The Beneficial Effects of Adding Magnesium Sulphate to General Anesthesia for Laparoscopic Sleeve Gastrectomy


Department of Anesthesia and Intensive Care, Al-Ansar Private Hospital, Jeddah, KSA [Department of Anesthesia and Intensive Care, Damietta Faculty of Medicine, Al-Azhar University, Egypt1], Department of Anesthesia and Intensive Care, Damietta Faculty of Medicine, Al-Azhar University, Egypt[2].

Corresponding author: Mahmoud
Email: gaballehmd@yahoo.com
Received at: August 18, 2020; Revised at: October 20, 2020; Accepted at: October 29, 2020

DOI: 10.21608/ijma.2020.121320

ABSTRACT

Background: Obesity is a notable health issue. It was estimated that, about 700 million were obese. Some call this trend as the “New World Syndrome”.

Aim of the work: To compare between intravenous injections of one to two grams of magnesium sulphate [MgSO₄] in patients scheduled for elective laparoscopic sleeve gastrectomy.

Patients and methods: It is a multicenter study, which included 800 patients, who were scheduled for elective laparoscopic sleeve gastrectomy under general anesthesia; all patients were randomly grouped into two equal groups [n = 400]. First group for one gram and second group for two grams of MgSO₄ over 10 minutes immediately after induction of anesthesia and before starting surgery. Then, all were assessed postoperatively for different variables.

Results: The duration of full recovery was significantly shorter, intensive care unit admission and post-operative pain immediately after recovery till the end of first 18 hours, was lower in M 2 when compared to M 1 group. Postoperative respiratory depression, nausea and vomiting were significantly decreased. Number of early ambulation was significantly increased, while length of stay was significantly reduced in M 2 group. Intraoperative bleeding and pain after 18 hours showed non-significant difference between both groups. Postoperative bleeding reported in two patients in M 2 group and returning to operating room again within 6 hours and managed by blood transfusion and surgical laparoscopy. No patients suffered from deep vein thrombosis or any other complications.

Conclusion: Adding MgSO₄ to general anesthesia in laparoscopic sleeve gastrectomy had beneficial effects which increased by increasing the dose from one to two grams.

Keywords: General Anesthesia; Obesity; Magnesium sulphate; Laparoscopic; Sleeve gastrectomy.

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Please cite this article as: Ali MGM, Ragab ASM, Diab AAA. The Beneficial Effects of Adding Magnesium Sulphate to General Anesthesia for Laparoscopic Sleeve Gastrectomy IJMA 2021; 3[1]: xxx-xxx [Article in Press]. DOI: 10.21608/ijma.2020.121320
INTRODUCTION

Obesity in North Africa and the Middle East is a notable health issue. It was estimated that at 2015, 2.3 billion people were overweight and 700 million were obese\[^2\]. The lifestyle changes associated with the discovery of oil and the subsequent increase in wealth is one of the contributing factors. The overweight or obesity is defined as “Excessive fat accumulation that may impair health”\[^2\].

It is estimated by calculation of the Body Mass Index [BMI]. BMI is defined as the sum of dividing person’s weight [kilograms] by the subject’s square of height in meters. BMI from 25 to 29 kg/m\(^2\) is assigned for overweight, while BMI ≥ 30 kg/m\(^2\) indicating obesity. Increased BMI is associated with increased risk of medical diseases as a result of obesity. These chronic disease comorbidities include gastrointestinal [GIT] problems\[^3\], cardiovascular [CV] diseases\[^4\], diabetes\[^5\], musculoskeletal disorders, cancer, and premature death\[^6\].

During the past years, innovations in surgical techniques, such as laparoscopic sleeve gastrectomy had allowed a large population the opportunity to receive treatment for their disease\[^9\]. However, it remains a highly challenging task for anesthesiologist, because of the anatomic and physiological implications and pharmacological alterations associated with obesity. This stresses reflected the importance of anesthesia, anesthetic technique and of postoperative [PO] analgesia to permit early ambulation and the ability to restore normal breathing. In such cases, anesthesia is usually described as beneficial or not; however, several subjects and techniques must be discussed and investigated to increase the effectiveness of anesthetic interventions and provide an optimal peri-operative care\[^7\]-\[^8\].

Using adjuvants could provide such benefits. However, its type and dose are of crucial importance to achieve the high benefit with low side effects.

AIM OF THE WORK

To compare between intravenous injections of one to two grams of magnesium sulphate [MgSO\(_4\)] in patients scheduled for elective laparoscopic sleeve gastrectomy

PATIENTS AND METHODS

This study included 800 patients of ASA I–II classes, aged between 20 and 60 years with BMI ranged between 40-70kg/m\(^2\) assigned for elective laparoscopic sleeve gastrectomy. They were selected from Al-Ansar Hospital [Kingdom of Saudi Arabia] [400 patients], Al-Azhar University Hospital [Damietta] [160 patients], and Dar-Al-Hyah Private Hospital [Damietta] [240]. They were enrolled into the study between January 2016 and January 2020.

Exclusion criteria were allergy to MgSO\(_4\) or any other study drug, renal, hepatic, or CV dysfunction, neurological disorders, atrioventricular conductance disorders, analgesic or opioid abuse. Also, any patient under treatment with calcium channel blockers were also excluded.

Ethical Considerations: The study protocol was approved by the ethical research committee of Al-Ansar Hospital [KSA], and written informed consent was obtained from all patients.

Surgery was performed by the same surgical and same anesthesia teams under general anesthesia for all patients. All patients were randomly [by closed envelope method] grouped into two equal groups [n = 400]. In the M1 group, all patients received intravenous [IV] one-gram of magnesium sulphate [MgSO\(_4\)] in 100 ml of isotonic saline over 10 minutes immediately after induction of anesthesia before starting surgery; while patients in the M2 group received IV two grams of MgSO\(_4\) in 100 ml of isotonic saline over 10 minutes immediately after induction and before starting surgery.

Pre-anesthetic evaluation was performed up to one week before surgery and fitness for anesthesia was given with further instructions regarding medication. On the day of surgery, patients were wheeled into the operation theatre and IV access was obtained with 18 or 16-gauge intravenous cannula. Electrocardiogram [ECG] and noninvasive arterial pressure [using large size blood pressure [BP] cuff which encircled ¾ of the upper arm], pulse oximetry monitoring was established. Electrodes were placed on the forehead to monitor bispectral index [BIS] [A-2000 BIS TM monitor, Aspect Medical Systems Inc., Natick, MA, USA] and neuromuscular block was monitored at the wrist using a peripheral nerve stimulator [TOF Watch

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Patients were pre-medicated with intravenous Ondansetron [8 mg], low molecular weight heparin [LMWH] [clexan 40 IU] subcutaneous below umbilicus, intravenous paracetamol two grams, 10 minutes before induction. Bolus injection of Fentanyl [1 μg/kg of total body weight [TBW]] and preoxygenation with 100% oxygen had been carried out for five minutes. Anesthesia was induced with injection Propofol [1.5-2 mg/kg of TBW], tracheal intubation after administration cis-atracurium [0.1 mg/kg of TBW]. After intubation all pressure points were adequately padded. The surgery was performed in anti-Trendelenburg position; patients were restrained properly to prevent slipping from operation table. Volume-controlled ventilation was applied with FiO2 of 50% of 0.6-1.0 liter flow with positive end expiratory pressure [PEEP] of 3-5 cm H2O [low flow 0.6 to one LO2 50% + N2O 50% + sevoflurane].

Intra abdominal pressure maintained between 12 to 15 mmHg. In addition, deep venous thrombosis [DVT] prophylaxis with DVT pump machine was applied to bath legs. End tidal carbon dioxide [ETCO2] was maintained between 35-40 mmHg, and arterial oxygen saturation [SpO2] between 95%-100%. Both blood pressure and heart rate were maintained at 20% of baseline value.

Intra-operatively, a gastric boogie was pushed into the stomach at the time of sleeve resection. At the end of the procedure residual neuromuscular block was reversed with injection of neostigmine 0.04 mg/kg and atropine sulphate 0.01 mg/kg. Tracheal extubation [BIS value of 70] was performed when the patients showed adequate clinical signs of reversal of neuromuscular block. After the operation, the patients were transferred to the recovery room in semi-sitting position with oxygen mask ventilation and with full monitoring. The consciousness score was evaluated every five minutes by the modified Aldrete score [0: not responding, 1: arousable with minimal stimulation, and 2: fully awake] until ready for discharge from the recovery room to surgical ward or post-anesthetic care unit [PACU].

Post operative pain relief was provided with local anesthetic wound infiltration of port site with 0.125% bupivacaine hydrochloride and intravenous paracetamol [Perphalgan; 1 gm/8 hours]. Oral fluids were started on the next day. DVT prophylaxis with LMWH was continued for the first 48 hours after surgery and provided till the patient was discharged from the hospital.

Early post-operative recovery and incidence of intensive care unit [ICU] admission, intensity of pain after full recovery in the recovery room assessed by using visual analog scale [VAS- scoring range 0 to 10] every 6 hours in the next 24 hours, incidence of any intra operative or post operative complication [like post operative respiratory depression, postoperative nausea and vomiting [PONV], intraoperative or postoperative bleeding or DVT]. In addition, early ambulation [unassisted mobility within 8 hours postoperatively] and length of hospital stay [LOS] were recorded. Lastly the surgeon and patients’ global satisfaction levels regarding comfort and quality of pain control were assessed using a five-point Likert scale [one: very unsatisfactory, and five: excellent].

All these data in addition to the demographic characteristics of the patients were analyzed using statistical package for social science [SPSS] software, version 20 [IBM®SPSS® statistics, One-New Orchard Road Armonk, New York 10504-1722]. For comparison between groups, independent samples student “t” test was used, while Chi square was used to compare between qualitative groups. Repeated measures [ANOVA test] were used to test variability over time. Values were expressed as counts, and percentages [for qualitative data], arithmetic mean and standard deviation [SD] for numerical data. P value <0.05 was considered statistically significant.

RESULTS

The results of analyses showed that, there were no significant differences between both groups regarding to age, sex, BMI or duration of operation [Table 1]. The duration of full recovery was significantly short in M 2 group [15±7 minutes], while in M 1 group it was [32 ±7 minutes]. Also, the incidence of intensive care unit [ICU] admission was significantly reduced in M 2 group [8 patients, 2%] while in M 1 group it was 33 patients [8.25%] [Table 2].

Regarding the mean value of pain immediately
after recovery in M2 and M1 groups, it was 2±1, and 5±2 respectively [P < 0.001]. After 6 hours, it was 3±1 an in M2 group and 6±1 in the M1 group [P < 0.001]. After 12 hours, it was 4±2 in the M2 group and 4±2 in the M1 group [P < 0.001], while at 18 hours postoperatively, it was 3±1 in M2 group and 3±2 in M1 group with no significant difference. It 24 hours, it was 1±1 in M2 group, and 2±1 in M1 group, with no significant difference [Table 3]. Intra- 
and post-operative complications revealed that, there was no significance difference between 
groups, regarding intraoperative bleeding [2.5% vs 1.5% in M2 vs M1 respectively]. However, there 
was significant reduction in post-operative respiratory depression in M2 when compared to M1 
group [2% vs 10.0% respectively]. Also, there was significant reduction in postoperative nausea and 
vomiting [PONV] in M2 than M1 group [5% vs 37.5% respectively]. Post operative bleeding was 
reported in two patients in [M2] group and managed by returning to operating room within six hours, had 
blood transfusion and surgical laparoscopy. No patient suffers from deep vein thrombosis [DVT] or 
any other complication [Table 4].

Early ambulation and length of stay [LOS] revealed that, early ambulation was significantly 
higher in M2 when compared to M1 group [67.5% vs 35.0% respectively]. In addition, LOS was 
significantly shortened in M2 when compared to M1 group [1.0±0.5 vs 2.3±1.0 days respectively] [Table 
5].

The level of surgeon and patient satisfaction, it was high in M2 when compared to M1 group 
[Figure 1].

<p>| Table 1: | Comparison of age, sex, BMI and duration of operation between the two groups |</p>
<table>
<thead>
<tr>
<th>Age [years]Mean ± SD</th>
<th>M1</th>
<th>M2</th>
<th>Test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>42.6±12.4</td>
<td>41±12.3</td>
<td>1.74</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>170 [42.5%]</td>
<td>159[39.5%]</td>
<td>0.62</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>230 [47.5%]</td>
<td>241[60.5%]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI [kg/m²]</td>
<td>52±8</td>
<td>51±12</td>
<td>1.23</td>
<td>0.21</td>
</tr>
<tr>
<td>Operation time [minutes]</td>
<td>72±15</td>
<td>71±17</td>
<td>0.34</td>
<td>0.66</td>
</tr>
</tbody>
</table>

<p>| Table 2: | Comparison of duration of full recovery and incidence of ICU admission between the two groups |</p>
<table>
<thead>
<tr>
<th>Duration of full recovery, [min.]</th>
<th>M1</th>
<th>M2</th>
<th>Test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 ±7</td>
<td>40.91</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence of ICU admission</td>
<td>33[8.25%]</td>
<td>8[2%]</td>
<td>16.06</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

<p>| Table 3: | Comparison mean value of pain between the two groups |</p>
<table>
<thead>
<tr>
<th>Immediately after recovery</th>
<th>M1</th>
<th>M2</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 ± 2</td>
<td>2 ± 1</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>After 6 H</td>
<td>6 ± 1</td>
<td>3 ± 1</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>After 12 H</td>
<td>4 ± 2</td>
<td>3 ± 2</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>After 18 H</td>
<td>3 ±2</td>
<td>3 ± 1</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>After 24 H</td>
<td>2±1</td>
<td>1 ± 1</td>
<td>&gt; 0.05</td>
</tr>
</tbody>
</table>

<p>| Table 4: | Incidence of intraoperative or postoperative complication |</p>
<table>
<thead>
<tr>
<th>Intraoperative bleeding</th>
<th>M1</th>
<th>M2</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/400(1.5%)</td>
<td>0/400 [0%]</td>
<td>&gt; 0.05</td>
<td></td>
</tr>
<tr>
<td>PO respiratory depression</td>
<td>40/400(10%)</td>
<td>8/400 [2%]</td>
<td>&lt; 0.0001*</td>
</tr>
<tr>
<td>PONV</td>
<td>150/400 [37.5%]</td>
<td>20/400 [5%]</td>
<td>&lt; 0.0001*</td>
</tr>
<tr>
<td>PO bleeding</td>
<td>0/400 [0%]</td>
<td>2/400 [0.5%]</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>PO DVT</td>
<td>0/400 [0%]</td>
<td>0/400 [0%]</td>
<td>-</td>
</tr>
</tbody>
</table>

<p>| Table 5: | Early ambulation and length of hospital stay |</p>
<table>
<thead>
<tr>
<th>Early post operative ambulation [no, %]</th>
<th>M1</th>
<th>M2</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>170/400[35%]</td>
<td>350/400[87.5%]</td>
<td>&lt; 0.0001</td>
<td></td>
</tr>
<tr>
<td>length of hospital stay[days] mean± SD</td>
<td>2.3±1.0</td>
<td>1.0 ±0.5</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
DISCUSSION

Results of the current work, the duration of full recovery was significantly short in M2 group than M1 group. The higher dose of MgSO₄ causes bronchodilatation, reverse cerebral vasospasm and causes reduced excitability of nerves to reduce the sense of pain[10]. So, the recovery was early when we give two grams of MgSO₄ when compared to the dose of one gram, and there was a trend to use increased dose of MgSO₄ for treatment of acute[11] and chronic pain[12]. In addition, incidence of ICU admission was significantly low in M2 when compared to M1 group; as the higher dose of MgSO₄ is associated with early recovery, less pain and less PONV[13].

The mean value of pain is significantly lower with high dose of MgSO₄. It is attributed to the role of Mg on NMDA receptor in pain perception[11-12].

Narcotic-based analgesia may be challenging because of the increased risk of hypoventilation and hypoxemia in obese patients. Mg and non-steroidal anti-inflammatory drugs should be part of multi-modal opioid-sparing postoperative analgesia[14]. Magnesium is NMDA receptor antagonist with anti-nociceptive effects[15] and has been previously investigated as a possible adjuvant for intra- and postoperative analgesia. The majority of these studies suggest that preoperative MgSO₄ reduces anesthetic requirements and improves post-operative analgesia[16]. However, two reports have suggested that MgSO₄ infusion has been reported to reduce remifentanil requirements but to have no effect on Propofol requirements in patients undergoing vitrectomy[17]. In addition, Ryu et al.[18] conclude that the addition of magnesium sulphate to patients receiving total intravenous anesthesia has no effect in reduction of pain severity after surgery.

The incidence of intraoperative or post operative bleeding is increased with M2 group. It could be attributed to the effect of magnesium in reduction of platelet activity, leading to prolongation of bleeding time especially with pre operative dose of Clexan[19]

Post operative respiratory depression was markedly decreased in M2 group, as magnesium sulphate is an effective bronchodilator but does not affect respiratory drive[10].

In the present study, patients in M2 group showed less postoperative shivering and PONV that mentioned and reported by Ryu et al.[18], and Xie et al.[20].

No DVT group had been reported in the current work. It could be due to use of preemptive analgesia, MgSO₄, Clexan and use of intraoperative preventive DVT pump machine. Early ambulation significantly increased in M2 group, and attributed to reduction of respiratory depression, low pain and significantly low PONV[21].

Figure [1]: Surgeon and patient satisfaction
Sherif et al. reported shorted LOS in high dose group, as in the current study. Mannaerts et al. reported that, the implementation of enhanced recovery after bariatric sugary (ERABS) can lead to shorter procedure duration and LOS, which may lead to more efficient and cost-effective care.

Lastly surgeon’s and patient’s satisfaction was significantly higher in M2 group. One of explanations is the increased discomfort and aggravates postoperative pain by shivering. In addition, the prevention of shivering and low PONV may attenuate postoperative pain and enhance patients’ satisfaction.

In conclusion, the beneficial actions achieved by magnesium sulphate addition to general anesthesia for laparoscopic sleeve gastrectomy was improved by increasing the dose from one to two grams and these effects was clear in reduction of the recovery duration, reduction of admission to ICU, reducing PO pain, low complication, early ambulation, shortening of LOS and higher patient’s and surgeon’s satisfaction.

Financial and Non-financial Relationships and Activities of Interest

None

REFERENCES


