

Effect of single low dose of magnesium sulphate on postoperative pain in lower abdominal surgeries for patients receiving general anesthesia

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Abstract: Background: Magnesium sulphate has been used for many years in cardiologicalland obstetric issues. There are another uses for magnesium sulphate such as analgesic effect. **Objective:** This randomized, double-blind, prospective study was done to evaluate the effects of magnesium sulphate on postoperative pain in patients undergoing lower abdominal surgeries after receiving general anesthesia. **Patients and Methods:** Block randomization method was used to generate a random list. The magnesium group (n=20) received 50 mg/kg of magnesium sulfate in 100 mL of normal saline solution “isotonic saline” given intravenously (single low-dose), just 15 minutes before the induction of balanced general anesthesia. Patients in control group (n=20) received 100 ml of 0.9% sodium chloride solution given intravenous at the same time. Pain was evaluated with Numeric Rating Scale (NRS) with 10 cm length (starting from 0, no pain, to 10, worst pain) was evaluated at 6, 12, and 24 hours after the surgeries and compared in both groups. Also, hemodynamic parameters (NIBP and HR) were recorded every 6 hours interval for 24 hours. **Results:** NRS (Numeric Rating Scale) with 10 cm length (starting from 0, no pain, to 10, worst pain) was evaluated at 6, 12, and 24 hours after the surgeries and compared in both groups and results was represented by column chart. Also, mean arterial pressure and heart rate were recorded preoperatively as baseline, after infusion of magnesium sulphate, after induction of anesthesia, 6 hours, 12 hours and 24 hours postoperatively. There were no significant differences in Heart rate (HR) between two groups at base line. HR increase after infusion of magnesium and started to decrease after induction of anesthesia in both groups, but still higher in magnesium group while after 24 hours HR decreased in magnesium group and still high in control group. **Conclusion:** The preoperative administration of single low dose of magnesium sulphate was a safe and effective method in the management of postoperative pain after lower abdominal surgery.

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Key words: Magnesium sulphate, pain; surgery

1. Introduction

Inadequate controlled acute pain has adverse effects on many physiologic systems including the cardiovascular, pulmonary, gastrointestinal, immunologic, renal, and hematologic systems (*Ramirez, 2012*). Surgical stress especially lower abdominal surgeries causes release of cytokines (e.g., interleukin-1, interleukin-6, and tumor necrosis factor- α) and precipitates adverse neuroendocrine and sympathoadrenal responses, resulting in detrimental physiological responses, particularly in high-risk patients (*Joshi and Ogunnaike, 2005*). Optimal postoperative pain relief is not only needed for patients comfort and satisfaction but also to facilitate their early mobilization and rehabilitation. Moreover, optimal postoperative pain relief has been found to be associated with less postoperative cognitive impairment, enhanced quality of life, reduced risk of chronic/persistent post-surgical pain with better overall outcome and reduced clinical expenses (*Baral et al., 2010*).

The mechanism of the analgesic effect of Mg is due to interference with calcium channels and N-methyl-D-aspartate (NMDA) receptor (*Woolf et al., 2005*). It seems that analgesic mechanism of NMDA-antagonists is made by preventing nociceptive central sensitization. Another suggesting mechanism is the role of it on reduction of catecholamine release with sympathetic stimulation, thereby decreasing peripheral nociception or the stress response to the surgery (*Haryalchi et al. 2013*). Data illustrate that the NMDA receptor antagonists “like Mg sulfate” have an effect on pain threshold and could prevent pain perception even with low doses. (*Tramèr M. R et al., 2007*).

We made this report on a clinical trial that tested the effect of a single low dose of magnesium sulfate on postoperative pain in patients undergoing lower abdominal surgeries.

2. Patients and Methods

After obtaining the Research/Ethics committee approval and written informed consent from the patients, prospective, randomized, single-blinded and

controlled study was done on forty adult patients including both gender with ASA physical status class I or II, aged 18-40 years who were going to have elective lower abdominal surgeries under general anesthesia such as (inguinal hernia repair) at Al-Azhar University hospitals. The patients were allocated randomly to one of two equal groups using a computer-generated list. The magnesium group received a 15min infusion of magnesium sulphate (50mg/kg in 100 ml of 0.9% saline) just before induction. The control group received a 15 min infusion of 100 ml of 0.9% saline.

After 3-5 minutes of preoxygenation, all patients received fentanyl (2µg/kg), after 2 minutes, Propofol was given (2mg/kg) throughout 60- 90 seconds, and the endotracheal intubation facilitated with Atracurium (0.5 mg/kg).

After tracheal intubation, anesthesia was maintained with 1.2% Isoflurane in O₂ via a closed circuit system. Mechanical ventilation was provided by Dragger anesthesia machine. The respiratory rate and tidal volume were adjusted to maintain the end-tidal CO₂ around 35mmHg. Neuromuscular blockade was maintained with atracurium (5mg/20 minutes), Incremental doses of fentanyl were administered if there were any signs of sweating, lacrimation, or 20% increase in heart rate or blood pressure. At the end of surgery, inhalational anesthesia was stopped, then the residual neuro-muscular block was reversed with Neostigmine (0.05 mg/kg) and Atropine (0.02 mg/kg). When the patient fulfilled extubation criteria, the

endotracheal tube was withdrawn and patients were transferred to the PACU. Hemodynamic parameters (NIBP and HR) were recorded every 6 hours interval for 24 hours. Time to first post-operative analgesic requested and total analgesic consumption at first 24hours post-operative were recorded. Numeric rating scale (NRS) were recorded every 6 hours during the first 24 hours Postoperatively. Pain was assessed by numeric rating scale (NRS) 10 cm length (starting from 0 of no pain, to 10 of worst pain).

Statistical Analysis was performed using the statistical package SPSS version 21. Data were summarized using mean, standard deviation (SD), median, minimum and maximum for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between groups were done using unpaired t-test in normally distributed quantitative variables while non-parametrical Mann-Whitney test was used for non-normally distributed variables. For comparing categorical data, Chi square test was performed. P-values less than 0.05 were considered as statistically significant.

3. Results

A total of 40 patients were included in this study with ASA I or II, aged 18-40 years, scheduled for elective lower abdominal surgeries. There were randomized into two groups. The two groups gave no statistically significant difference for demographic parameters.

Table (1): Demographic data of patients in two magnesium sulfate and saline groups.

Variables		Groups		P value
		Control group N = 20	Magnesium sulphate group N = 20	
Age (years)		37.85 ±5.39	35.45±5.74	0.431
Weight (Kg)		76.55±11.05	78.85±12.21	0.829
sex	male	60%	55%	0.732
	female	40%	45%	
Duration of surgery (hours)		1.55 ± 0.20	1.53 ± 0.23	0.718

Pain scores using numerical rate scale (NRS) decreased in magnesium sulfate group, compared with

normal saline group at 6, 12, and 24 hours after the surgeries (**Table 2**).

Table (2): The comparison of numerical rate scale (NRS) mean in different time between two groups over 24 hours.

Groups		Control group N = 20	Magnesium sulfate group N = 20	P value
(NRS)				
After 6 h		9.80 ± 0.62	6.45 ± 1.05	0.0001
After 12 h		7.80 ± 1.11	5.90 ± 0.79	0.0001
After 24 h		5.90 ± 0.45	4.60 ± 0.94	0.102

Mean arterial pressure (MAP) and heart rate (HR) were recorded preoperatively as a baseline, after infusion of magnesium sulphate, after induction of

anesthesia, 6 hours, 12 hours and 24 hours postoperatively.

There were no significant differences in HR between two groups at base line, i.e (81.033±5.54) in control group vs. (82.8±4.029) in magnesium group, HR increase after infusion of magnesium and started to decrease after induction of anesthesia in both

groups but still higher in magnesium group (78.133±3.89) vs. (74.4±5.21) in control group (P-value 0.003) while after 24 hours HR decrease in magnesium group (79.966±2.94) and still high in control group (87.06±4.92) (P-value<0.001 - table 3).

Table (3): Comparison between heart rate of two groups:

Parameters	Groups		P-value
	Control group N=20	Magnesium Sulphate group N=20	
HR base	81.033±5.54	82.8±4.029	0.164
HR after infusion of magnesium sulphate	80.16±5.766	89.200±5.21	0.001
HR after induction	74.4±5.21	78.133±3.89	0.003
HR after 6 hours	85.466±6.27	81.866±3.84	0.058
HR after 12 hours	88.33±5.22	85.666±3.54	0.155
HR after 24 hours	87.06±4.92	79.966±2.94	0.001

There were no significant changes in (MAP) at base line. However, after induction, MAP decreased in magnesium group more than control group. After 12

hours MAP in magnesium group still lower than control group (Table 4).

Table (4): Comparison between mean arterial pressure of two groups:

Parameters	Groups		P-value
	Control group N=20	Magnesium Sulphate N=20	
MAP base	74.76±3.58	75.93±4.01	0.240
MAP after infusion of magnesium sulphate	74.26±3.60	70.93±3.91	0.001
MAP after induction	71.86±4.34	64.66±3.45	0.001
MAP after 6 hours	78.33±3.83	68.43±3.07	0.001
MAP after 12 hours	80.166±4.60	70.9±4.60	0.001
MAP after 24 hours	79.76±4.81	70.26±5.04	0.001

4. Discussion

Our study has demonstrated that IV infusion of magnesium sulfate (50 mg/kg in 100 mL of normal saline solution), just 15 minutes before the induction of balanced general anesthesia, alleviates postoperative pain throughout the first day after lower abdominal surgeries. Furthermore, opioid consumption has been reduced over that time after the surgeries with no report of nausea, vomiting, hypotension, or hypermagnesemia. Pain after lower abdominal surgeries can be multifactorial. Incision pain, pain from deeper (visceral) structures, and, particularly, dynamic pain, such as during straining, coughing, or mobilizing, can be quite severe. Opioids remain the common analgesic drugs after abdominal surgeries but their adverse effects such as respiratory depression, nausea, and vomiting or hypotension make this category of drugs undesirable (Hines, 2012).

Parenteral Mg sulfate has been used for a long time in obstetric and cardiovascular practices, but its role as an adjuvant analgesic during preoperative period specially after lower abdominal surgeries has been in negotiation (Lysakowski, 2007). As Mg sulfate is a CNS depressant, sedation should be carefully monitored postoperatively. Low doses of Mg sulfate

dose not interact with non-depolarizing muscle blockers (NDMB); thereby it could be its advantage. Muscle relaxant property of Mg depends on the decrease in acetylcholine release at the presynaptic level of the neuromuscular junction (Ozcan, 2007).

There have been numerous studies on the clinical efficacy of magnesium sulfate on postoperative pain relief that have shown conflicting results. Lysakowski and colleagues (2007) in a systemic review randomized trial reached different conclusions as to whether Mg is a useful adjuvant to postoperative analgesia. Their trials do not provide convincing evidence that perioperative Mg has favorable effects on postoperative pain intensity and analgesic requirement. In our study, results were different, and preoperative small bolus dose of Mg sulfate reduced postoperative pain scores significantly. Maybe, the source of difference was for the different method of administration.

Mavrommati and Colleagues (2004) assessed the infusion of low dose Mg sulfate in hernioplasty and concluded that preventive lower bolus doses of Mg sulfate are an effective adjuvant for perioperative analgesic management. Ryu and Colleagues (2008) in a randomized double-blinded study assessed the effect

of Mg sulfate on intraoperative anesthetic requirement and postoperative analgesia in gynecologic patients who underwent TIVA (total intravenous anesthesia) and concluded that IV Mg sulfate improves the quality of postoperative analgesia during TIVA. Results were the same of ours, but maybe the difference was for use of TIVA against balanced general anesthesia. **Kiran and Colleagues (2011)** evaluated the efficacy of single-low-dose of IV Mg sulfate for prevention of postoperative pain after inguinal surgery and concluded; it could decrease post operative pain and equivalent of rescue analgesia. On our study throughout the first 24 hours after the surgeries, NRS was lower in Mg sulfate group compared to the control one significantly. There was not any evidence of nausea and vomiting, hypotension or hypermagnesemia. Also MAP was lower in Mg sulphate group than control group, this Hypotensive effect of Mg explained with its direct vasodilating effect through the calcium channel blockade and rarely observed with Mg up to 60 mg/kg (**Albrecht E, Anaesthesia, 2013**).

Conclusion

We found that preventive doses of Mg sulfate could be useful as an adjuvant drug for lower abdominal surgeries under balanced general anesthesia.

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