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A DESCRIPTIVE STUDY OF EFFECT OF MAGNESIUM SULFATE IN ATTENUATING ARTERIAL BLOOD PRESSURE IN ELECTIVE LAPAROSCOPIC SURGERIES

Dr. Kattamanchi Sreenivasulu[1], Dr. Kethireddy Koushik[2], Dr. Nagepalli Monika[3], Dr.R.Annamalai[4*], Dr C. Sunil[5]

[1]Assistant Professor, Department of Anesthesiology, SVMC/SVRRGGH, Tirupati.
[2]Post Graduate Department of Anaesthesiology, GMC, Kadapa.
[3]Post Graduate Department of Anaesthesiology, GMC, Kadapa.
[4*]Post Graduate Department of Anaesthesiology, GMC, Kadapa.
[5]Professor Department of Anaesthesiology, GMC, Kadapa.

Corresponding Author: Dr.R.Annamalai
Post Graduate, Department of Anaesthesiology, GMC, Kadapa.

Abstract

Introduction: For many surgical diseases, laparoscopic surgery has become the conventional treatment. The physiological repercussions of pneumoperitoneum, on the other hand, are cause for concern. The formation of pneumoperitoneum with carbon dioxide (CO2) presents a unique haemodynamic problem for patient anaesthesia management. The increased intra-abdominal pressure caused by pneumoperitoneum, combined with the head-up tilt, causes changes in cardiovascular, respiratory, stress, and acid-base physiology. Pneumoperitoneum causes alterations in the cardiovascular system such as an increase in mean arterial pressure, a decrease in cardiac output, and an increase in systemic vascular resistance, which can lead to altered tissue perfusion.

Materials and methods: In the haemodynamic changes, the most important outcome measure is systolic blood pressure. Thus, expecting a 15 mmHg difference in systolic blood pressure between the Intervention and Control groups, a 95% confidence interval, power 85% and population variance 500, the sample size calculated for each arm was 80. All adult male patients aged 18-50 years, American Society of Anaesthesiologists Grade I/II with informed written consent and Mallampati score of up to Class II undergoing elective laparoscopic abdominal surgery under general anaesthesia were included. Patients with systemic disorders, on calcium channel blockers and in whom the surgery could not be completed laparoscopically were excluded.

Results: Two groups of 80 each were labelled as Group A (magnesium sulfate 50 mg/kg)- Intervention group and Group B (Normal Saline 50 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.

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: laparoscopic surgery, magnesium sulfate, catecholamine, vasopressin.

INTRODUCTION

For many surgical diseases, laparoscopic surgery has become the conventional treatment. The physiological repercussions of pneumoperitoneum, on the other hand, are cause for concern. The formation of pneumoperitoneum with carbon dioxide (CO2) presents a unique haemodynamic problem for patient anaesthesia management. The increased intra-abdominal pressure caused by pneumoperitoneum, combined with the head-up tilt, causes changes in cardiovascular, respiratory, stress, and acid-base physiology. Pneumoperitoneum causes alterations in the cardiovascular system such as an increase in mean arterial pressure, a decrease in cardiac output, and an increase in systemic vascular resistance, which can lead to altered tissue perfusion.[1]

Magnesium inhibits catecholamine release from both adrenergic nerve terminals and the adrenal gland. Furthermore, magnesium causes vasodilation by acting directly on blood vessels, and high dose magnesium has been shown to reduce vasopressin-stimulated vasoconstriction and normalise vasopressin sensitivity.[2]

The reverse trendelenberg position, which is employed in laparoscopic cholecystectomy, also causes reduced venous return, which causes adverse cardiovascular reaction. Furthermore, substantial haemodynamic alterations can endanger patients, especially those with reduced heart function.[3] As a result, many medicines are explored to reduce the deleterious cardiovascular response during pneumoperitoneum, including opioid vasodilators, beta blocking agents, and alpha-2adrenergic agonists, but each has its own set of side effects and disadvantages. Although there has not been much research done utilising magnesium sulphate alone, magnesium sulphate has recently attracted attention for the same.[4] Magnesium has the ability to inhibit catecholamine release from both the adrenal gland and adrenergic nerve terminals. Apart from that, magnesium can produce vasodilatation by acting directly on blood vessels and is also capable of attenuating vasopressin stimulated vasoconstriction. Intravenously administered magnesium sulphate is capable of attenuating the adverse hemodynamic responses associated with endotracheal intubation also.[5]

The purpose of the present research was evaluating the effects of magnesium sulphate on arterial blood pressure in cases of elective laparoscopic surgeries.

MATERIALS AND METHODS

Study Period: Six months.

Study Design: Prospective randomised control trial.

Sample Size: In the haemodynamic changes, the most important outcome measure is systolic blood pressure. Thus, expecting a 15 mmHg difference in systolic blood pressure between the Intervention and Control groups, a 95% confidence interval, power 85% and population variance 500, the sample size calculated for each arm was 80.

Patient Selection

All adult male patients aged 18-50 years, American Society of Anaesthesiologists Grade I/II with informed written consent and Mallampati score of up to Class II undergoing elective laparoscopic abdominal surgery under general anaesthesia were included. Patients with systemic disorders, on calcium channel blockers and in whom the surgery could not be completed laparoscopically were excluded.

Study Groups

Group A: Magnesium Sulfate group- 40 patients.

Group B: Control group- 40 patients.

Randomization

A computer generated randomization allotted equal number of patients in each group.

Method of Collection of Data

A thorough pre-anaesthesia examination of the patient was conducted. The patient was examined the previous day. The procedure was explained and written informed consent was obtained. The patient was kept fasting since the previous night. Oral premedication of tablet Pantoprazole 40 mg, tablet Ondansetron 4 mg and tablet Alprazolam 0.25 mg were given at 10 p.m. the day before surgery and at 6 a.m. on the day of surgery. On the morning of surgery, patient was examined again. Once shifted to the Operation theatre, electrocardiogram, pulse oximeter, peripheral nerve stimulator, non-invasive blood pressure monitor and end-tidal CO2 (etCO2) monitor were attached. The patient's vitals were checked and noted at every 5 mins. Interval. The patient was preoxygenated for 3 mins. with 100% oxygen. Premedicated and induced with injection glycopyrrolate 0.01 mg/kg, injection midazolam 0.03 mg/kg mg, injection morphine 0.1 mg/kg, injection thiopentone 3-5 mg/kg, intubation facilitated with injection succinylcholine 1.5 mg/kg. Immediately after intubation, just before pneumoperitoneum, patient received magnesium sulfate 50 mg/kg in 50 mL normal saline (Group A) or normal saline 50

mL (Group B) infused over 3-5 minutes. Patient was then maintained on O2 in 50% air, isoflurane 2-3%, injection vecuronium for maintenance of muscle paralysis. CO2 pneumoperitoneum was created and intraabdominal pressure was maintained between 12 - 14 mmHg, EtCO2 between 35-45 mmHg. Isoflurane was turned off when last port was sutured. Residual neuromuscular blockade was reversed using injection neostigmine 0.05 mg/kg with injection glycopyrrolate 0.02 mg/kg when TOF count is 4. Extubation was performed using Double Burst Stimulation (DBS). Assessment Pulse Rate (PR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) readings were recorded before induction, post induction before pneumoperitoneum, every five minutes after pneumoperitoneum till thirty minutes, then every fifteen minutes till end of surgery. Sedation evaluated using Ramsay sedation scale.

Statistical Analysis: Data was analysed using computer software "Statistical Package for Social Sciences" (SPSS). Quantitative data is summarised using mean and standard deviation. The difference in mean between quantitative variable tested using student's 't' test.

RESULTS

Two groups of 80 each were labelled as Group A (magnesium sulfate 50 mg/kg)- Intervention group and Group B (Normal Saline 50 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 Mean (SD)	Group B Mean (SD)	P Value
Age (years)	32.85 (9.62)	30.15 (8.21)	0.1807
Height (cm)	158.58 (6.94)	160.45 (6.69)	0.2224
Weight (kg)	65.10 (10.21)	62.45 (6.61)	0.1721

Table 1: Demographics Profile

	Group A Mean (SD)	Group B Mean (SD)	P Value
Pre-induction HR	74.93 (7.47)	74.38 (7.79)	0.7482
Post-induction HR	76.40 (7.41)	74.38 (7.79)	0.2292
HR 5 mins	75 (7.004)	77.15 (5.824)	0.2124
HR 10 mins	74.63 (6.29)	74.15 (6.32)	0.7372
HR 20 mins	75.40 (6.15)	74.28 (6.22)	0.4183

HR 30 mins	72.25 (6.36)	73.78 (7.50)	0.3294

Table 2: Comparison of Heart Rate (HR) at different Point of Time between Group A and Group B

The heart rate between Intervention group and Control group were compared pre- and post-induction at 5 mins, 10 mins, 20 mins, 30 mins. There was no difference in Group A (Intervention group) and Group B (Control group).

	Group A Mean (SD)	**Group B Mean (SD)**	**P Value**
Pre-induction SBP	122.58 (11.64)	122.05 (11.03)	0.8365
Post-induction SBP	123.10 (12.02)	121.95 (13.05)	0.4457
Systolic BP at 5 minutes	118.0 (9.52)	135.7 (12.97)	0.001
Systolic BP at 10 minutes	113.7 (9.33)	139.8 (11.81)	0.001
Systolic BP at 20 minutes	113.4 (8.92)	139.50 (11.25)	0.001
Systolic BP at 30 minutes	113.3 (8.43)	137.9 (12.24)	0.001

Table 3: Comparison of Systolic Blood Pressure (SBP) at different Point of Time between Group A and Group B

The systolic BP between Group A (Intervention group) and Group B (Control group) were compared at 5 mins, 10 mins, 20 mins and 30 mins. There was reduction in systolic BP post-intubation in Intervention group, which was found to be statistically significant ($P < 0.001$).

	Group A Mean (SD)	**Group B Mean (SD)**	**P Value**
Pre-induction DBP	75.36 (6.39)	75.24 (6.88)	0.9484
Post-induction DBP	74.43 (5.96)	74.30 (7.98)	0.9369
DBP 5 mins	70.30 (4.16)	83.60 (11.45)	0.001
DBP 10 mins	67.71 (4.01)	86.20 (11.26)	0.001
DBP 20 mins	68.25 (3.18)	84.95 (10.67)	0.001
DBP 30 mins	68.76 (3.81)	83.71 (10.44)	0.001

Table 4: Comparison of Diastolic Blood Pressure (DBP) at different Point of Time between Group A and Group B

The diastolic BP between Group A (Intervention group) and Group B (Control group) were compared at 5 mins, 10 mins, 20 mins and 30 mins. There was reduction in DBP in Intervention group, which was statistically significant (P < 0.001).

Group	Sedation Scale Score		Total
	2 or Less	Above 2	
Intervention group	48 (60.0%)	32 (40.0%)	80 (100.0%)
Control group	48 (60.0%)	32 (40.0%)	80 (100.0%)
Total	96 (60.0%)	64 (40.0%)	160 (100.0%)

Table 5: Comparison of Sedation Score between Group A and Group B

There was no significant difference in the sedation in both groups.

DISCUSSION

In our study, we evaluate whether magnesium sulfate administration before pneumoperitoneum attenuates increases in arterial pressure during CO2 pneumoperitoneum in patients under general anaesthesia.[6]

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.[7]

In a study by Jee et al, 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.[8]

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.[9]

In a study by Kalra et al, 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.[10]

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. This attenuation is apparently related to reductions in the release of catecholamine, vasopressin or both by magnesium sulfate. In our study, we also found that there is no adverse effect of magnesium like sedation or prolonged neuromuscular blocked at the dose we used. The mean of patients' age, weight and height were calculated between the two groups. Thus, it was concluded that the distribution of age, weight and height among the two groups were comparable and these factors did not have any influence on outcome.

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