Efficacy of Intravenous Dexamethasone and Magnesium Sulfate Injection on Pain After Laparoscopic Cholecystectomy

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Abstract- Postoperative pain is a complex physiological response to tissue damage. Providing effective postoperative analgesia prevents complications and improves patients' quality of life. The present study aimed to compare the effects of intravenous dexamethasone and magnesium sulfate on pain after laparoscopic cholecystectomy (LC). In this double-blind randomized controlled clinical trial, 60 patients aged 18 to 70 years undergoing laparoscopic cholecystectomy were randomly divided into two groups, (dexamethasone group and magnesium sulfate group) after obtaining written consent. The magnesium sulfate group received 50 mg/kg of magnesium sulfate diluted in 100 mL of 0.9% normal saline after endotracheal intubation for 15 min, and group D received 0.1 mg/kg (up to a maximum of 8 mg) intravenous dexamethasone 15 minutes before anesthesia induction. Pain levels were compared between the two groups based on a Visual Analog Scale (VAS). Pain intensity decreased in both groups, but VAS scores was significantly lower in the dexamethasone group at 1, 2, and 24 hours after surgery. The incidence of complications including chills, itching, and nausea and vomiting was lower in the dexamethasone group, but no statistically significant difference was found. Heart rate and mean arterial pressure decreased in both groups. Hemodynamic stability was significantly higher in the magnesium sulfate group at 1, 2, and 24 hours after surgery. Although magnesium sulfate has fewer effects on patients' hemodynamics and reduces pain intensity, the administration of dexamethasone has greater and more extensive effects in controlling pain and reducing complications in patients after laparoscopic cholecystectomy.

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Introduction

Laparoscopic cholecystectomy (LC) is a standard treatment for gallstones, and is more popular than laparotomy, due to less tissue trauma and fewer postoperative side effects (1). In spite of progression in medicine, postoperative pain remains the most common complaint among patients and is a major cause of prolonged hospitalization and delayed recover after surgery (2,3). Postoperative pain following LC is caused by several factors such as, intra-abdominal organs' stretch, peritoneal inflammation and phrenic nerve stimulation due to residual CO2 in peritoneal cavity, some treatments were suggested and some studies have shown that glucocorticoids are good pain control agent in various surgeries (4,5), meanwhile a Meta-analysis study reported that dexamethasone (DXM), is a sufficient supplement to decrease postoperative pain and opioid dosage for the same reason (3).

Dexamethasone is a potent long acting anti-inflammatory drug, one of the most effective agents for reducing tissues' edema during surgery and its short-term administration (less than two weeks) has been shown to be safe, even in upper than physiologic doses in the span of time (6,7).

Magnesium sulfate (MgSo4) is a physiological calcium channel blocker and an NMDA receptor (N-methyl-D-Aspartate), theoretically can take part in

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molecular sensitization process and pain reduce by blocking NMDA receptors after operation, as confirmed by clinical investigations (8,9).

Magnesium interferes in neurotransmitter (NT) release in all synaptic junctions of peripheral nervous system (PNS) and can bolster the local anesthesia activity, also vis a physiologic antagonist of voltage gated ca channels, which is effective in pain control, so is a supplement drug during surgery and even after that (10).

Due to conflicting results in previous studies and the lack of studies comparing these two drugs with each other on postop pain, we decided to design the current study.

Materials and Methods

Study design and participants

The current study was a double-blind randomized controlled clinical trial conducted on a statistical population consisting of 60 patients, candidate for elective laparoscopic cholecystectomy in ASA CLASS I or II, who were referred to Golestan and Imam Khomeini hospitals in Ahvaz city, Iran in 2024. The inclusion criteria were patients aged 18-70 years who were candidates for elective laparoscopic cholecystectomy. The exclusion criteria of study were ASA class more than II, age outside the range of 18 to 70, uncontrolled diabetes and hypertension, positive allergy history to dexamethasone and MgSo4; renal, hepatic or cardiac dysfunction, neuromuscular disease, use of steroid, opioid or calcium channel blocker drugs within the last 3 days and patient's dissatisfaction.

Grouping and intervention

The eligible subjects were assigned to two groups of 30 patients, (M: magnesium sulfate, D: dexamethasone) using a four-block randomization method. 15 minutes before general anesthesia induction, the magnesium sulfate group received 50 mg/kg of magnesium sulfate diluted in 100 mL of 0.9% normal saline in, and group D received 0.1 mg/kg (up to 8 mg) intravenous dexamethasone. During surgery pulse rate (PR), heart rate (HR) and noninvasive blood pressure (NIBP) were recorded at specific time intervals (every 5 minutes). The patients' pain intensity was measured and recorded based on the Visual Analog Scale (VAS) criterion at specific times immediately after induction, one hour, two hours, and 24 hours after surgery.

During surgery no unusual complication was recorded. In situations like blood pressure decreased by more than 20% from baseline or systolic blood pressure <90 mmHg, the patient received 5 mg IV ephedrine either in bradycardia (HR<60) received 0.5 mg IV Atropine.

Both patients and nurses were blinded by the patient's allocation to the group receiving intravenous magnesium sulfate and dexamethasone. The CONSORT (Consolidated Standards of Reporting Trials) flow diagram is shown in Figure 1.

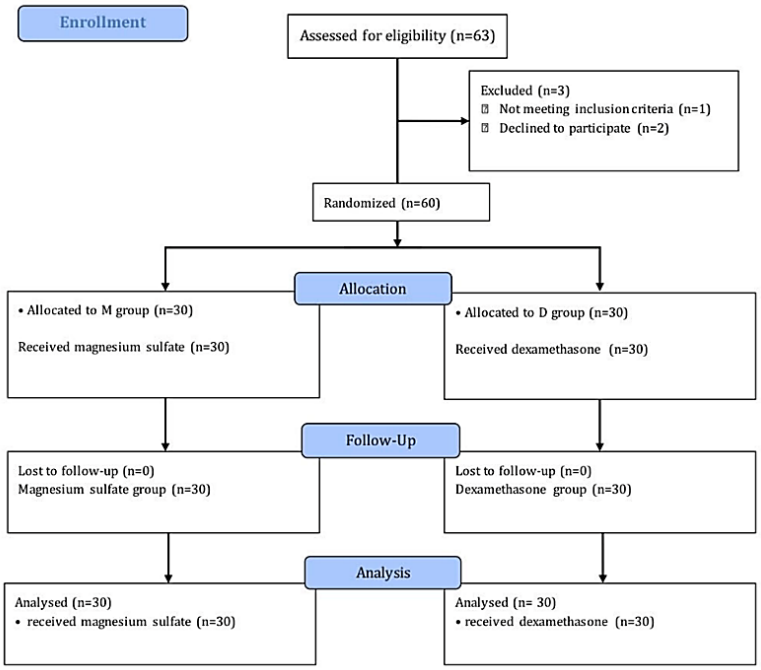

Figure 1. The CONSORT flow diagram

The study was approved by the Medical Ethical Committee of Ahvaz Jundishapur University of Medical Sciences (Ethics code: IR.AJUMS.HGOLESTAN.REC.1402.057), and this trial was registered in the Iranian clinical trial system with the patented number of IRCT20240226061110N1. The written informed consent was obtained from each patient.

Statistical analysis

Statistical analysis was performed by SPSS software Version 22 (IBM, Chicago, USA). Mean±SD (95% confidence intervals) and number (percentage) indicate quantitative and qualitative variables, respectively. After examining the data for normal distribution using the Kolmogrov-Smirnov statistical test, Paired-T test; Chi-Square, One-Way ANOVA, and Pearson correlation statistical analysis or its non-parametric equivalent were used. $P<0.05$ was considered statistically significant.

Results

A total of 60 patients were included in the study, 53.3% of whom were male (n=32). There was no significant difference in gender between the two groups (P=0.500). The mean age in the Dexamethasone group and Magnesium sulfate group was 41.90±11.42 and 37.80±12.34 years, respectively (P=0.609) (Table 1).

Based on Table 2, the pain levels immediately after the operation in Dexamethasone and Magnesium sulfate groups were 7.90±1.12 and 8.00±1.11, respectively (P=0.609). The pain levels one hour after the surgery in the Dexamethasone group was significantly less than the Magnesium sulfate group (6.20±1.27 vs. 7.13±0.90, P=0.032). The pain levels 2 hours after the surgery in Dexamethasone and Magnesium sulfate groups were 5.23±0.89 and 6.33±1.29, respectively, and in the dexamethasone group, pain was considerably less than in the magnesium sulfate group (P=0.045). The level of pain 24 hours after the surgery was markedly lower in the Dexamethasone group than in the Magnesium sulfate group (2.00±0.69 vs. 2.57±0.97, P=0.007).

The mean arterial pressure decreased at all measurement times in both groups and was lower in the magnesium sulfate group than in the dexamethasone group, there were significant differences at 1, 2, and 24 hours after surgery ($P<0.05$).

The rate of chills in the dexamethasone group was lower than in the magnesium sulfate group, but this difference was not statistically significant (6.7% vs. 11.7%, P=0.506). The rate of nausea in patients in the dexamethasone and magnesium sulfate groups was 5% and 11.7%, respectively, but no significant difference was observed between the two groups (P=0.299). More details regarding the comparison of vital and clinical signs in the two groups are shown in Table 3.

Table 1. Demographic variables in two groups

Variable		Dexamethasone group	Magnesium sulfate group	*P*
Age (Year), mean±SD		41.90±11.42	37.80±12.34	0.609
Sex, n (%)	**Female**	14 (23.3)	13 (21.7)	0.500
	Male	16 (26.7)	17 (28.3)	

Table 2. Pain score based on VAS at different times in the two groups

VAS	Dexamethasone group	Magnesium sulfate group	*P*
Immediately after the surgery	7.90±1.12 (7.48 - 8.32)	8.00±1.11 (7.58 – 8.42)	0.609
1 hour after the surgery	6.20±1.27 (5.73 – 6.67)	7.13±0.90 (6.8 – 7.47)	0.032
2 hours after the surgery	5.23±0.89 (4.9 – 5.57)	6.33±1.29 (5.85 – 6.82)	0.045
24 hours after the surgery	2.00±0.69 (1.74 – 2.26)	2.57±0.97 (2.20 – 2.93)	0.007

Data are presented as mean±Standard deviation (95% Confidence Intervals)

Table 3. Comparison of vital and clinical signs in the two groups

Variables		Dexamethasone group	Magnesium sulfate group	*P*
MAP	**Immediately after the surgery**	97.01 ±7.70 (94.13 – 99.89)	96.60 ± 5.87 (94.41 – 98.79)	0.53
	1 hour after the surgery	93.87±8.94 (90.53 – 97.21)	90.39 ± 4.84 (88.58 – 92.20)	0.03
	2hours after the surgery	92.43± 7.41 (89.67 – 95.20)	84.70 ± 10.20 (80.89 – 88.51)	0.04

Cont. table 3

HR	**24 hours after the surgery**	85.01 ± 8.68 (81.77 – 88.25)	79.89 ± 6.67 (77.40 – 82.38)	0.04
	Immediately after the surgery	80.83 ±16.51 (74.67 – 87.00)	84.83 ± 14.05 (79.58 – 90.08)	0.272
	1 hour after the surgery	80.23 ± 12.79 (75.46 – 85.01)	74.90± 10.63 (70.93-78.87)	0.047
	2hours after the surgery	77.87± 12.74 (73.11 – 82.63)	74.57± 10.00 (70.83-78.30)	0.067
	24 hours after the surgery	77.53 ± 11.72 (73.16 – 81.91)	67.13 ± 8.68 (63.89 – 70.38)	0.033
Chills, n (%)		4 (6.7)	7 (11.7)	0.506
Nausea, n (%)		3 (5)	7 (11.7)	0.299
Itching, n (%)		2 (3.3)	7 (11.7)	0.145

MAP: mean arterial pressures, HR: Heart Rate.
Data are presented as mean ± Standard deviation (95% Confidence Intervals) and frequency (%)

Discussion

The current study compared the analgesic effects of dexamethasone and MgSo4 on postoperative pain reduction and opioid analgesics. Based on results, we see decrease in post-operative pain in both groups, more decrease in D group than M group. Other post-operative side effects such as chills, itching, nausea and vomiting (8).

Peng *et al*., evaluated the analgesic effects of MgSo4 relief and less analgesics on patients under upper extremity surgery, reported less need to opioid analgesics in IV MgSo4 receiving patients (11).

Aligned with our study Shubhi *et al*., evaluated the MgSo4 effect on pain decrease on patients which had lower extremities and reported less pain and less need to opioid analgesics with a statistically significant difference in comparison to control group (12). In another study Taheri *et al*., in evaluated MgSo4 effect on pain relief after hysterectomy and final result showed prescription of MgSo4 in preoperative time caused less pain in postoperative either less pain killer usage (13).

The highlight study by Mohtadi *et al*., dexamethasone role in postoperative pain relief in comparison to placebo reported significantly lower VAS pain scores on the basis of VAS criteria is less in dexamethasone receiving patients than MgSo4 ones (14).

In another double blind RCT study by Suncher-Rodrigur and colleague on IV dexamethasone and placebo which were injected preoperative in candidates of LC the results showed postoperative nausea and vomiting (PONV) and pain in dexamethasone group obviously was less in comparison to placebo group. Another study by Gasbjerg, on candidates of knee arthroplasty showed that IV dexamethasone which prescribed in two doses caused decrease in morphine need as analgesic drug during 48 hours after the operation (15). In another similar study by Singh and colleague, prescription of IV dexamethasone after cesarean section caused lower pain score and less need to opioid analgesics in comparison to control group (12).

In the same direction, Mitchell and colleague received similar conclusion, on patients under intra-abdominal surgery (16). Current study showed that patients in MgSo4 group exhibited more stable hemodynamic parameters like MAP and HR noting that similar result was confirmed by Kiaie *et al*., (17) ,Aghamohammadi *et al*., (18) and Kieraki *et al*., (19). Shine *et al*., suggested the use of MgSo4 in patient with unstable hemodynamic situation due to drug effect on hemodynamic stability (20).

Although MgSo4 has less effect on patients hemodynamic situations and decrease pain severity, Dexamethasone has more effect on pain control and decreases side effects, such as chills, itching, nausea and vomiting in patients who undergone laparoscopic cholecystectomy surgery.

References

1. Nayeb D, Hamed A, Mohammadhosein H, Farzad FK. Laparotomy versus laparoscopy cholecystectomy for surgical treatment in patients with gallstone disease: a comparative cost-effectiveness analysis. Health Technol Assess Action 2024;8:27-36.
2. Har A, Biswas A, Chatterjee S, Bhowmik DK, Bhattacharya S, Biswas B. Preoperative dexamethasone reduce postoperative pain and analgesic consumption in patient undergoing laparoscopic cholecystectomy. Age 2015;46:44.8-8.
3. Barazanchi A, MacFater W, Rahiri JL, Tutone S, Hill A, Joshi G, et al. Evidence-based management of pain after laparoscopic cholecystectomy: a PROSPECT review update. Br J Anaesth 2018;121:787-803.

4. Lirk P, Thiry J, Bonnet MP, Joshi GP, Bonnet F. Pain management after laparoscopic hysterectomy: systematic review of literature and PROSPECT recommendations. Reg Anesth Pain Med 2019;44:425-36.
5. Ituk U, Thenuwara K. The effect of a single intraoperative dose of intravenous dexamethasone 8 mg on post-cesarean delivery analgesia: a randomized controlled trial. Int J Obstet Anesth 2018;35:57-63.
6. Szucs S, Jessop D, Iohom G, Shorten GD. Postoperative analgesic effect of preoperatively administered dexamethasone after operative fixation of fractured neck of femur: randomised, double blinded controlled study. BMC Anesthesiol 2015;16:79.
7. Shalu PS, Ghodki PS. To study the efficacy of intravenous dexamethasone in prolonging the duration of spinal anesthesia in elective cesarean section. Anesth Essays Res 2017;11:321-5.
8. Ghaffaripour S, Mahmoudi H, Eghbal H, Rahimi A. The effect of intravenous magnesium sulfate on post-operative analgesia during laminectomy. Cureus 2016;8:e626.
9. Shah PN, Dhengle Y. Magnesium sulfate for postoperative analgesia after surgery under spinal anesthesia. Acta Anaesthesiol Taiwan 2016;54:62-4.
10. Zeng J, Chen Q, Yu C, Zhou J, Yang B. The use of magnesium sulfate and peripheral nerve blocks: an updated meta-analysis and systematic review. Clin J Pain 2021;37:629-37.
11. Peng YN, Sung FC, Huang ML, Lin CL, Kao CH. The use of intravenous magnesium sulfate on postoperative analgesia in orthopedic surgery: a systematic review of randomized controlled trials. Medicine (Baltimore) 2018;97:e13583.
12. Shubhi S, Devang B, Sangeeta Y, Nitin H. Effect of IV infusion of magnesium sulfate on postoperative pain after spinal anesthesia: a prospective randomized trial. Arch Anesth Crit Care 2021;7:209-15.
13. Taheri A, Haryalchi K, Mansour Ghanaie M, Habibi Arejan N. Effect of low-dose single-dose magnesium sulfate on postoperative analgesia in hysterectomy patients receiving balanced general anesthesia. Anesthesiol Res Pract 2015;2015:306145.
14. Mohtadi A, Nesioonpour S, Salari A, Akhondzadeh R, Rad BM, Aslani SMM. The effect of single-dose administration of dexamethasone on postoperative pain in patients undergoing laparoscopic cholecystectomy. Anesth Pain Med 2014;4.
15. Gasbjerg KS, Hägi-Pedersen D, Lunn TH, Laursen CC, Holmqvist M, Vinstrup L, et al. Effect of dexamethasone as an analgesic adjuvant to multimodal pain treatment after total knee arthroplasty: randomised clinical trial. BMJ 2022;376:e067325.
16. Mitchell C, Cheuk S, O'Donnell C, Bampoe S, Walker D. What is the impact of dexamethasone on postoperative pain in adults undergoing general anaesthesia for elective abdominal surgery: a systematic review and meta-analysis. Perioper Med 2022;11:13.
17. Kiaee MM, Safari S, Movaseghi GR, Dolatabadi MRM, Ghorbanlo M, Etemadi M, et al. The effect of intravenous magnesium sulfate and lidocaine in hemodynamic responses to endotracheal intubation in elective coronary artery bypass grafting: a randomized controlled clinical trial. Anesth Pain Med 2014;4:e15905.
18. Aghamohammadi D, Farzin H, Khanbabayi Gol M, Fooladi S. The effects of intravenous magnesium sulfate on hemodynamic status and pain control in patients after laparotomy surgery: a double blind clinical trial. J Anesthesiol Pain 2018;9:66-73.
19. Kiraci G, Demirhan A, Tekelioglu U, Akkaya A, Bilgi M, Erdem A, et al. A comparison of the effects of lidocaine or magnesium sulfate on hemodynamic response and QT dispersion related with intubation in patients with hypertension. Acta Anaesthesiol Belg 2014;65:81-6.
20. Shin YH, Choi SJ, Jeong HY, Kim MH. Evaluation of dose effects of magnesium sulfate on rocuronium injection pain and hemodynamic changes by laryngoscopy and endotracheal intubation. Korean J Anesthesiol 2011;60:329-33.