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Intravenous Magnesium Sulphate ($MgSO_4$) for Postoperative Analgesia in Patients Undergoing Hip Surgeries Under Spinal Anaesthesia

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Abstract

Objective: This study is conducted to assess the analgesic effects of intravenous magnesium sulphate (50 mg/kg) in hip surgeries under spinal anaesthesia. *Methods:* This prospective, randomised, double blinded control study was done on 60 patients posted for hip surgeries (Dynamic hip screw fixation, Proximal femur nailing and Hemiarthroplasty) under spinal anaesthesia. The patients were randomly divided into two groups with 30 patients each. Group S (Study) received magnesium sulphate 50 mg/kg intravenously in 250 ml Normal saline, 15 minutes before spinal anaesthesia and group C (Control) received same volume of normal saline. Hemodynamic variability, duration of analgesia and analgesic requirements were evaluated upto 12 hours after surgery. (30 minutes, 2, 4, 8 and at 12 hours). *Results:* Postoperative pain scores were significantly lower in Group S ($p<0.05$) at 2nd hour after surgery and was not significant at other time intervals. Time to first analgesic requirement was significant ($p=<0.005$) between two groups. Rescue analgesic requirement was lower in Study group compared to Control group, and was statistically significant ($p=0.009$). The two groups had no significant differences with regards to hemodynamic variability and had no side effects. *Conclusion:* Intravenous magnesium sulphate 50 mg/kg when given as a bolus reduced the postoperative pain and decreased the need of rescue analgesics after spinal anaesthesia for hip surgeries.

Keywords: Anaesthesia; Bupivacaine; Magnesium sulphate; Postoperative; Rescue analgesia.

Introduction

Postoperative pain following hip surgeries is usually severe in nature, adequate pain management in the postoperative period is essential for early rehabilitation and to improve functional recovery [2,3].

Neuroendocrine responses, catecholamine release, increased morbidity and central sensitization are thought to be among the mechanisms implicated in persistence of postoperative pain [4,5]. Excitatory amino acid transmitters such as aspartate and

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glutamate are associated with central sensitisation by activation of N-methyl-D-aspartate (NMDA) receptors [5,6].

Magnesium blocks NMDA receptor in a voltage-dependent way [7], NMDA receptor antagonists causes pre-emptive analgesia when administered before tissue injury occurs, as they prevent central sensitisation from peripheral nociceptive stimulation [8,9].

The main purpose of this study is to evaluate the efficacy of magnesium sulphate (50 mg/kg) to prolong postoperative analgesia and subsequent analgesic requirement in hip surgeries, when administered intravenously 15 minutes before induction of spinal anaesthesia.

Methods

The present study was conducted at Apollo Institute of Medical Science and Research (AIMSR), Chittoor, over a period of one year. Institutional Ethical Committee approval was obtained. Informed written consent were obtained from participating patients.

In the present randomised controlled double blinded study, 60 patients of ASA 1 and 2 undergoing hip surgeries were included. Patients with neurological, respiratory, cardiac, renal diseases, bleeding disorders, known hypersensitivity to magnesium, local anesthetics, patients on treatment with calcium channel blockers and magnesium, infection at lumbar spine were excluded from the study.

Patients were randomly assigned into two groups (30 patients each). Standard monitoring included ECG (Electrocardiogram), pulse oximetry, and NIBP (Non-invasive blood pressure).

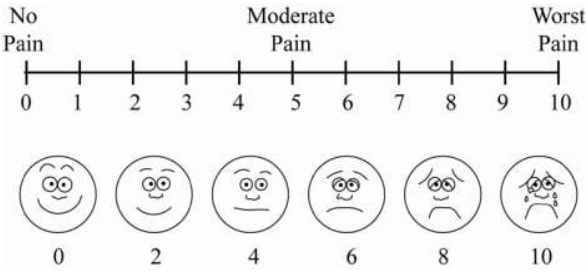
After obtaining the baseline values of hemodynamic variables, the Group S received 50 mg/ kg magnesium sulphate ($MgSO_4$) in 250 ml of Normal saline intravenously (IV) over 15 minutes before induction of spinal anaesthesia, and the Group C received the same volume of Normal saline over 15 minutes before induction of spinal anaesthesia.

An injection of 0.3 mg/kg of 0.5% hyperbaric bupivacaine was given intrathecally in L_3-L_4 interspace using 25 G spinal (quincke) needle in sitting position. The anaesthesiologist and the patient were not aware of study and control groups. Baseline Heart Rate (HR), NIBP, SpO_2 were recorded immediately after spinal anaesthesia, and at 5, 10, 15, 30, 60, 90 and at 120 minutes. Bradycardia (HR<45) is treated with atropine 0.6 mg and hypotension (mean arterial pressure <65 mmhg) treated with injection mephentermine 6 mg IV bolus. At the end of the surgery patients were shifted to postoperative ward.

The level of pain was assessed immediately after the surgery and at 30 minutes, 2,4,8 and at 12 hours post surgery, based on visual analogue score (VAS), where 0 = no pain and 10 = severe pain. Rescue analgesia (tramadol 100 mg IV) was administered when VAS score was 4 and above. Patients were monitored and managed appropriately for any side effects (nausea, vomiting, pruritus).

Descriptive statistical analysis was represented as Mean ± SD and results on categorical measurements are represented as percentages. Appropriate tests of significance like the independent t- test and chi-square test were used depending on nature and distribution of variables. Values of $p<0.05$ were considered significant.

Visual analogue scale



Results

The patient's characteristics like age, sex, height, ASA grade and anaesthetic time were matched in the two groups and they were not statistically significant. (Table 1).

Table 1: Patient characteristics and anaesthetic time. Values shown are for mean for age, or patient numbers (n) and group S for study and group C for control.

	Group S (N=30)	Group C (N=30)
Age (years)	57 (45-70)	54 (43-65)
Sex (M/F)	20/10	18/12
Height (cm)	166.5	166
Weight (kgs)	65	67
ASA 1,2	18/12	21/9
Anaesthetic time(min)	125	120

The height of spinal block achieved in the two groups were not statistically different, with average

level at T6 for Group S and T8 for Group C, whereas the time to first pain between the two groups were statistically significant (p=<0.05) with average time of 199.2 minutes for Group S and 179.2 minutes for Group C. The doses of bupivacaine used in the two groups were not statistically different (Table 2).

Table 2: Characteristics of spinal block. Values are presented as means (range) for height of spinal block or means (sd). Group S for study group and group C for control group.

	Group S (N=30)	Group C (N=30)	p Value
Height of spinal block	T6 (T4-T8)	T8 (T6-T10)	0.32
Time to first pain (min)	199.2 (41)	179.2 (38)	<0.05*
Dose of bupivacaine (mg)	15.7 (0.8)	16.08 (0.9)	0.9

The postoperative VAS score compared between the two groups was only significant at the 2nd hour with p value 0.002, whereas it was not significant at other intervals. (Table 3).

Table 3: Postoperative VAS score

Time interval	Group S		Group C		p value Chi square test
	VAS 0-3	VAS 4-6	VAS 0-3	VAS 4-6	
Immediate postoperative period	29	1	27	3	0.30
30 min	27	3	25	5	0.44
2 hours	26	4	15	15	0.002 *
4 hours	20	10	17	13	0.42
8 hours	24	06	22	08	0.54
12 hours	24	06	22	08	0.54

VAS – Visual Analogue Scale

The time to rescue analgesia between the two groups was not significant (p=0.177), whereas the rescue analgesia requirement was more in the control group and was statistically significant with p =0.009 (Table 4).

Table 4: Time for rescue analgesia

Parameter	Study, S	Control, C	p value
Time to rescue analgesia(hr),mean+/-.SD	7.5+/-4.5	4.5+/-4	0.177
Rescue analgesia (n) (%)	9(30%)	19(63%)	0.009*

Discussion

Our study showed that IV magnesium sulphate (50 mg/kg) bolus given 15 minutes before spinal anaesthesia reduced postoperative pain and rescue analgesia requirement, without any significant hemodynamic variations (Table 5).

Following hip surgeries, postoperative pain is usually severe in nature, adequate postoperative pain management is required for early rehabilitation and recovery [2,3]. Regional anaesthesia is usually preferred over general anaesthesia for lower limb surgeries for certain advantages like spontaneous breathing during intraoperative period and easy recovery. Pre-emptive analgesics before exposure to painful stimulus has shown to prevent the central sensitisation and amplification of postoperative pain [2,3].

In a study done by Prerana N. Shaw et al., shown that intravenous magnesium sulphate when given as bolus followed by infusion, delayed and decreased the need of rescue analgesics after spinal anaesthesia [1].

Our study findings were partly similar to the study done by Apan A et al. where they compared 5 mg/kg of magnesium sulphate immediately after spinal block followed by 500 mg/hr infusion in the same volumes for 24 hours showed reduced analgesic requirement in spinal aneaesthesia [10].

In a study done by Ryu JH et al., it was noted that pre and intraoperative administration of

Table 5: Patients post-operative hemodynamic variables

Time interval	Heart rate (per minute)			Blood pressure (MAP) mmhg		
	Group S	Group C	p Value	Group S	Group C	p Value
Immediate postoperative period	82	90	0.10	62	66	0.55
30 min	87	92	0.24	65	70	0.45
2 hr	75	85	0.07	62	70	0.23
4 hr	92	95	0.38	66	74	0.21
6 hr	90	98	0.0515	70	76	0.339
8 hr	95	98	0.24	68	72	0.537
12 hr	92	96	0.23	72	80	0.185

MAP = mean arterial pressure

magnesium sulphate at 50 mg/kg bolus and 15 mg/kg/hr infusion in gynaecological patients undergoing surgery under total intravenous anaesthesia reduced rocuronium requirement and improved postoperative analgesia [11].

In a study done by Dabbagh A et al., it was shown that VAS scores were significantly lower in patients receiving perioperative magnesium undergoing lower limb orthopaedic surgery [12].

In the present study, VAS score was significantly lower in Group S ($p<0.002$) at postoperative 2nd hour. Rescue analgesia requirement was significantly lower ($p=0.009$) in Group S when compared to Group C and there was significant difference between two groups with regards to time to first analgesic requirement ($p=<0.05$). There was no significant difference between the Group S and Group C in terms of height of spinal block. There was no significant hemodynamic variation in the two groups in postoperative period and there were no complications.

Conclusion

Intravenous magnesium sulphate 50 mg/kg when given as a bolus reduced the postoperative pain and decreased the need of rescue analgesics after spinal anaesthesia for hip surgeries.

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