EFFECT OF INTRAVENOUS MAGNESIUM SULPHATE ON POSTOPERATIVE PAIN FOLLOWING SPINAL ANESTHESIA. A RANDOMIZED DOUBLE BLIND CONTROLLED STUDY

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Abstract

Background: Magnesium sulphate ($MgSO_4$), NMDA receptor antagonist, is known to reduce perioperative requirement of anesthetics and analgesics. However, no studies assessed the effect of $MgSO_4$ on onset and recovery from spinal anesthesia. A prospective, randomised, double blind study was designed to assess the effect of intravenous (IV) $MgSO_4$ on onset and recovery from spinal anesthesia and post operative analgesic requirement following below umbilical surgery.

Methods: Sixty patients (ASA class I & II) were selected randomly and divided into two groups. Patients were given either $MgSO_4$ 50mg kg^{-1} in 10mL within 10min, followed by an infusion of $MgSO_4$ 10mg kg^{-1} hr^{-1} IV in 4mL (MG group) for 12 hrs or normal saline in same volume and rate for 12 hrs as used in MG group (NS group). After initiating the infusion, spinal anesthesia was given with 0.5% bupivacaine (Hyperbaric) 2.5mL at L3/4 or L4/5 space. Time taken for sensory block at the level of T-10 and motor block (modified Bromage Score-1) was noted. Postoperatively, time taken for recovery from spinal anesthesia, pain score and requirement of postoperative analgesic in 24 hours were observed and compared between the two groups.

Results: The first rescue analgesia was required after 334 ± 202 min in MG group and after 233 ± 141 min in NS group with significant difference ($p < 0.05$). The morphine required over 24 hours for analgesia was significantly less in MG group (3.99 ± 1.25 mg) as compared to NS group (7.13 ± 2.68 mg) ($p < 0.000$).

Conclusion: Intravenous $MgSO_4$ improves postoperative analgesia without affecting the onset and recovery from spinal anesthesia.

Key words: Magnesium sulphate, spinal anesthesia, postoperative analgesia.

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Introduction

Post operative pain may result into various physiological changes with physical and psychological trauma[1]. Various techniques and drugs are used to make a patient pain free in the post operative period[2]. Magnesium sulphate ($MgSO_4$), a NMDA receptors antagonist, has been tried to control perioperative pain by modifying the pain mechanism[3,4,5]. Search of literature shows many studies assessing the analgesic effect of magnesium sulphate following general anesthesia[3,6-11]. Only few studies assessed the effect of magnesium sulphate on postoperative pain following regional anesthesia[12,13]. However to our knowledge, no studies have evaluated the effect of $MgSO_4$ on the onset and recovery from spinal anesthesia as well as postoperative pain control. The aim of the present study is to assess the effect of intravenous magnesium sulphate on onset and recovery of spinal anesthesia and postoperative analgesic requirement following below umbilical surgery.

Methods

After getting approval from institutional research board, sixty adult patients of either sex, aged 18-60 yrs, to ASA class I and II with the ability to understand the Visual Analogue Scale, scheduled for elective below umbilical surgery under spinal anesthesia were selected randomly. All patients were asked to give informed consent to participate in the study. Patients having compromised renal, hepatic, cardiac functions, bleeding disorder, skeletal muscles disorder or any other neurological deficit or not willing to participate in the study were excluded. Patients on alcohol, analgesics, narcotics or any other drug containing magnesium were also excluded from the study. The selected patients were randomized by blocks into two equal groups.

The demographic parameters of each patient were recorded. Continuous monitoring of electrocardiograph (ECG), heart rate, non-invasive blood pressure (NIBP - systolic, diastolic and mean arterial blood pressure) and pulse oximetry (SpO_2) was started and continued throughout the study period by using Colin-BP 508 monitor.

Patients of MG group were pre-treated with magnesium sulphate 50 mg kg^{-1} body weight intravenously (IV) in 10 ml volume over 10 minutes, followed by IV infusion of 10 mg kg^{-1} hr^{-1} in 4 ml for 12 hrs. Similarly, patients of NS group received normal saline 10 ml IV within 10 min, followed by IV infusion of normal saline 4 ml hr^{-1} for 12 hrs. Infusion was given by using Soveta-S1 syringe infusion pump. After initiating the infusion, as per the group allocated, fluid co-loading was started with 500 mL ringer lactate solution. Spinal anesthesia was administered to each patient with 0.5% heavy bupivacaine 2.5 ml at L3-L4 or L4-L5 intervertebral space in the sitting position using a midline approach with a 25 G Whitacre needle. Level of sensory block by pin prick method and motor block by modified Bromage score[18] was assessed at every 2 minutes following subarachnoid injection, and the time taken to achieve complete loss of sensations up to T-10 level and complete motor block (modified Bromage score-1) was noted. Surgery was allowed when there was no sensation. Oxygen 4L/min through face mask and adequate fluid therapy was given to all patients.

Postoperatively, block was assessed every 15 min

Table 1

Demographic profile of the two groups

	Group MG (n = 30)	**Group NS (n = 30)**	**P value**
Age (Yrs)	33.20 ± 12.19	30.93 ± 11.66	0.46
Weight (Kg)	55.70 ± 10.22	53.37 ± 8.16	0.33
Height (cm)	160.43 ± 6.31	159.43 ± 6.54	0.55
M:F	23:7	22:8	

(p-value <0.05 significant)

Table 2

Mean ± SD of various parameters in two groups

	Group MG (n = 30)	Group NS (n = 30)	p-value
Time (min) taken to achieve-			
Sensory block up to T -10	7.47 ± 2.67	7.93 ± 3.25	0.54
Motor block to MBS-1	8.13 ± 1.96	8.33 ± 2.17	0.70
Time (min) taken for recovery from			
Sensory block to L-1	237.10 ± 37.19	242.80± 23.88	0.48
Motor block to MBS - 6	287.87 ± 31.61	270.40± 24.87	0.39
Duration of post operative analgesia (min)	333.91±202.41	232.68±140.62	0.04
Total morphine (mg) required in 24 hrs	3.99 ± 1.25	7.13 ± 2.68	0.000

(p value: <0.05 significant difference, < 0.000 highly significant difference)
(MBS-Modified Bromage Score).

and time taken for regression of sensory block to the level of L-1 and recovery of motor block to modified Bromage score 6 was noted. Pain at rest was assessed by using the visual analogue scale (VAS) every 30 minutes for three hours and then every three hours for next 21 hours (total 24 hours). Rescue analgesia was given in the form of morphine 0.05 mg kg^{-1} body weight IV when VAS score was more than 3. Period of analgesia (from the time of subarachnoid injection to the time of first rescue analgesia required) and total requirement of analgesic in 24 hours was recorded. Both the observer of the parameters and the patient were blind to the drug injected IV and in the subarachnoid space. The collected data were statistically analyzed by using 'repeated measures ANOVA test' and Group't' test.

Results

Demographic data was statistically comparable for both groups (p >0.05) (Table 1). There was no statistical difference between two groups for their mean time required to achieve complete sensory block up to the level of T-10, motor block to modified Bromage score -1, complete recovery from sensory block to the level of L-1 and complete motor recovery to modified Bromage score-6 (p >0.05) (Table 2). The period of analgesia (the time interval between subarachnoid injection and requirement of first rescue analgesic) was longer in MG group (333.91 ± 202.41 min) as compared to NS group (232.68 ± 140.62 min) with statistical significant difference (p value <0.05) (Table 2 The mean postoperative rescue analgesia requirement

Table 3

Showing type of surgeries done under two groups

Type of surgery	Group MG	Group NS
Inguinal hernioplasty	15	18
Appendicectomy	6	3
Patellar fracture-(Wiring)	1	2
Varicose vein-ligation	1	1
Below knee amputation	2	2
Interlock nailing-tibia	2	1
Fistulectomy	3	3

Modified Bromage Score[18]

1- Complete block (unable to move feet and knees).
2- Almost complete block (able to move feet only).
3- Partial block (able to move knees).
4- Detectable weakness of hip flexion while supine (full flexion of knees).
5- No detectable weakness of hip flexion while supine.
6- Able to perform partial knee bend.

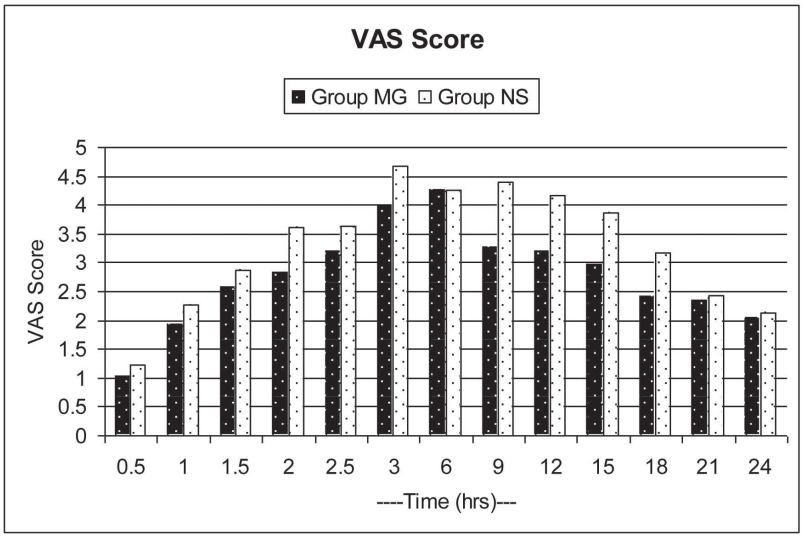

Fig. 1
Showing mean of VAS score of two groups at different points of time postoperatively. (P <0.05)

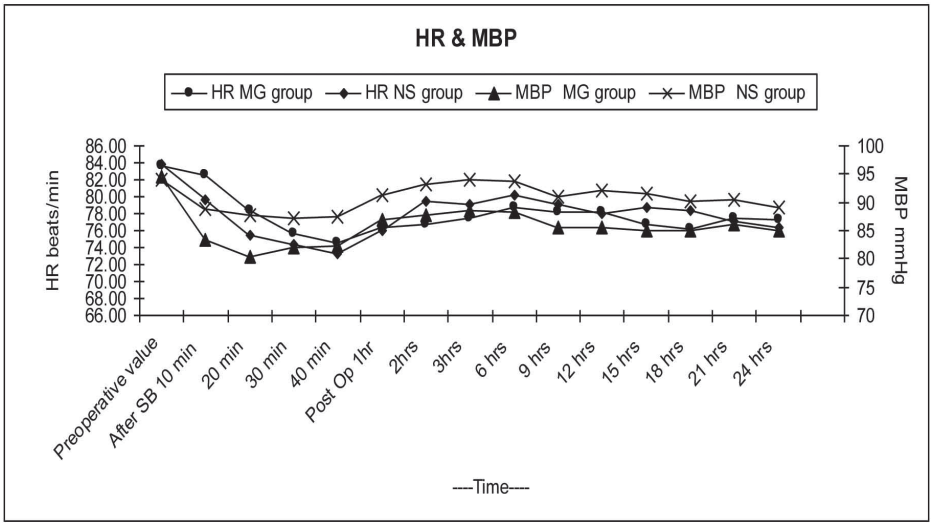

Fig. 2
Showing mean of heart rate and mean blood pressure of both groups at different points of time perioperatively

(Inj Morphine) in 24 hrs was much less in MG group (3.99±1.25mg) as compared to NS group (7.13 ± 2.68mg) (Table 2). The statistical analysis shows highly significant difference between the two groups (p <0.006). Postoperative pain assessement on VAS score was significantly lower in MG group compared to NS group (p <0.05) (Fig. 1). Perioperatively all patients remained hemodynamically stable. Heart rate and mean arterial blood pressure was noted (Fig. 2) and found to be comparable in both groups. No episode of bradycardia or hypotension was observed in any patient in both groups throughout the study period.

During the study, no side effects of magnesium sulphate were observed except for burning sensation in four patients at the injection site.

Discussion

Post operative pain is associated with physical and psychological trauma[1], it is treated with various drugs and techniques to make a patient pain free[2]. Magnesium sulphate has been tried to control perioperative pain by modifying pain mechanism. Magnesium sulphate is a noncompetitive NMDA receptor antagonist[3] having antinociceptive effects by two mechanisms: i) it prevents central sensitization which occurs due to peripheral nociceptive stimulation[4], ii) it also acts as physiological calcium antagonist by inhibiting calcium entry inside the cells at different voltage gated calcium channels by blocking NMDA receptors[5].

It has been used as an adjuvant to the analgesics

and anesthetic agents for intra and postoperative analgesia[6,7]. Intravenous administration of magnesium sulphate as bolus and intraoperative infusion during general anesthesia reduces the requirement of narcotics and anaesthetic agents with low postoperative pain score[6,7,8,9]. Comparing magnesium sulphate to fentanyl showed better intraoperative antinociceptive efficacy of intravenous magnesium sulphate[10]. Postoperative morphine requirement has been reported progressively higher following fentanyl as compared to magnesium administration[11].

Only few studies are available with the use of magnesium sulphate following regional anesthesia as compared to general anesthesia. In these studies it was observed that administration of magnesium sulphate as bolus followed by IV infusion under spinal anesthesia was associated with postoperative increased time to analgesic requirement, significantly lower pain score and lower cumulative patient controlled analgesia (PCA) drug consumption[12,13].

But observations of Ko et al were different in this regard, they did not find any reduction in postoperative cumulative analgesic dose requirement with a bolus of intravenous magnesium sulphate followed by infusion in the patients undergoing abdominal hysterectomy under epidural block[14]. The difference might be due to the short duration of infusion (6 hours) of magnesium sulphate while pain assessment was done for a prolonged postoperative period (72 hrs).

In our study, the mean time required for the achievement of a sensory, a motor blockade and their recovery in both groups was comparable. Hemodynamic parameters of both groups were also comparable and no patient developed hypotension in any group. As compared to those who received normal saline, patients who received $MgSO_4$ had a longer duration of post-operative analgesia and required lower doses of morphine. Serum magnesium levels could not be done, but no patient showed any clinical sign of hypermagnesemia. In the literature, many studies have shown that the use of magnesium sulphate in the dose of 40-60 mg kg^{-1} did not show any clinical sign of hypermagnesemia, even after infusion of magnesium sulphate for many hours[6,7,15,16]. In the presence of a normal renal function, magnesium is rapidly eliminated. Magnesium is safe to use, its toxicity begins at the concentration of 2.5-5 mmol L^{-1}, which is much higher than the levels observed (maximum level 1.5 ± 0.2 mmol L^{-1}) in other studies following magnesium sulphate administration[15,17]. In our study, we used a bolus of magnesium 50 mg kg^{-1} followed by 10 mg $kg^{-1}hr^{-1}$ infusion which was supposed to be a safe dose referring to the results of the above mentioned studies[15,17].

Thus observations of our study suggest that IV bolus (50 mg kg^{-1}) and infusion (10 mg kg^{-1} hr^{-1}) of magnesium sulphate is safe to use; it improves postoperative analgesia and reduces analgesic requirement without having any effect on onset and recovery from spinal anesthesia.

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