

Research Article

Effects of Adding Three Different Doses of Magnesium Sulfate to Bupivacaine in Epidural Anesthesia for Lower Abdominal Surgeries

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Abstract

Introduction: Magnesium has been used as an adjuvant to local anesthetic via epidural route to augment the quality of block and prolong postoperative analgesia. **Aim of the work:** To assess and compare the effect of adding three different doses of magnesium sulfate to bupivacaine in epidural anesthesia in patients scheduled for lower abdominal surgeries on onset of sensory and motor block, duration of block, number of top up doses, duration of analgesia, early postoperative pain and to evaluate any possible side effects. **Patients and Methods:** This study was controlled, randomized, prospective and double blinded. A total of 120 patients, ASA grade I-II, aged between 18 and 64 were scheduled for lower abdominal surgery. All patients were assessed clinically after taking medical history and through physical examination and investigated for exclusion of any contraindications, complete blood picture (CBC), Prothrombin time and concentration, liver function, renal function and resting ECG was done. The patients were randomly allocated into four equal groups according to the dose of magnesium sulfate injected in the epidural space, 30 patients in each. Each group received total volume of 15 ml which may be (14 ml bupivacaine + 1 ml saline), (14 ml bupivacaine + 50 mg MgSO₄ in 1 ml saline), (14 ml bupivacaine + 75 mg MgSO₄ in 1 ml saline) or (14 ml bupivacaine + 100 mg MgSO₄ in 1 ml saline). The onset and duration of sensory and motor block, duration of postoperative analgesia, postoperative visual analogue scale and any side effect were noted. **Results:** Onset of sensory and motor block was faster in (100 mg group) than other groups. Duration of sensory and motor block and time to first analgesic request were longer in 100 mg group than others. **Discussion:** Epidural magnesium sulfate (100mg) significantly prolonged postoperative analgesia compared to 50mg, 75mg and bupivacaine alone. **we recommend:** Usage of magnesium sulfate as adjuvant to epidural anesthesia in a dose of (100 mg) for earlier onset and prolonged postoperative analgesia.

Keywords: epidural anesthesia, magnesium sulfate, postoperative analgesia

Introduction

Central neuraxial blockade is widely used for lower abdominal and lower limb surgeries. Epidural anesthesia being a safe technique, has a unique feature of segmental blockade and better control over hemodynamic variables and provision of prolonged postoperative analgesia (White et al., 2007).

Pre-emptive analgesia is defined as an antinociceptive treatment that prevents the establishment of altered central processing of afferent input, which amplifies postoperative pain. (Kissin et al., 2000)

The goals of pre-emptive analgesia are to decrease acute pain after tissue injury, to prevent pain related pathologic modulation of

the central nervous system, and to inhibit the persistence of postoperative pain and the development of chronic pain (Grape S and Tramer M, 2007).

Magnesium is the fourth most plentiful cation in our body. It has antinociceptive effects in animal and human models of pain (Begon et al., 2002).

Magnesium has been used as an adjuvant by various routes, including intravenous, intrathecal, and epidural in different dosage regimens (Farouk S, 2008).

Aim of the work

To assess and compare the effect of adding three different doses of magnesium sulfate to

bupivacaine in epidural anesthesia in patients scheduled for lower abdominal surgeries on onset of sensory and motor block, duration of block, number of top up doses, duration of analgesia, early postoperative pain and to evaluate any possible side effects.

Patients and Methods

This study was controlled, randomized, prospective and double blinded. A total of 120 patients, ASA grade I-II, aged between 18 and 64 were scheduled for lower abdominal surgery.

Pre-operative assessment and preparation:

All patients were assessed clinically after taking medical history and through physical examination and investigated for exclusion of any contraindications, complete blood picture (CBC), Prothrombin time and concentration, liver function, renal function and resting ECG were done.

The patients were randomly allocated into four equal groups according to the dose of magnesium sulfate injected in the epidural space, 30 patients in each. Each group received total volume of 15 ml which may be (14 ml bupivacaine + 1 ml saline), (14 ml bupivacaine + 50 mg MgSO₄ in 1 ml saline), (14 ml bupivacaine + 75 mg MgSO₄ in 1 ml saline) or (14 ml bupivacaine + 100 mg MgSO₄ in 1 ml saline)

Technique of the study:

On arrival to the operating room A good peripheral intravenous line was accessed by 18-G intravenous cannula in the preoperative room; and patients were preloaded with lactated ringer solution 10 ml/kg before the initiation of epidural block.

Standard monitors (Datex Ohmeda-Cardiicap/5) were applied preoperatively including ECG, Non invasive blood pressure (NIBP), and pulse oximetry; and the baseline measurements were recorded.

Epidural technique was used for anesthesia and postoperative analgesia. With the patients in the sitting position and under complete aseptic conditions, After local infiltration with 2% lidocaine, the epidural space was identified at the L3-L4 intervertebral level with an 18-G Tuohy needle (Perifix®) using the loss of resistance to saline technique., A 20-G epidural

catheter was positioned 3-5 cm into the epidural space and secured in place for intraoperative and postoperative analgesia, The position of catheter was checked by aspiration for blood or CSF. A test dose of 3 ml of 2% lignocaine was administered to detect intrathecal or intravenous injection then patients turned to supine position. After 3 minutes the patients received study solution according to randomization schedule at rate of 3 ml/10 seconds by epidural catheter.

The sensory block was assessed by the bilateral pin-prick method using a short beveled sterile 26G hypodermic needle along the midclavicular line, bilaterally after giving the study drug at 5, 10, 15, 20, 25 and 30 min. Then every 15 min till the end of the surgery. The time to achieve anesthesia up to T6- T4 level was noted.

If patient complained of pain intraoperatively, reassessment of the level of the blockade and a top up dose of 1.5 ml bupivacaine 0.5% for each unblocked segment was given accordingly.

Motor blockade was assessed by using Modified Bromage scale:

0. No motor block;
1. Inability to raise extended leg; able to move knees and feet.
2. Inability to raise extended leg or move knee but able to move feet.
3. Complete motor block of limb.

Motor blockade was assessed at 5, 10, 15, 20, 25 and 30 minutes intervals after the epidural administration of the drugs. Then every 30 minutes after complete establishment of sensory and motor block.

Hemodynamics: heart rate (HR), blood pressure (BP) and oxygen saturation pre-operative, after induction, after intubation and every 5 minutes till the end of operation.

Postoperative pain was controlled by rescue analgesics (15 mg/kg/dose paracetamol) and if pain continuo if VAPS more than 3 we will add another analgesia *nalbuphine* (0.2-0.5mg/ kg)

Postoperative pain was assessed by the patient using the visual analog pain scale (VAPS 0=no pain; 10=worst possible pain) immediate post operative, after 6 hours and 24 hours after operation. The time of first request for post-operative analgesia and the number of analgesia were recorded.

Time to first analgesic request was measured as the time from the end of surgery to the patient's first request for analgesic administration.

Any side effects including hypotension, bradycardia, nausea and vomiting, back pain on injection, headache, hallucination and shivering were noted. Nausea and vomiting were treated with 4mg Ondansetron .

Table (1): Patient's characteristics.

	Group A (n=30)	Group B (n=30)	Group C (n=30)	Group D (n=30)	p value
Sex [Number (%)]					
Male	18 (60%)	15 (50%)	20 (66.7%)	16 (53.3%)	0.570
Female	12 (40%)	15 (50%)	10 (33.3%)	14 (46.7%)	
Age (Mean±SD)	38.6±13.2 (21-61)	36.5±8.8 (27-55)	36±13.5 (21-65)	45±12.7 (25-63)	0.063
Duration of operation (min) (Mean±SD)	83.4±15.9 (60-107)	83.2±20.8 (57-116)	82.8±20.9 (60-125)	73.5±17.4 (45-107)	0.234
Duration of anesthesia (min) (Mean±SD)	96±14.8 (77-120)	96.8±19.5 (70-128)	96.6±19.5 (75-138)	94.5±18.2 (68-129)	0.975
ASA classification [Number (%)]					
ASA I	19 (63.3%)	23 (76.7%)	22 (73.3%)	20 (66.7)	0.662
ASA II	11 (36.7%)	7 (23.3)	8 (26.7%)	10 (33.3%)	

Our results demonstrated that there were no statistically significant differences ($p \geq 0.05$) between the four groups as regard to age, sex, duration of operation and ASA score as shown in (Table 1).

Results

By the end of the study, the key was opened by the investigator and showing that:

- **Group A** was representing {100 mg Group}
- **Group B** was representing {75 mg Group}
- **Group C** was representing {50 mg Group}.
- **Group D** was representing {control Group}.

Hemodynamic data:

1- Heart rate: -

As regards HR, there were statistically insignificant differences between the four groups at all time intervals as shown in (figure 1)

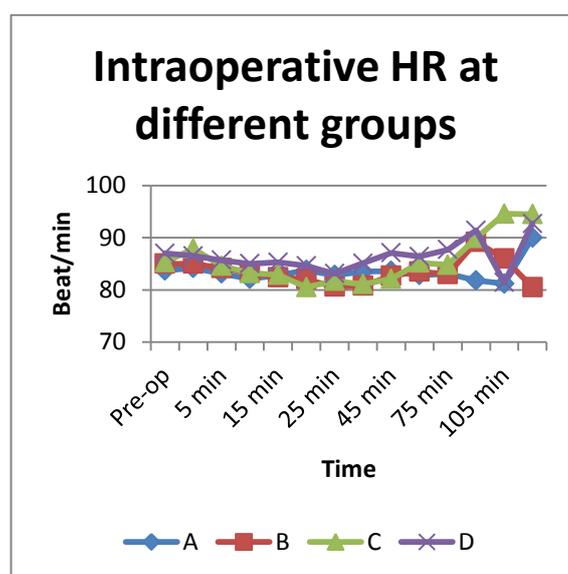


Figure (1): heart rate (beat/min) among studied groups

2- Mean arterial pressure:

As regard MAP, there were no statistically significant difference between the four groups except at 20 and 25 min

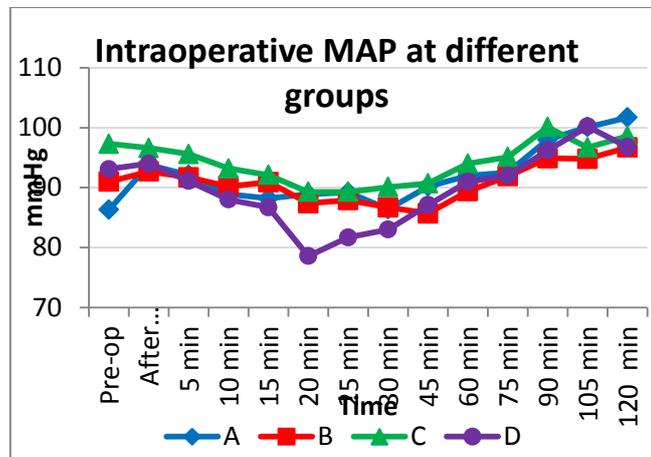


Figure (2): Intraoperative MAP

Characteristics of the epidural block:

Patients in group A reach maximum sensory (T4) and motor (modified bromage scale 3) block level faster than other groups (Mean ± SD

11.4 ± 1.6 min) and (Mean ± SD 13.9 ± 1.9 min) respectively. The difference was statistically significant between all groups as shown in (Table 2).

Table (2): Characteristics of the epidural block

	Group A (n=30)	Group B (n=30)	Group C (n=30)	Group D (n=30)	p value
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Sensory block (min)					
Onset time	8.1±1.8	10.8±1.7	10.0±1.5	14.8±1.5	<0.001*
Maximum	11.4±1.6	14.2±1.3	14.0±1.7	19.3±0.7	<0.001*
Motor block (min)					
Onset time	10.3±1.6	13.2±1.9	12.1±1.5	16.6±1.3	<0.001*
Complete	13.9±1.9	16.2±1.5	16.5±1.7	21.3±0.8	<0.001*

Postoperative pain:

As regard postoperative pain, VAS score was statistically insignificant between all study groups (p value> 0.05) immediately post-operative but it was significantly higher in

group D than other groups at 6 hours post-operative. After 24 hours, there was statistically significant difference between all groups with the least at Group A and highest score at Group D.

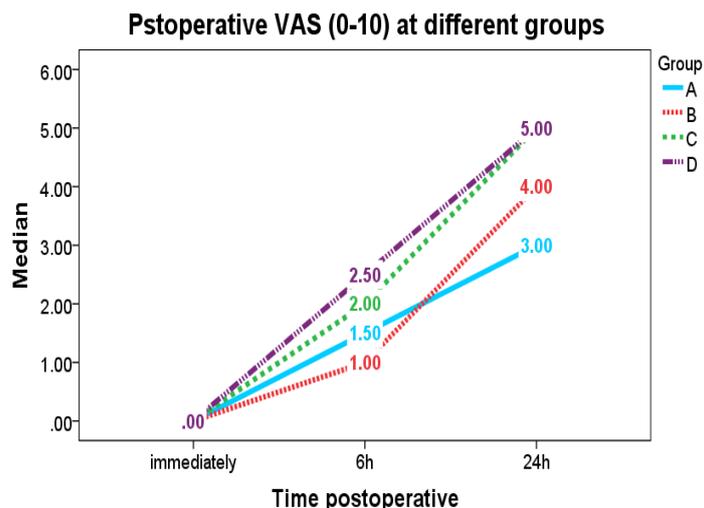


Figure (3): postoperative VAS

Postoperative analgesia:

Patients of group D request analgesia earlier than those in other groups mean± SD (3.3±0.5

hours postoperative). Otherwise patients in groups A, B and C take more time before requesting for analgesia as shown in (Table 3)

Table (4): postoperative analgesia

	Group A (n=30)	Group B (n=30)	Group C (n=30)	Group D (n=30)	p value
	Mean±SD (Range)	Mean±SD (Range)	Mean±SD (Range)	Mean±SD (Range)	
Time taken to first analgesia request (hr)	5.6±0.4 (4.5-6.0)	4.8±0.5 (4.0-5.5)	4.7±0.6 (3.8-6.0)	3.3±0.5 (2.5-4.0)	<0.001*
no. of analgesic doses	2.5±0.5 (2.0-3.0)	3.0±0.0 (3.0-3.0)	3.3±0.5 (3.0-4.0)	3.9±0.4 (3.0-4.0)	<0.001*

Discussion

This study compared the effect of three different doses of magnesium sulfate (50 mg, 75 mg and 100 mg) when added to local anesthetic (bupivacaine 0.5%) in epidural anesthesia on onset of sensory and motor block, duration of block, presence of any adverse effects and early postoperative pain .

The study revealed that adding magnesium sulfate to epidural local anesthetic resulted in significant prolongation of postoperative analgesia duration, reduction of number of analgesic doses required postoperative, early initiation of both sensory and motor block and prolongation of duration of that block. Hemodynamics like SBP, DBP, MAP and HR showed more stability in MgSO₄ groups. No

statistically significant difference as regard side effects were detected .

By comparing effect of different doses, results were nearly similar while using doses of (50 mg & 75 mg). Otherwise, using a dose of 100 mg resulted on more rapid onset and prolonged duration of block with more hemodynamics stability and insignificant difference on the reported adverse effects. Postoperative analgesia was longer in this group and VAS score was better till 24 hours postoperatively. Also, the first analgesic request was delayed and the use of analgesics was lesser within this group.

In agree to our study, Omar H , 2018 studied the effect of magnesium sulfate as a pre-emptive adjuvant to levobupivacaine for post-

operative analgesia in lower abdominal and pelvic surgeries under epidural anesthesia.

Two groups, each with fifty patients undergoing lower abdominal and pelvic surgeries with epidural anesthesia. Group M received 15 ml of a mixture of 14 ml levobupivacaine 0.5%, 0.5 ml magnesium sulfate 10% (50 mg), and 0.5 ml 0.9 NaCl at induction. Group L received 15 ml of 14 ml levobupivacaine 0.5% and 1 ml 0.9 NaCl at induction. Then, continuous infusion was used as 5 ml/h of the specific mixture of each group till the end of the surgery.

The results demonstrated that there was no statistically significant difference between the two groups regarding intraoperative hemodynamics ($P > 0.05$). Sensory and motor block onset was significantly shorter in Group M (14.5 [± 1.51] and 12.42 [± 1.69]) compared to Group L (19.86 [± 1.39] and 19.34 [± 1.62]) ($P = 0.001$). Group M showed lower VAS pain score compared to Group L from the 2nd to the 5th h postoperatively. Time for first analgesic dose was longer in Group M (294.98 [± 21.67]) compared to Group L (153.96 [± 10.04]) ($P = 0.001$). According to these results, preoperative and intraoperative epidural Mg infusion with levobupivacaine resulted in prolonged postoperative analgesia and lower VAS.

Kim et al., 2009 studied the effects of epidural MgSO₄ on postoperative pain management in patients with patient-controlled epidural analgesia after thoracotomy on 40 patients divided in 2 groups control group and MgSO₄ group (100 mg) and reported that the VAS score with no difference between 2 groups, in our study on adding magnesium sulfate (100 mg) to bupivacaine in epidural anesthesia for lower abdominal surgeries we found that there was prolongation of postoperative analgesia with lower VAS score and lesser number of analgesic doses requested. This difference may be due to different type of operation and time of administration of magnesium sulfate as this study used it postoperatively for analgesia but in our study we used it preoperative.

Conclusion

From our results, we concluded that adding magnesium sulfate to epidural local anesthetic resulted in significant prolongation of post-

operative analgesia duration, reduction of number of analgesic doses required postoperative, early initiation of both sensory and motor block and prolongation of duration of that block. No side effects were detected. Hemodynamics like SBP, DBP, MAP and HR showed more stability in MgSO₄ groups.

By comparing effect of different doses, we found that results are nearly similar while using doses of (50 mg & 75 mg). Otherwise, using a dose of 100 mg resulted on more rapid onset, prolonged duration of block, prolonged period of postoperative analgesia and delayed the period before the first analgesic request with more hemodynamics stability with no significant difference on the reported adverse effects.

Recommendation

We recommended

- 1- Usage of magnesium sulfate as adjuvant to epidural anesthesia in a dose of (100 mg) for earlier onset and prolonged postoperative analgesia.
- 2- The population involved in our study includes the young and otherwise healthy patients. So, we recommend further studies to investigate the effect of MgSO₄ in older patients and patients with other comorbidities.
- 3- It is also recommended to perform further studies to compare other drugs with epidural anesthesia. Aiming towards evaluating their synergistic effects with the possible emergence of a better anesthetic and analgesic properties and hemodynamic stability.
- 4- Studying the effect of other doses of magnesium sulfate.
- 5- Comparison between effects of magnesium sulfate when administered in different routes (IV, intrathecal, epidural and nerve block).

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