

A Single Preoperative Dose Of Intravenous Magnesium Sulfate In Lower Limb Surgeries For Postoperative Pain Relief – A Boon Or A Bane

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Abstract

Background –Post operative pain scores and post operative analgesic requirement were reduced with single intravenous dose of Magnesium sulfate. The present study focuses on the same issue with regard to lower limb surgeries.

Materials and Methods – Forty patients in the age group between 22 – 57 years of ASA grade I or II were randomly divided into two groups M and C of 20 each. In Group M, magnesium sulfate (50mg/kg) was given as a single intravenous infusion in 100ml Normal Saline over 15 mins preoperatively. In Group C, 100ml of plain NS was given as an intravenous infusion. General Anaesthesia(GA) was induced with Thiopentone Sodium (5mg/kg) and Intubation was done with a tube of suitable size with Vecuronium bromide (0.1mg/kg). Intra operative analgesia is facilitated by Fentanyl (2 µg/kg). In the both groups, patients were reversed with Neostigmine (0.05 mg/kg) and Glycopyrrolate (0.01mg/kg). Patients were assessed at recovery from anesthesia with VAS scores and also at 2, 4, 6, 8, 12 and 24 hours postoperatively.

Result – In Group M, the 1st dose of rescue analgesic was administered between 6th – 10th postoperative hrs and 2nd dose between 16th – 19th postoperative hrs whereas in Group C, 1st dose was given between 2nd – 4th postoperative hrs, 2nd dose between 8th – 12th postoperative hrs and 3rd dose between 20th – 22nd hrs.

Conclusion – It was observed that VAS scores were low in Group M in comparison with Group C. Also it was observed that there was a decreased post operative analgesic requirement in Group M with long intervals between I and II doses of post operative analgesics.

INTRODUCTION

Magnesium is the second most available intracellular cation and ranks fourth in the body. It is present in high concentrations in the bone and skeletal muscle amounting to approximately 70% of the total. Magnesium ions are involved as a cofactor in many enzymatic reactions in the body and is also involved in several important processes such as hormone receptor binding, gating of calcium channels, transmembrane ion flux, regulation of the adenylcyclase system, neuronal activity, vasomotor tone, cardiac excitability and neurotransmitter release¹.

Magnesium is useful in the treatment of eclampsia and pre-eclampsia, hypokalemia, premature labor, for protection of myocardium after ischemia, asthma crisis, postoperative

acute pain control and also for hemodynamic stability during intubation in clinical practice²⁻⁶.

Magnesium is a calcium channel blocker and is also a NMDA receptor antagonist. Previously Magnesium sulphate has been used as a possible adjuvant for intra- and postoperative analgesia. The majority of these studies suggest that perioperative magnesium sulphate reduces anaesthetic requirements and improves postoperative analgesia, but most of these studies used continuous administration of magnesium sulfate⁷⁻¹¹.

Very few studies have emphasized on the importance of usage of single dose of magnesium sulfate in intraoperative period and its effects in the postoperative period¹².

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The present study has been designed as a randomized placebo controlled prospective study to evaluate the efficacy of a single preoperative dose of intravenous magnesium sulfate to reduce post operative pain in lower limb surgeries.

MATERIALS AND METHODS

The study was approved by local ethical committee and was performed according to the declaration of Helsinki.

The study was conducted on 40 patients of both the sexes, between the age group of 22-57 years, who were randomly sorted out into the two study groups of 20 each (table 1).

American society of Anaesthesiologist's (ASA) grade I/II cases were included for the study. Patients on treatment for uncontrollable diabetes, hypertension, those with renal and hepatic dysfunction, those having a history of epilepsy, patients diagnosed with muscular dystrophies, pregnant women have been excluded from the study.

Patients were informed about the purpose and protocol of the study and a written consent was obtained. Baseline heart rates, blood pressure, oxygen saturation, ECG were noted. The patients in Group M were administered 50 mg/kg body weight (wt) of magnesium sulfate in 100 ml of isotonic saline IV 30 mins before the administration of anesthesia and the patients in Group C were administered 100 ml of isotonic saline IV 30 mins before initiation of anesthesia by an anesthesiologist who was independent of the study and was blinded by its proceedings. The patients were premedicated with Inj Ondansetron 4mg IV, Inj Glycopyrrolate 0.2 mg IV and fluids were started. Induction was initiated with inj Thiopentone sodium 5 mg/kg, inj Fentanyl 2 µg/kg. Endotracheal intubation was facilitated with the use a non depolarizing muscle relaxant Inj Vecuronium bromide 0.1 mg/kg. The patient was maintained on N₂O and O₂ mixture and maintenance doses of Inj Vecuronium bromide as required. At the end of the surgery, patient was reversed with Inj Neostigmine 0.05 mg/kg and Inj Glycopyrrolate 0.01 mg/kg and extubated on table.

The patients were assessed for pain at recovery from anesthesia and then in the post operative ward by using Visual Analog Scale 0(no pain) to 10(worst pain) at 2hrs, 4hrs, 6hrs, 8hrs, 12hrs, 24hrs postoperatively. In all the cases, rescue analgesic was administered if the VAS score was > 3. Inj Tramadol 2 mg/kg IV was given. If there was an additional demand for analgesic, it was met with IM Diclofenac Sodium 75mg and Inj Paracetamol 1 gm IV as a 3rd dose of rescue analgesic. The timing, dose and total

consumption of rescue analgesics during the first 24 hrs of the postoperative period were noted.

RESULTS

There was no difference in Groups M and C in terms of the basic variables such as age, sex and duration of surgery. The patients' VAS score, duration of pain free period and timing of the next dose of analgesic were assessed.

It was observed that on recovery from anesthesia, pain scores were less in Group M as compared to Group C but none of the cases in group C also required rescue analgesic (table 2). It was in the 2nd postoperative hour that 16 out of 20 patients in Group C had VAS Score 3 (p value < 0.0000001). All of them were administered rescue analgesic. At the same time, most of the patients in Group M were comfortable and tolerating pain well and none of them required any analgesic.

At the end of 4th postoperative hour, 19 out of 20 patients in Group C had VAS Score of 3 and everyone had been given a dose of rescue analgesic by then. All the patients in Group M had VAS Score < 3 (p value < 0.0000001) and everyone was comfortable. In the present study, at the end of 6th postoperative hour, 9 out of 20 patients from Group M had a VAS Score of 3 (p value < 0.0000001) and in need of rescue analgesic. 6 out 20 patients in Group C who had already been given a dose of rescue analgesic had a VAS Score of 4, but were tolerating the pain well. The rest in that group had a VAS Score of 3.

In the 8th postoperative hour, remaining 14 out of 20 patients in Group M had a VAS Score of 3 (p value < 0.0000001) and were given 1st dose of rescue analgesic. Meanwhile, 6 of the patients in Group C had a VAS score of 5 and were given a 2nd dose of rescue analgesic. Almost all the patients in Group C needed a 2nd dose of rescue analgesic between 8th and 12th postoperative period in comparison with group M patients who were comfortable with a single dose till then.

A demand for a 2nd dose of rescue analgesic arose in Group M between 16th and 19th postoperative hour and almost all of them were administered with a 2nd dose of rescue analgesic. In Group C, there was a need for administration of a 3rd dose of analgesic between 20th and 22nd hr of postoperative period when the VAS Scores was 5. Inj Paracetamol 1gm IV was administered.

Thus, on an average, Group M was administered the 1st

dose of rescue analgesic between 6th – 10th postoperative hrs and 2nd dose between 16th – 19th postoperative hrs whereas in Group C 1st dose was given between 2nd – 4th postoperative hrs, 2nd dose between 8th – 12th postoperative hrs and 3rd dose between 20th – 22nd hrs.

None of the cases landed in delayed recovery or required any postoperative mechanical ventilation.

DISCUSSION

Many authors have studied the role of magnesium sulfate for postoperative analgesia. Tramer MR et al. have performed a randomized, double blind study, in which they showed that the perioperative application of magnesium sulfate is associated with smaller analgesic requirement, lesser discomfort, and a better quality of sleep in the postoperative period but not with adverse effects¹³.

Present study establishes that intravenous magnesium sulfate administration given before induction of anesthesia for orthopedic surgery of the lower extremities significantly reduces pain and total requirement analgesics in the first few hours after the surgery.

The pain scores in both groups immediately after extubation, were nearly equal and none of the patients required any rescue analgesic. This implies patients were still covered by the analgesic effect of fentanyl that was given during surgery.

Patients with magnesium sulfate administration required first dose of analgesic at a longer interval, nearly thrice the duration required by the control population. The patients also needed less dosage of analgesic, as none of the patients with magnesium sulfate administration required third dose of rescue analgesic.

Postoperative complications including behavioral changes like irritability, burning sensation at the site of surgery, positional discomfort were none in magnesium sulfate group. This could be attributed to blockage of the N-methyl-D-aspartate receptor and its associated ion channels, which prevent central sensitization caused by peripheral nociceptive stimulation

T. Fuchs-Buder et al, T. Okuda et al and H. Hino et al have investigated the interaction between magnesium sulfate 40 mg /kg i.v. and vecuronium in their studies and ascertained that the neuromuscular potency of vecuronium was increased by pretreatment with magnesium sulfate, in

addition to modifying the time course of its neuromuscular block^{14,15}. As the present study focused only on post-operative analgesia it was not being investigated.

Magnesium, which is an antagonist of the NMDA receptor and a physiological calcium channel blocker, has analgesic properties in acute and chronic pain conditions. Herbert Koinig et al stated that preoperative magnesium administration also reduces intraoperative analgesic requirements by stating lesser usage of fentanyl compared to control group¹⁶.

Dabbagh and others observed that magnesium sulfate can serve as a supplementary analgesic leading to less morphine consumption in postoperative period in patients undergoing orthopaedic surgery under spinal anesthesia¹¹. But we have used general anesthesia to eliminate the masking effect of spinal anesthesia (residual spinal anesthesia and analgesia mask the effect of magnesium sulfate postoperatively).

Levaux et al have reported that magnesium sulfate boluses were effective for post operative pain relief after orthopaedic surgery⁸. However, they used continuous infusion or repeated bolus in addition to initial bolus of magnesium sulfate in their studies in comparison to single bolus of magnesium sulfate in our study. There was no need for repeated bolus or continuous infusion of magnesium sulfate for postoperative pain relief in the present study.

In addition, Wadhwa and colleagues suggested that magnesium sulphate infusion reduces the shivering threshold in humans, and i.v. magnesium sulphate has been studied previously to suppress post-anaesthetic shivering. Shivering causes discomfort and aggravates postoperative pain and the prevention of shivering may attenuate postoperative pain and enhance patient's satisfaction. None in either group had shivering in the present study.

The effects of pre-treatment with intravenous magnesium sulfate have shown to decrease cardiovascular responses and catecholamine release associated with tracheal intubation as was observed by Michael F. M. James et al¹⁸. The same was also found in the present study.

The limitation of the study was the inability to measure serum magnesium levels at any point of time during the surgery. Only VAS score was used to assess the pain grading and it is not entirely reliable as it is subjective in nature.

In conclusion, preoperative administration of intravenous

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magnesium sulphate (50 mg/ kg) in orthopedic patients receiving GA, significantly reduced analgesic requirement after operation. In addition, preoperative magnesium sulphate administration attenuated the increase in arterial pressure after intubation and surgery, reduced postoperative nausea and vomiting, shivering and also improved patient satisfaction scores. Thus, it can be concluded that a single intravenous dose of magnesium sulfate given preoperatively is efficient for postoperative pain relief with increasing time intervals between successive rescue analgesics.

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