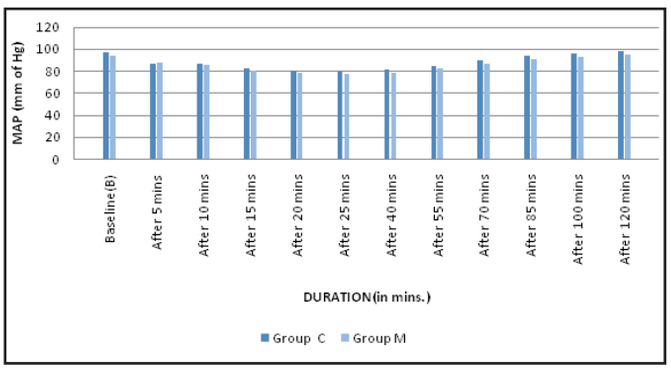

Table 2 : Post Operative Observations of Parameters

Time	Parameters	Group C	Group M	P Value	Results
140 mins	HEART RATE	85.23±5.72	82.2±6.88	0.01	SS
	MAP	98.6±6.76	95.99±7.6	0.07	NS
160 mins	HEART RATE	86.65±5.43	84.4±5.98	0.05	SS
	MAP	99.96±5.87	96.76±6.98	0.01	SS
180 mins	HEART RATE	86.34±6.34	84.3±4.43	0.04	SS
	MAP	100.18±6.8	97.96±3.8	0.03	SS

Characteristics of Spinal blockade

1). Time taken (mins) to achieve the highest level of sensory blockade

GROUP C : 13.42 ± 1.56

Group M : 16.2 ± 1.51

P value : 0.0001

The median onset of sensory blockade to the maximum level of spread was slower in the magnesium group (16 min vs. 12 min,) which is statistically significant. (P < 0.05)

2). Time taken (mins) to achieve Bromage score 3 (Motor blockade)

GROUP C : 18.92 ± 2.34

Group M : 24.06 ± 3.87

P value : 0.0001

The time taken to achieve Bromage score 3 (motor blockade) was significantly delayed in Group M(24 mins) as compared to Group C(19 mins).

3). Duration of sensory analgesia (mins)

GROUP C : 240.86 ± 13.23

Group M : 317.24 ± 20.91

P value : 0.0001

The duration of sensory blockade was more in the group M(317 mins) as compared to the group C(240 mins) ,which is statistically significant(P < 0.05)

4). Duration of motor blockade (mins)

GROUP C : 136.56 ± 3.99

Group M : 161.28 ± 13.47

P value : 0.0001

The mean duration of motor blockade was significantly prolonged on addition of MgSO4. (Median 136 mins vs 161 mins on addition of MgSO4 , which is extremely statistically significant).

5). Total Duration of spinal anesthesia(mins)

GROUP C : 153.4 ± 3.80

Group M : 187.96 ± 21.87

P value : 0.0001

The total duration of spinal anaesthesia was longer by around 8% in group M (median 187 min vs. 153min; P < 0.001), but there were no significant differences in mean pain scores at any time .

Figure 3 : Characteristics of Spinal blockade

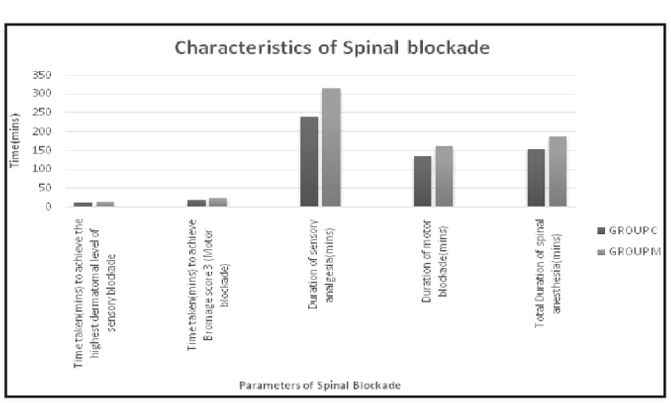

Table 3 : Adverse Drug Effects

Complication	Group C (no. of Pt /percentage)	Group M (no. of Pt /percentage)
Nausea	6(12%)	4(8%)
Vomiting	3(6%)	2(3%)
Resp. depression	Nil	1(2%)
Bradycardia	3(6%)	4(8%)
Hypotension	4(8%)	5(10%)
Shivering	7(14%)	6(12%)
Itching	2(4%)	1(2%)

Adverse effects were comparatively lesser in the group M as compared to the group C. However, Respiratory depression was observed in 1 patient immediately post operatively which did not require active management as such and subsided on oxygen supplementation.

Incidence of hypotension (when MAP < 20% of the first recorded MAP) and bradycardia (when HR< 60/min) were also slightly higher in the group M which was managed by administration of intravenous fluids through a large bore cannula and as such no administration of vasopressors or inotropes was required.

DISCUSSION

Subarachnoid block is commonly used anaesthetic technique for undergoing lower abdominal & lower limb surgeries which is safe, inexpensive and easiness to administer. Nowadays various additives are used to prolong the anaesthesia & analgesia given by this technique.

Magnesium is integral element to many of the body's basic functions and has an increasing role in the world of anaesthetics. Magnesium occurs naturally in spinal cord & blocks the NMDA glutamate channel mainly by its NMDA receptor antagonist action which plays an important role in the prevention of central sensitization of pain. Noxious stimulation leads to release of neurotransmitters such as glutamate & aspartate which bind to NMDA receptors and other excitatory amino acid receptors.[1] Magnesium blocks NMDA channels in voltage dependent manner leads to marked reduction in NMDA induced currents. Insufficient blood brain barrier penetration to achieve effective CSF concentrations limits the parenteral application of magnesium for anti-nociceptive modulation as NMDA receptor antagonist. Intrathecal magnesium potentiates opioid spinal analgesia and avoids the potential side effects of larger doses of IV magnesium that may be required to observe anti-nociceptive modulations in humans.

This study was conducted on 100 adult patients ranging from 18 to 65 years of age to test the addition of 50mg of MgSO4 to bupivacaine hydrochloride in spinal anaesthesia for lower abdominal and lower limb surgeries.

In our study, there are no statistically significant differences in terms of demographic properties or ASA gradings. it was found that the onset of both the sensory and motor blockade were delayed in the Magnesium M group as compared to the control C group. The time taken to reach the highest dermatomal level of sensory blockade was 16 mins in the M group (compared to 13mins in group C) whereas the motor blockade was achieved in 24 mins(compared to 19 mins in group C). Our results was similar with a study conducted by M. Ozalevli et al.[3] in Turkey, they observed that in patients undergoing lower extremity surgeries, the addition of MgSO4 to spinal anaesthesia induced by bupivacaine hydrochloride and fentanyl significantly delayed both sensory and motor blockade but prolonged the period of anaesthesia without additional side effects[3][4][5].

Marzieh –Beigom et al[6] also found in their study that onset of both sensory and motor blocks were prolonged in the magnesium group compared with the fentanyl and control group which is similar with our study.

It was found in our study that the duration of sensory analgesia was 240mins in group C as compared to 317mins in group M, which indicates significantly larger and prolonged analgesia in the magnesium group. This is also in correspondence with the study of **Maleeswaran et al**[7] who found that the addition of MgSO4 50mg to bupivacaine hydrochloride and fentanyl prolonged the onset and the duration of analgesia and reduced the analgesic requirements with minimal side effects.

In our study, the comparison of parameters indicating hemodynamic stability in the perioperative and post operative period were found to be statistically insignificant in both magnesium as well as the control group. In the perioperative period in M group decrease in MAP after 40 mins was found to be statistically significant indicating MgSO4 plays a role in preventing the rise in MAP over the course of surgery, which may be deleterious for the patient and may result in excessive bleeding. **Ashraf E**[5] also found hemodynamic stability in the perioperative period in his study and a non significant number of patients in the magnesium group demonstrated a hypotensive episode requiring treatment.

We found in our study that the duration of anaesthesia was prolonged by magnesium sulphate to 187 minutes as compared to 153 minutes in the control group. Our results are consistent with the findings of **M.Ozalevli et al** [3] and Buvanendran et al[8]. **Ashraf et al**[5] compared Magnesium sulphate versus neostigmine as an additive

to bupivacaine hydrochloride in spinal anaesthesia and found statistically significant larger duration of analgesia in MgS04 group.These above findings are in correspondence with our study.[5][9]

Jaiswal[10] et al mentioned that magnesium sulphate significantly reduced the shivering threshold which is a incidental finding of our study as the drug not only exerts a central effect but also has a mild muscle relaxant effect. Neuraxial anaesthesia impairs thermoregulatory control. Consequently , addition of magnesium sulphate intrathecally to bupivacaine hydrochloride reduces the shivering threshold by a few tenths of a degree Celsius to act as an effective anti shivering agent.

CONCLUSION

After further comparisons with previous works of different authors in the similar or nearly similar direction, in our study we were able to conclude that Administration of Intrathecal Magnesium sulphate to spinal anaesthesia induced by bupivacaine hydrochloride significantly delays the onset of both sensory and motor blockade but alsoprolongs the period of anaesthesia without additional side effects. So, magnesium sulphate is a cheap, easily available alternative which can be used as an additive to spinal anaesthesia induced by bupivacaine hydrochloride.

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