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A Prospective Randomized Study of Effect of Magnesium Sulfate In Attenuating Artirial Blood Pressure In Elective Laparoscopic Abdominal Surgeries

Dr.Pawan Kumar Dutta[1*]
[1]*Associate Professor, Department of Anesthesia, Mahatma Gandhi Memorial Medical College, Jamshedpur, East Singhbhum, Jharkhand.*
Corresponding author: Dr.Pawan Kumar Dutta

ABSTRACT
INTRODUCTION: *Magnesium is well known to inhibit catecholamine release and attenuate vasopressin-stimulated vasoconstriction. We investigated whether i.v. magnesium sulphate attenuates the haemodynamic stress responses to pneumoperitoneum by changing neurohumoral responses during laparoscopic cholecystectomy.*
AIM AND OBJECTIVES: *The main objective of this study is to determine the effect of magnesium sulfate in attenuating artirial blood pressure in elective laparoscopic abdominal surgeries.*
MATERIALS AND METHODS: *100 patients who underwent laparoscopic abdominal surgery were randomly divided in to two groups, group A and group B. Group A received magnesium sulphate 50 mg/kg diluted in normal saline to total volume of 20 ml at 240 ml/hour over 5 minutes. The control group (group B) received same amount of normal saline (20 ml).*
RESULTS: *The baseline characteristics of the magnesium sulphate and Control groups were comparable and there was no significant difference between the groups. Systolic and Diastolic BP were higher in Control group than magnesium group. There was no significant difference in sedation levels in both groups.*
CONCLUSION: *In our study, we conclude that IV magnesium sulfate, when given before pneumoperitoneum attenuates arterial pressure increase during elective laparoscopic abdominal surgeries. This attenuation is apparently related to reductions in the release of catecholamine, vasopressin or both by magnesium sulfate. We also found that there is no adverse effect of magnesium like sedation or prolonged neuromuscular blockade at the dose we used.*
KEY WORDS: *magnesium sulfate, normal saline, BP.*

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I. Introduction

Laparoscopic surgical procedures aim to achieve a satisfactory therapeutic result while minimizing the traumatic and metabolic stress of the intervention. Tissue trauma is significantly less than conventional open procedures, thus results in less postoperative pain. Other advantages include smaller incisional sites, lower risks of wound complications, shorter hospital stay, more rapid return to normal activities, and cost saving.[3] Pneumoperitoneum required for the smooth conduct of laparoscopy, affects homeostasis and leads to alterations in cardiovascular, pulmonary physiology and stress response. Cardiovascular changes include increase in mean arterial pressure (MAP) with no significant change in heart rate, decrease in cardiac output and increase in systemic vascular resistance. The mechanism of the decrease cardiac output is multifactorial.

Various surgical methods like change in nature of insufflating gas, use of low intra-abdominal pressure, use of abdominal wall lift methods, have been tried to decrease the hemodynamic alterations seen with pneumoperitoneum, but all with practical limitations. Various anaesthetic interventions like use of epidural, segmental spinal, combined epidural and general anesthesia, use of various pharmacologic interventions like nitroglycerin, esmolol, have been used with varying success and practical limitations.

Magnesium blocks release of catecholamine from both adrenergic nerve terminals and adrenal gland. Intravenous magnesium sulphate inhibits catecholamine release associated with intubation. Magnesium also produces vasodilatation by acting directly on blood vessels, and in high doses, attenuates vasopressin mediated vasoconstriction .

II. Materials And Methods:

Inclusion criteria: 100 ASA I or II patients undergoing laparoscopic abdominal surgery were enrolled into the study.

Exclusion criteria:

- Known allergy to any drug in study,
- Cardiovascular disease patient
- Asthma patient
- Body weight >75 kgs,
- Hypermagnesemia,
- Kidney disease,
- Endocrine and metabolic disease,
- Diabetes mellitus,
- Patients on calcium channel blockers.

Patients were randomly divided into two groups according to computer generated randomization table. A patient received one of these solutions as a bolus intravenously 5 minutes after intubation but before pneumoperitoneum was created.

Group A: (Magnesium group) received magnesium sulphate 50 mg/kg 5 minutes after intubation over a period of 5 minutes diluted in normal saline to total volume 20ml @ 240 ml/hr through infusion pump but before pneumoperitoneum was created.

Group B: (control group) received 20 ml of normal saline @ 240 ml/hr through infusion pump 5 minutes after intubation over a period of 5 minutes but before pneumoperitoneum was created.

On the night prior to surgery all patients received tab Pantoprozole 40 mg & Tab Alprazolam 0.5 mg orally as premedication and patients were kept nil by mouth 6 hrs prior to surgery.

On arrival in the operating room, after confirming the identity of the patient, the consent was checked; the preoperative assessment was reviewed and up dated. The nil by mouth status of the patient was confirmed. Anesthesia machine, monitors and resuscitation equipments were checked. ECG, NIBP and pulse oximeter were applied and baseline readings of parameters like HR, SBP, DBP, MAP and SpO_2 were noted. Capnometer ($ETCO_2$) was attached after intubation.

All patients received premedication injection midazolam 0.02 mg/kg, injection fentanyl 2 µg/kg, and injection Glycopyrolate 4 µg/kg body weight intravenous.

Patients were pre-oxygenated with 100% O_2 for 3 minutes before induction. Induction was done with Inj. Propofol 2 mg/kg body weight i.v in both the groups and injection Rocuronium 0.8 mg/kg iv to facilitate endotracheal intubation. Bilateral air entry was confirmed by auscultation, $ETCO_2$ reading noted and the endotracheal tube was firmly secured using adhesive tape.

Anesthesia was maintained with oxygen and nitrous oxide mixture 50:50, sevoflurane end- tidal 1.5 to 2.5% and rocuronium 0.2 mg/kg intermittent boluses.

During surgery ringer lactate was infused in accordance with deficit, maintenance and blood loss. CO_2 pneumoperitoneum was created and intra-abdominal pressure maintained between 12-14 mm Hg. Patients were ventilated mechanically. Tidal volume and respiratory rate were adjusted to maintain end-tidal CO_2 between 35-45mm Hg. Monitoring of HR, SBP, DBP, MBP, SpO_2, $ETCO_2$ and TOF was done on a multi-channel monitor and TOF monitor. All patients were given injectionondanseteron 4mg, injection diclofenac sodium 75mg intravenous towards the end of surgery.

III. Statistical Analysis:

After data collection, data entry was done in Excel. Data analysis was done with the help of SPSS Software ver 15 and Sigmaplot Ver 11.Quantitative data is presented with the help of Mean, Std Dev, Median and IQR, comparison between study groups is done with the help of Unpaired t-test or Mann-Whitney test as per results of Normality test. Qualitative data is presented with the help of Frequency and Percentage table, association among study group is assessed with the help of Chi-Square test. p-value less than 0.05 is taken as significant level.

IV. Results:

Two groups of 50 each were labelled as Group A (magnesium sulfate 50 mg/kg)- Intervention group and Group B (Normal Saline 20 mL)- Control group. The mean of patients' age, weight and height were calculated between the two groups and were tabulated as shown below. Thus, it was concluded on the basis of the p value that the distribution of age, weight and height among the two groups were comparable and these factors did not have any influence on outcome.

Parameter	Group A	Group B	P value
Age (years)	36.97 ± 10.66	37.16 ± 8.41	0.1803
Weight (Kgs)	59.10 ± 7.59	61.33 ± 8.10	0.2234
Height (cms)	156.68 ± 6.59	160.68 ± 7.24	0.1741

Table 1: Patient demographic characteristics

Parameter	Group A	Group B	P value
PR	90.40±15.70	89.40±15.90	0.615
SBP	125.45±16.80	125.89±14.40	0.827
DBP	76.12±20.40	73.24±19.56	0.442
MAP	85.81±9.57	87±10.64	0.97

Table 2: Baseline vitals.

There was no significant difference in the base line pulse rate, systolic, diastolic and mean arterial pressure.

Parameter	Group A (Mean ±SD)	Group B (Mean ±SD)	P value
Pre induction HR	73.17±6.37	72.16±5.28	0.7651
Post induction HR	73.28±6.50	74.10±6.31	0.2281
HR 5 min	74.17±5.37	74.16±5.30	0.2297
HR 10 min	74.17±6.20	72.16±5.28	0.2641
HR 20 min	72.17±6.30	72.16±5.20	0.2361
HR 30 min	73.17±6.37	72.16±5.28	0.2709
Pre induction SBP	123.56±10.54	124.56±12.54	0.8365
Post induction SBP	120.46±10.34	122.46±11.34	0.8865
Systolic BP at 5 min	123.77±9.54	123.77±9.54	0.8265
Systolic BP at 10 min	121.56±10.57	125.56±10.57	0.8165
Systolic BP at 15 min	126.56±10.64	126.56±10.64	0.8865
Systolic BP at 20 min	123.56±13.54	127.56±13.54	0.8165
Pre induction DBP	75.36±6.38	84.36±6.38	<0.001
Post induction DBP	77.39±6.30	80.39±6.30	<0.001
DBP 5 min	72.37±6.38	79.37±6.38	<0.001
DBP 10 min	75.36±6.23	78.36±6.23	<0.001
DBP 20 min	75.40±7.78	73.40±7.78	<0.001
DBP 30 min	75.40±6.39	75.40±6.39	<0.001

Table 3: Comparition of heart rate, systolic blood pressure, diastolic blood pressure at different points of time between group A and Group B.

V. Discussion:

Laparoscopic surgeries are the most common surgeries performed in the present era. Alteration of haemodynamic status in laparoscopic surgeries are unavoidable. Pneumoperitoneum during laparoscopy produces significant haemodynamic changes which can be detrimental, especially in elderly and haemodynamically compromised patients.

In our study, we evaluate whether magnesium sulfate administration before pneumoperitoneum attenuates increases in arterial pressure during CO2 pneumoperitoneum in patients under general anaesthesia.

In our study, the systolic BP measurements were compared between Intervention groups and Control groups at pre-induction, post-induction at 5 mins, 10 mins, 20 mins and 30 mins post-induction. It was found that the mean systolic BP in Intervention group was lower compared to Control group after intubation, which was statistically significant.

In a study by Jee et al, 11 magnesium sulfate 50 mg/kg was administered over 2 - 3 mins before pneumoperitoneum in patients undergoing laparoscopic cholecystectomy was found to effectively attenuate the effects of pneumoperitoneum by decreasing the systolic BP. In that study, they compared the arterial pressure and heart rate at different time periods and found to have significant increase in systolic BP and diastolic BP in Control group compared to Intervention group.

In our study, the diastolic BP was also compared between Intervention and Control groups at 5 mins, 10 mins, 20 mins and 30 mins and it was found that the diastolic BP in Intervention group was lower compared to Control group which was statistically significant. In a study by Kalra et al, 13 they compared clonidine and magnesium sulfate in attenuating haemodynamic response to pneumoperitoneum. They found that both clonidine and magnesium were effective in reducing systolic BP and diastolic BP in Intervention group compared to Control group which was statistically significant. Hence, both the drugs were effective in decreasing stress response by reducing systolic and diastolic BP.

In one study, Jean LJ et al14 concluded that the raise in systemic vascular resistance was due to vasopressin and catecholamines, which were produced after pneumoperitoneum. They used clonidine before pneumoperitoneum and found that it reduced release and attenuated haemodynamic changes during laparoscopy.

Another study by Ishizaki et al5 tried to evaluate the safe intra-abdominal pressure during laparoscopic surgery. They observed significant fall in cardiac output at 16 mmHg of intra-abdominal pressure. Haemodynamic alterations were not observed at 12 mmHg of intra-abdominal pressure. Based on all these observations, the current recommendation is to monitor intra-abdominal pressure and to keep it as low as possible within 10 - 12 mmHg. In one study, Doyle15 gave antenatal magnesium sulfate therapy to women at risk of preterm birth. He established the effect of magnesium sulfate as a neuroprotective agent when given antenatally to women at risk of preterm birth.

Yosry16 in one study compared magnesium sulfate and sodium nitroprusside to induce controlled hypotension and to reduce choroidal blood flow during choroidal melanoma resection. Magnesium sulfate reduces intra-operative arterial pressure and provided good surgical conditions.

VI. Conclusion:

In our study, we investigated whether magnesium sulfate attenuates haemodynamic stress response to pneumoperitoneum during laparoscopic abdominal surgeries. The systolic and diastolic blood pressure increased abruptly after creation of pneumoperitoneum. The increase in arterial pressure was sustained during pneumoperitoneum in Control groups. But in magnesium group, haemodynamic response to pneumoperitoneum was effectively blunted. In our study, we conclude that IV magnesium sulfate when given before pneumoperitoneum attenuates arterial pressure increases during elective laparoscopic abdominal surgeries.

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