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Original Research Article

The effects of magnesium sulphate on haemodynamic stress response to pneumoperitonium in laparoscopic cholecystectomy: a double blinded randomised controlled study

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ABSTRACT

Background: To study the effect of intravenous magnesium sulphate on hemodynamic response to pneumoperitoneum during laparoscopic cholecystectomy and to study the side effects of the drug of any.
Methods: Patients were randomly allocated into two groups of 40 each. Automated NIBP, Heart rate, Nausea, headache was noted. Magnesium ion concentration was measured. Chi square test was used to test the association between different study variables under study. Corrected test was used in case of any one of the cell frequency was found less than 5 in the bivariate frequency distribution. Fisher's Exact Test was also used in the case where the test could not be applied. Test of proportion (Z-test) was used to test the significant difference between two proportions. t-test was used to test the significant difference between means. $P \leq 0.05$ was considered statistically significant.
Results: Patients' characteristics were comparable in both groups. Most data related to surgery and anaesthesia were comparable in both groups. The MAP of group N (control) was significantly higher than that of group M throughout surgery (P5,P10,P20,P30, and at extubation) except at baseline and at the time of PP (P0). The MAP is better maintained in M group. Usage of GTN in the control group was significantly higher. HR of the control group was significantly higher after 20 min (P20) of pneumoperitoneum and after extubation. There was significantly more incidence of nausea and vomiting in the control group.
Conclusions: Use of magnesium sulphate just before pneumoperitoneum is very useful for attenuating haemodynamic alterations to pneumoperitoneum and the requirement of antihypertensive GTN is significantly much less compared to the control group during laparoscopic surgery without increasing any adverse outcome.

Keywords: Pneumoperitoneum, MgSO4, Magnesium, Laparoscopic surgery, General anaesthesia

INTRODUCTION

Laparoscopic cholecystectomy was first performed by Phillipe Mouret in 1987.[1] Since then, this procedure has become prevalent worldwide because of its benefits compared to open cholecystectomy that includes reduced tissue trauma, reduced postoperative morbidity, reduced hospital stay and thereby reduced healthcare costs. For laparoscopic cholecystectomy, carbon dioxide is commonly used to create pneumoperitoneum.[2,3] Both carbon dioxide and pneumoperitoneum cause adverse cardiovascular effects characterized by abrupt elevation of arterial pressure, systemic vascular resistance, and decreased cardiac output.[4,5] These vasopressor responses are mainly due to increased release of catecholamines, vasopressin, or both.[6,7] Adverse cardiovascular response is also secondary to decreased venous return caused by reverse trendelenberg position, which is used in laparoscopic cholecystectomy.[8] Moreover, severe haemodynamic changes can put patients at risk, especially for patients with compromised cardiac function.[9]

Hence, various drugs are tried to attenuate the adverse cardiovascular response during pneumoperitoneum, namely, opioids vasodilators, beta blocking agents, and alpha-2adrenergic agonists but all have their own side effects and drawbacks.[10-13] Recently magnesium sulphate has gained attention for the same although there is not much study done yet using magnesium sulphate only.

Magnesium has the ability to block the release of catecholamines from both the adrenal gland and the adrenergic nerve terminals.[14] Apart from that, magnesium can produce vasodilatation by acting directly on blood vessels and is also capable of attenuating vasopressin stimulated vasoconstriction.[15,16] Intravenously administered magnesium sulphate is capable of attenuating the adverse hemodynamic responses associated with endotracheal intubation also.[17] So it has been hypothesized that intravenously administered magnesium sulphate would be efficacious to attenuate the adverse hemodynamic responses in patients undergoing elective laparoscopic cholecystectomy with carbon dioxide pneumoperitoneum. This study was conducted to study the effects of intravenous magnesium sulphate on the haemodynamic response to pneumoperitoneum during laparoscopic cholecystectomy and to study the side effects of the drug if any.

METHODS

This was a double-blinded randomised controlled study conducted in the Operation Theatre and Post-Operative Recovery Room of B. R. Singh Hospital and Centre for Medical Education and Research Eastern Railway, Sealdah, Kolkata. The study period was from November, 2013 to October, 2015.

Patients planned for elective laparoscopic cholecystectomy under general anaesthesia were selected from pre-anaesthetic check-up clinic.

Inclusion criteria

Age: 20-90 years, weight: 40-100 kg, height: 140-180 cm, ASA- I/II, scheduled for laparoscopic. Cholecystectomy.

Exclusion criteria

Hypo/hyper-magnesaemia, a known allergy to magnesium sulphate, any degree of heart block, hypertension, diabetes mellitus, congenital or acquired neuropathy or myopathy, cardiovascular / kidney, or endocrine /metabolic diseases, initial SBP <90 or >180 mmHg, ASA-III/IV, surgery was converted to open procedure within 30 minutes pneumoperitoneum, patient refusal.

Randomisation /sampling techniques

Patients were assigned to the two groups of the study with the help of computer-generated random numbers by the process of randomization. Two operator technique was used to maintain blinding. The principal investigator had done the monitoring. The second investigator had given the drug and left the OR (Operating room).

Procedure

Pre-operative visit and clinical examination

Patients were examined properly for preoperative counselling. Anaesthesia technique was also explained to patients at our pre-anaesthesia clinic.

A detailed history was obtained from every patient regarding any symptoms of breathlessness, asthmatic attack, and drug allergy, loss of consciousness, black out, snoring, history of surgery, anaesthesia, unconsciousness, seizures, hereditary neurological disorders, addiction and prolonged medication, if any. Functional status was also assessed.

Heart rate, blood pressure, anaemia, jaundice, cyanosis, clubbing were noted. Assessment of the airway was done to anticipate any difficulty in intubation.

Thorough examinations of the cardiovascular and respiratory system were done in all patients. Examinations of the other systems were conducted as well. The body weight of each patient was also recorded. Routine investigations were carried out in all patients as per this institutional protocol.

Evening before surgery, the patient was counselled about the study and they were asked about their willingness to participate in the study. If they agreed to take part, informed consent was taken. Night sedation and medication was given according to institutional protocol.

Day of surgery

After obtaining informed written consent from patients, patients were randomly divided into 2 groups by means of computer-generated randomisation -

a. Group I: Magnesium sulphate group (M group) – 40 patients

b. Group II: Control group or normal saline group (N group)- 40 patients.

Upon arrival at operating room, all standard baseline monitors like noninvasive blood pressure monitor (NIBP), peripheral oxygen saturation monitor (SpO2), electrocardiography monitor (ECG) having lead II and lead V4 were attached.

All baseline values of blood pressure (systolic blood pressure, diastolic blood pressure, and mean arterial pressure), pulse rate, SpO2, and electrocardiography were obtained and recorded.

Intravenous access was done with an 18 G IV cannula and free flow of intravenous fluid was checked.

Ringer lactate [compound sodium lactate injection, RL, parenteral drugs (India) limited] (at room temp) was used as crystalloid.

Patients were injected with Injection glycopyrolate 0.2 mg injection, midazolam 0.03 mg/kg, injection, fentanyl- 2 mcg/kg.

After preoxygenation, the patient were induced with injection propofol 2 mg/kg.

Intubation was facilitated with injection vecuronium 0.1 mg/kg and muscle paralysis was maintained with top-up dose of the same drug 0.02 mg/kg with proper neuromuscular monitoring.

Immediately after intubation, just before pneumoperitoneum, Group N patients (control gp) received IV normal saline 0.5 ml/kg and patients of Group M (study gp) received 0.5 ml/kg of 10% of $MgSO_4$ (50 mg/kg) over 2-3 mins.

Patients were maintained with 1.5% end tidal Sevoflurane and 1:1 oxygen and air @4 lt/min. CO_2 pneumoperitoneum was created and intra-abdominal pressure was maintained between 12-14 mmHg. $ETCO_2$ was maintained between 35-45 mmHg. Sevoflurane was turned off when the last port were sutured. Residual neuromuscular blockade was reversed by injection neostigmine 0.05 mg/kg, injection glycopyrolate 0.02 mg/kg when TOF count is 4. Extubation was performed after the patient generated adequate tidal volume.

Parameters observed

Continuous monitoring of parameters like peripheral oxygen saturation (SpO2), noninvasive blood pressure, heart rate, ECG, temperature, end tidal CO_2, end tidal Sevoflurane, neuromuscular monitoring ware done till the end of surgery. For this data, we took heart rate (HR) and mean arterial pressure (MAP) at baseline, at the time of pneumoperitonium (P0), 5 (P5),10 (P10), 20 (P20), 30 (P30) min after pneumoperitonium and after extubation.

Bradycardia defined as HR <60 treated with IV Atropine 0.6 mg. Hypotension defined as MAP<60 treated with injection Phenylephrine 100 mcg IV. For hypertension defined as MAP >110 treated with injection glyceryl tri nitrate (GTN) 0.5-5 mcg/kg/min.

Serum magnesium concentration was measured in mmol/lt before the starting of the operation, at the time of pneumoperitonium and after surgery was completed.

In post-operative period, adverse effects of magnesium sulphate were noted like headache, nausea, vomiting, hypotension, bradycardia, sedation, visual problems, respiratory difficulty, and strict monitoring of hemodynamics and knee jerk reflex were done.

Statistical analysis

Statistical methods

Statistical Analysis was performed with help of Epi Info (TM) 3.5.3. Chi Square test was used to test the association between different study variables under study. Corrected (Chi square test) was used in case of any one of the cell frequency was found less than 5 in the bivariate frequency distribution. “Fisher’s Exact Test” was also used in the case where (Chi square) test could not be applied. Test of proportion (Z-test) was used to test the significant difference between two proportions.The “t-test” was used to test the significant difference between means. $P \leq 0.05$ was considered statistically significant.

Sample size

Keeping the power of the study as 80% and the confidence limit at 95% to detect a 10% change in mean arterial pressure (MAP), the minimum sample size required is 31 in each group of studies and control respectively. Therefore 40 patients were included in each group. 80 patients classified as per American Society of Anesthesiologists (ASA) classes I and II scheduled for elective laparoscopic cholecystectomy were studied. The patients were randomly allocated into two groups of 40 each. Therefore, the sample size was 80.

Sampling techniques

Patients were assigned to the two groups of the study with the help of computer-generated random numbers by the process of randomization.

$P \leq 0.05$ was considered statistically significant.

Approval from Institutional Ethical Committee, Approval from Institutional Scientific Committee, Written Informed Consent from Each Patient and Participant Information Sheet were obtained.

RESULTS

From November, 2013 to December, 2014, a total 100 patients were assessed for study eligibility, but 9 patients failed to meet the inclusion criteria and 4 patients refused. The remaining 87 patients were included in the present study, but another 7 patients were converted to open cholecystectomy due to surgical indications. Thus, 80 patients were included in the final study and their data were collected and calculated.

Table 1: Distribution of age of the patients.

Age group (in years)	Group-M (n=40)	Group-N (n=40)	Total
25-34	4	3	7
Row%	57.1	42.9	100.0
Col%	10.0	7.5	8.8
35-44	10	11	21
Row%	47.6	52.4	100.0
Col%	25.0	27.5	26.3
45-54	14	12	26
Row%	53.8	46.2	100.0
Col%	35.0	30.0	32.5
55-64	6	7	13
Row%	46.2	53.8	100.0
Col%	15.0	17.5	16.3
65-74	3	3	6
Row%	0.0	50.0	100.0
Col%	7.5	7.5	7.5
75-84	3	4	7
Row%	42.9	57.1	100.0
Col%	7.5	10.0	8.8
Total	40	40	80
Row%	50.0	50.0	100.0
Col%	100.0	100.0	100.0
Mean±SD	50.05±12.07	51.00±13.53	

χ^2 = 0.56; p=0.98; Ns- Not Significant

Patient characteristics

There were 40 patients in each group. Thus, in this the patients in two groups were allotted in the ratio 1:1. Patient demographics are as per Table 1.

Corrected Chi-square test showed that there was no significant association between age and group (p=0.98).

The mean age (mean±SD) of the patients of Group-M was 50.05±12.07 years with the range 26-78 years and the median age was 48.5 years.

The mean age (mean±SD) of the patients of Group-N was 51.00±13.53 years with the range 28-79 years and the median age was 48.5 years. t-test showed that there was no significant difference in the mean age of the patients of the two groups (t78=0.33; p=0.74). Thus, the patients of the two groups were matched for age.

Chi-square test showed that there was no significant association between gender and group (p=0.81).

Table 2: Distribution of ASA of the patients.

ASA	Group-M (n=40)	Group-N (n=40)	Total
I	18	12	30
Row%	60.0	40.0	100.0
Col%	45.0	30.0	37.5
II	22	28	50
Row%	44.0	56.0	100.0
Col%	55.0	70.0	62.5
Total	40	40	80
Row%	50.0	50.0	100.0
Col%	100.0	100.0	100.0

Thus, the patients of the two groups were matched for gender. The ratio of gender was found as male: Female=0.6: 1

Corrected Chi-square test showed that there was no significant association between weight and groups (p=0.51). The mean weight (mean±SD) of the patients of Group-M was 66.02±8.79 kg with the range 48-80 kg and the median was 68 kg. The mean weight (mean±SD) of the patients of Group-N was 65.40±9.23 kg with range 48-Thus, the patients of the two groups were comparable in respect of their weights.

Table 3: Duration of surgery of the patients.

Duration of surgery (in minutes)	Group-M (n=40)	Group-N (n=40)	Total
20-29	23	14	37
Row%	62.2	37.8	100.0
Col%	57.5	35.0	46.3
30-39	17	26	43
Row%	39.5	60.5	100.0
Col%	42.5	65.0	53.8
Total	40	40	80
Row%	50.0	50.0	100.0
Col%	100.0	100.0	100.0
Mean±SD	29.45±3.98	30.82±4.03	

χ^2 = 3.21; p=0.07; Ns- Not Significant

Chi-square test showed that there was no significant association between duration of surgery and groups (p=0.07). The mean duration of surgery (mean±SD) of the patients of Group-M was 29.45±3.98 minutes with the range 24-38 minutes and the median was 28.5 minutes. The mean duration of surgery (mean±SD) of the patients of Group-N was 30.82±4.03 minutes with the range 22-39 minutes and the median was 30.0 minutes. t-test showed that there was no significant difference in the mean duration of surgery of the patients of the two groups (t78=1.52; p=0.13). Thus, the patients of the two groups were comparable in respect to their duration of surgery.

Table 4: Distribution of intra-operative MAP of the patients.

Time	Group-M (n=40)	Group-N (n=40)	t_{78}-value	P value
Baseline	91.35± 11.75	87.12±14 .21	1.45	0.15
At the time of pneumoperitonium (P_0)	92.62± 14.23	92.15±18 .01	1.23	0.22
After 5 Minute (P_5)	88.10± 12.26	96.47±23 .35	2.01	0.047*
After 10 Minute (P_{10})	87.02± 7.18	97.07±19 .21	3.09	0.002*
After 20 Minutes (P_{20})	87.57± 6.78	96.70±15 .07	3.49	0.0007*
After 30 Minutes (P_{30})	89.58± 12.52	96.96±14 .94	2.39	0.019*
Extubation	96.57± 5.97	105.70±1 5.77	3.52	0.0007*

*- Statistically Significant

Table 4 shows the distribution of intraoperative MAP of the patients.

The MAP of Group-N was significantly higher than that of Group-M in all time intervals except for baseline and at the time of pneumoperitoneum.

Table 5 shows distribution of intraoperative Heart Rate of the patients.

The mean magnesium concentration of Group-M was significantly higher than that of Group-N in post-operative period.

Table 7 shows the distribution of GTN usage among groups.

Chi-square test showed that there was a significant association between GTN and groups (p=0.0002). Test of proportion showed that the proportion of use of GTN in Group-N (60%) was significantly higher than that of Group-M (20%) (Z=5.77; p=0.0001).

Corrected Chi-square test on the use of phenylephrine showed that there was no significant association between phenylephrine and groups (p=0.73). Thus, there was no significant difference in the proportion of phenylephrine in group M (10%) and Group N (15%) (Z=1.06; p=0.28).

Corrected Chi-square test on the use of atropine showed that there was no significant association between atropine and groups (p=0.42). However, proportion of Atropine in Group-N (12.5%) was higher than that of Group-M (5%).

Table 5: Distribution of intra-operative heart rate of the patients.

Time	Group-M (n=40)	Group-N (n=40)	t_{78}-value	P value
Baseline	86.40±14 .97	83.52± 12.56	0.93	0.35
At beginning	78.35±12 .97	78.77± 13.94	0.13	0.89
After 5 Minute	76.12±9. 45	77.45± 8.01	0.67	0.50
After 10 Minute	82.27±12 .80	79.50± 8.46	1.14	0.25
After 20 Minutes	80.82±9. 91	86.25± 9.06	2.55	0.012 *
After 30 Minutes	89.23±9. 06	89.88± 8.29	0.33	0.74
Extubation	94.22±11 .42	104.40 ±11.36	3.99	0.000 1*

* - Statistically Significant

Proportions of headache in the two groups were equal (12.5%). Hence Chi-square test could not be applied. However, Fisher's Exact Test showed that there was no significant difference in the proportion of headache in the two groups (p=0.63).

Table 6: Serum magnesium concentrations (mmol litre-1).

Time	Group-M (n=40)	Group-N (n=40)	t_{78}-value	P value
Baseline	0.924±0.0 34	0.928±0.0 32	0.54	0.59
At beginning	0.939±0.0 32	0.929±0.0 32	1.39	0.16
Post-operative	1.322±0.0 29	0.929±0.0 31	58.5 5	<0.00 1*

* - Statistically Significant

Chi-square test (Table 8) showed that there was a significant association between nausea among the groups. (p=0.03). Thus, the proportion of nausea in Group-N (47.5%) is higher than Group-M (32.5%) (Z=2.16; p=0.03) and is statistically significant.

Table 9 shows the Chi-square test and there was a significant association between vomiting among the groups (p=0.048). Thus, the proportion of vomiting in Group-N (35%) is greater than Group-M (20%) (Z=2.37; p=0.017) and it is statistically significant.

Table 7: Distribution of GTN usage among groups.

GTN	Group-M (n=40)	Group-N (n=40)	Total
Yes	8	24	32
Row%	25.0	75.0	100.0
Col%	20.0	60.0	40.0
No	32	16	48
Row%	66.7	33.3	100.0
Col%	80.0	40.0	60.0
Total	40	40	80
Row%	50.0	50.0	100.0
Col%	100.0	100.0	100.0

X^2= 13.33; p=0.0002; s- Significant

In both groups there was no case of postoperative respiratory distress, bradycardia, and no history of visual problem, and hypotension. Moreover, there was no change in knee jerk reflex in both groups in the postoperative period.

Table 8: Distribution of nausea of the patients.

Nausea	Group-M (n=40)	Group-N (n=40)	Total
Yes	13	19	32
Row%	40.6	59.4	100.0
Col%	32.5	47.5	40.0
No	27	21	48
Row%	56.3	43.8	100.0
Col%	67.5	52.5	60.0
Total	40	40	80
Row%	50.0	50.0	100.0
Col%	100.0	100.0	100.0

X^2= 4.87; p=0.03; s- Significant

Table 9: Distribution of vomiting in patients.

Vomiting	Group-M (n=40)	Group-N (n=40)	Total
Yes	8	14	22
Row%	36.4	63.6	100.0
Col%	20.0	35.0	27.5
No	32	26	58
Row%	55.2	44.8	100.0
Col%	80.0	65.0	72.5
Total	40	40	80
Row%	50.0	50.0	100.0
Col%	100.0	100.0	100.0

X^2= 4.25; p=0.048; s- Significant

DISCUSSION

Since the introduction of laparoscopic cholecystectomy by Phillipe Mouret in 1987.[1] The procedure has become prevalent worldwide because of its benefits compared to open cholecystectomy that includes reduced tissue trauma, postoperative morbidity and hospital stay, and thereby reduced healthcare costs. For laparoscopic cholecystectomy, carbon dioxide is commonly used to create pneumoperitoneum.[2,3] Both carbon dioxide and pneumoperitoneum cause adverse cardiovascular effects.[4] Adverse cardiovascular changes are characterized by abrupt elevation of arterial pressure, systemic vascular resistance, and decreased cardiac output.[5] These vasopressor responses are mainly due to increased release of catecholamines, vasopressin or both.[6,7] Laparoscopic cholecystectomy is performed in reverse Trendelenburg position.[8] Cardiac output is further decreased secondary to the decreased venous return caused by the above said position. Severe increases in arterial pressure and heart rate can be deleterious to patients, especially for patients with compromised cardiac function.[9]

Attenuation of the circulatory response to pneumoperitoneum is usually done by opioids, vasodilators, beta blocking agents, and alpha2 adrenergic agonists.[10-13] Several drugs and regimes are often used to attenuate the hemodynamic stress response to pneumoperitoneum in laparoscopic surgery but there was not much study done yet using magnesium sulphate alone. Magnesium has the ability to block the release of catecholamines from both the adrenal gland and adrenergic nerve terminals.[14] Apart from that, magnesium can produce vasodilatation by acting directly on blood vessels and is also capable of attenuating vasopressin stimulated vasoconstriction.[15,16] Intravenously administered magnesium sulphate is capable of attenuating the adverse hemodynamic responses associated with endotracheal intubation also.[17] So in the present study we attempted by using IV 0.5 ml/kg of 10% $MgSO_4$ (50 mg/kg) just before pneumoperitoneum to see the effect of $MgSO_4$ in attenuating haemodynamic stress responses to pneumoperitonium in laparoscopic cholecystectomy and compared it with control group which received 0.5 ml/kg of NS.

Patients' characteristics (age, weight, sex, and ASA status) were comparable in both groups. Most data related to surgery and anaesthesia were comparable in both groups. Baseline hemodynamic values (MAP and HR) were also comparable in both groups.

In the study, we found that there is significantly less incidence of haemodynamic alteration in M gp compared to the control group N. Moreover, there is significantly less amount of GTN requirement in M gp compared to the control group.

Haemodynamic parameters, i.e., MAP and HR, were compared between the two groups. The result showed that MAP of group N (control) was significantly higher than that of group M in all time intervals of surgery (P5, P10, P20, P30 and at the time of extubation) except at baseline and at the time of PP (P0). So, it is seen that MAP is better maintained in M group compared to the control group. Additionally this test of proportion shows that the usage of

GTN (anti-hypertensive) in the control group was significantly higher than that of group M. Therefore, this result correlates with this hypothesis that usage of IV MgSO4 will attenuate the increase of arterial pressure during CO2 pneumoperitonium in patients undergoing laparoscopic surgery under GA.

Furthermore, it is seen that HR of control group was significantly higher than that of group M after 20 min (P20) of pneumoperitonium and after extubation. Therefore, it can be said that administration of MgSO4 just before pneumoperitonium can result in better haemodynamic stability and MAP and HR remained at a significantly lower level when compared to the control group. Moreover, it was seen that proportion of phenylephrine (vasopressor) requirement in gr M (10%) is less than gr N (15%) but it is not statistically significant. Moreover, the proportion of atropine usage in gr N (12.1%) was higher than gr M (5%), but it was not statistically significant. However, the mean magnesium ion concentration of group M was significantly higher than group N.

While comparing the complications, there was no significant difference in the incidence of headache between the two groups. In both the groups there was no case of post-operative respiratory distress, bradycardia, and no history of visual problem, and hypotension. Additionally, there was no change in knee jerk reflex in both groups. However, it was incidentally found that there was significantly more incidence of nausea and vomiting in the control group compared to M group.

There are very few studies regarding the use of magnesium sulphate solely for attenuating haemodynamic stress responses to pneumoperitonium. The result of this study is matched with the result of a prospective randomised controlled study by Jee et al which recommended that administering IV magnesium sulphate 50 mg/kg before pneumoperitoneum attenuates the arterial pressure increase during laparoscopic cholecystectomy.[18]

Similar result was also found by Paul et al who concluded that magnesium sulphate can be used in the bolus dose just before PP for attenuating the haemodynamic stress response of laparoscopic surgery. However, this study was conducted by using magnesium sulphate with a dosage of 30 mg/ kg in contrary to this study where we used magnesium sulphate 50 mg/kg of 10 % solution similar to the dosage used by Jee et al. However, they have not studied the requirement of antihypertensive and vasopressors in the magnesium group compared to the control group. However, this result clearly showed that requirement of antihypertensive was significantly less in the magnesium group compared to the control group.

Similar result was also found by Kalra et al who concluded that magnesium sulphate 50 mg/kg produces hemodynamic stability comparable to clonidine 1 μg/kg and recommended that administration of magnesium sulphate or clonidine attenuates the hemodynamic response to pneumoperitoneum.[19] However, they recommended that higher dosage of clonidine (1.5 μg/kg) producing better haemodynamic stability in laparoscopic surgery than magnesium sulphate and clonidine of dosage1 μg/kg. However, we have not done a comparative study using clonidine.

Likewise, Ray et al conducted a study on the effect of clonidine and magnesium sulphate on anaesthetic consumption, hemodynamic and postoperative recovery have shown that perioperative use of both clonidine and magnesium sulphate significantly reduced the requirement of propofol and fentanyl citrate.[20] They were able to attenuate the hemodynamic response to tracheal intubation and recommended magnesium sulphate can be used for attenuating the stress response to laryngoscopy and intubation. They have used magnesium sulphate with a dosage of 30 mg/kg as a bolus before induction and 10 mg/kg/hour by infusion to know the effect of magnesium sulphate on anaesthetic consumption, haemodynamics and postoperative recovery. However, we have not used magnesium sulphate in infusion dosage as we have not studied the effect of magnesium sulphate on anaesthetic consumption.

Chaithanya et al in their comparative study using magnesium sulphate and dexmeditomidine to reduce the stress response to laryngoscopy and intubation, also proved that very rarely used magnesium sulphate is an equally effective agent to attenuate the stress response.[21]

Piplai et al in their study shown perioperative administration of magnesium sulphate (30 mg/kg bolus followed by 10 mg/kg continuous infusion) in patients undergoing lumbar spine surgery significantly reduced the stress response to endotracheal intubation and anesthetic requirement along with significant reduction of postoperative shivering without any major adverse effects and concluded that IV magnesium sulphate may be useful for spine surgery for attenuating haemodynamic stress response.[22,23]

Similar recommendation was made by Rajan et al in their study published in Amrita Journal of Medicine, that pre-treatment with magnesium attenuated the hemodynamic responses to laryngoscopy and intubation.[24]

Likewise Hossain et al in their comparative study between the efficacy of magnesium sulphate and lignocaine in attenuating haemodynamic response to laryngoscopy and endotracheal intubation published in Journal of Armed Forces Medical College, Bangladesh showed that IV MgSO4 (50 mg/kg) is superior to IV Lignocaine (1.5 mg/kg) for attenuation of haemodynamic response to laryngoscopy and ET intubation.[25] However we have not done comparative study using lignocaine.

Also Altan et al in their study on effects of magnesium sulphate and clonidine on propofol consumption, hemodynamic, and postoperative recovery have observed that both clonidine and magnesium sulphate lowered propofol consumption and attenuated the hemodynamic response to tracheal intubation.[26]

Minami et al had shown an effective use of magnesium sulphate for intraoperative management of laparoscopic adrenalectomy for pheochromocytoma in a paediatric patient.[27]

However, there are limited studies available showing usages of magnesium sulphate only for attenuating the haemodynamic stress response to pneumoperitoneum. Most of the studies were done to show the effect of magnesium sulphate in attenuating the stress response to laryngoscopy and intubation. Similar haemodynamic alteration also happens after CO2 pneumoperitonium during laparoscopic surgeries, so in this study we used magnesium sulphate which has the ability to block the release of catecholamines from both the adrenal gland and the adrenergic nerve terminals, can produce vasodilatation by acting directly on blood vessels and also capable of attenuating vasopressin stimulated vasoconstriction for attenuating this haemodynamic stress responses.[14,15] Results showed that the use of magnesium sulphate just before pneumoperitoneum is very useful for attenuating haemodynamic alterations to pneumoperitoneum compared to the control group receiving only NS. Results clearly showed the intraoperative requirement of antihypertensive GTN is significantly much less compared to the control group during laparoscopic surgery which was not clearly depicted in previous literatures. Incidentaly, it was found that there is less incidence of postoperative nausea and vomiting in magnesium group compared to control group. No significant adverse effect of magnesium sulphate was noted in this study.

Moreover, magnesium sulphate is a cheaper drug and is readily available compared to other drugs and methods used for blunting haemodynamic stress responses.

The study concludes that magnesium sulphate can be safely used to attenuate the haemodynamic stress response to pneumoperitonium during laparoscopic surgery with an optimum dose regime.

Limitations

There are few drawbacks of the study. We did not include hypertensive patients and ASA - III/IV patients. Although we did not find any incidence of delayed recovery with a single bolus dosage of magnesium sulphate, but we have not studied the recovery time in this study. There are some studies which showed that magnesium sulphate can be used for post-operative analgesia but in our present study we have not measured post-operative analgesia after using magnesium sulphate.

In the future, this study can be extended to ASA III/IV patients, hypertensive patients as study populations, and postoperative analgesia can be taken into account if there is any by using a single bolus dose timing of administration of the drug, if the same dosage can prevent laryngocopic reflex along with haemodynamic alteration after pneumoperitonium if administered before intubation.

CONCLUSION

The result of this study clearly showed that the use of magnesium sulphate just before pneumoperitonium is very useful for attenuating haemodynamic alteration to pneumoperitonium compared to the control group and it is seen that the intraoperative requirement of antihypertensive GTN is significantly much less compared to the control group during laparoscopic surgery without increasing any adverse outcome. Hence, from this study we may conclude that the use of iv magnesium sulphate at a dose of 50 mg/kg just before pneumoperitonium is capable of attenuating the haemodynamic stress response to pneumoperitonium in laparoscopic surgery. Moreover, magnesium sulphate, being a cheaper and easily available drug compared to other drugs and methods used for blunting the haemodynamic stress response of pneumoperitonium can be a novel alternative.

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