EFFECT OF MAGNESIUM SULFATE IN ATTENUATING ARTERIAL BLOOD PRESSURE IN ELECTIVE LAPAROSCOPIC ABDOMINAL SURGERIES

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ABSTRACT

BACKGROUND

A Prospective Randomised Control Trial was done to evaluate the effect of Magnesium Sulfate on haemodynamic parameters in patients undergoing elective laparoscopic abdominal surgeries.

MATERIALS AND METHODS

80 patients were divided into 2 groups of 40 each. Group A received Magnesium Sulfate 50 mg/kg and Group B received 50 mL Normal Saline.

Statistical Analysis used- The statistical difference in age, weight, height of the subjects and haemodynamic parameters such as pulse rate, systolic blood pressure, diastolic blood pressure and sedation were compared. Quantitative data is summarised using mean and standard deviation. The difference in mean between quantitative variable was tested using student's 't' test.

RESULTS

The baseline characteristics of the Intervention 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.

KEYWORDS

Magnesium Sulfate, Arterial Pressure, Anaesthesia- General, Laparoscopy, Pneumoperitoneum.

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BACKGROUND

Laparoscopic surgery has become the standard procedure for many surgical pathologies. However, the physiological effects of pneumoperitoneum are of concern.[1] The creation of pneumoperitoneum with carbon dioxide (CO_2) produces unique haemodynamic challenge for the anaesthetic management of patients. The increased intra-abdominal pressure during pneumoperitoneum together with the head-up tilt leads to alterations in cardiovascular, respiratory, stress response and acid base physiology. The changes in cardiovascular system associated with pneumoperitoneum includes an increase in mean arterial pressure, decrease in cardiac output and increase in systemic vascular resistance which can lead to altered tissue perfusion.

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These changes are most likely due to increased release of catecholamines, vasopressin[2] or both. Severe increases in arterial pressure can be a risk factor in patients with pre-existing essential hypertension, ischaemic cardiac disease or increased intracranial/intraocular pressure. Various surgical methods like change in nature of insufflating gas,[3] use of low intra-abdominal pressure,[4,5] use of abdominal wall lift methods[6] etc. have been tried to decrease the haemodynamic alterations seen with pneumoperitoneum, but all with practical limitations. Various anaesthetic interventions like use of epidural, segmental spinal,[7] combined epidural and general anaesthesia,[8] use of pharmacological interventions like nitroglycerine,[9] esmolol,[10] magnesium sulphate[11] have also been used with varying success.

Magnesium blocks the release of catecholamines from both adrenergic nerve terminals and the adrenal gland.[12] Moreover, magnesium produces vasodilatation by acting directly on blood vessels and high dose magnesium is found to attenuate vasopressin stimulated vasoconstriction and normalises sensitivity to vasopressin.

In this study, we have investigated the ability of magnesium sulfate to modulate hypertension and neurohormonal responses in patients undergoing elective laparoscopic abdominal surgeries using CO2 pneumoperitoneum.

Aims

To study the effect of magnesium sulfate on haemodynamic parameters during elective laparoscopic abdominal surgeries.

Primary Objective

To study the effect of magnesium sulfate on pulse rate, systolic blood pressure and diastolic blood pressure.

Secondary Objective

To evaluate sedation or any other side effect of the drug.

MATERIALS AND METHODS

Study Period

Six months.

Study Design

Prospective randomised control trial.

Study Approval

The study was approved by the Institutional Medical Ethics Committee and written informed consent was obtained from all included patients.

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 40.

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.

Randomisation

A computer generated randomisation 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 ($etCO_2$) 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. CO_2 pneumoperitoneum was created and intraabdominal pressure was maintained between 12 - 14 mmHg, $EtCO_2$ 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 used

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 40 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. Demographic Profile

Comparison of Observations

	Group A Mean (SD)	Group B Mean (SD)	T- value	df	P-value
Pre-induction HR	74.93 (7.47)	74.38 (7.79)	0.3222	78	.7482
Post-induction HR	76.40 (7.41)	74.38 (7.79)	1.2120	78	.2292
HR 5 mins	75 (7.004)	77.15 (5.824)	1.2574	78	.2124
HR 10 mins	74.63 (6.29)	74.15 (6.32)	0.3368	78	.7372
HR 20 mins	75.40 (6.15)	74.28 (6.22)	0.8138	78	.4183
HR 30 mins	72.25 (6.36)	73.78 (7.50)	0.9814	78	.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)	T-value	df	P-value
Pre-induction SBP	122.58 (11.64)	122.05 (11.03)	0.2071	78	.8365
Post-induction SBP	123.10 (12.02)	121.95 (13.05)	0.7666	78	.4457
Systolic BP at 5 minutes	118.0 (9.52)	135.7 (12.97)	6.9561	78	< 0.001
Systolic BP at 10 minutes	113.7 (9.33)	139.8 (11.81)	10.9674	78	< 0.001
Systolic BP at 20 minutes	113.4 (8.92)	139.50 (11.25)	11.4970	78	< 0.001
Systolic BP at 30 minutes	113.3 (8.43)	137.9 (12.24)	10.4651	78	< 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)	T -value	Df	P value
Pre-induction DBP	75.35 (6.39)	75.25 (6.88)	0.0650	78	0.9484
Post-induction DBP	74.43 (5.96)	74.30 (7.98)	0.0794	78	0.9369
DBP 5 mins	70.30 (4.16)	83.60 (11.45)	6.9036	78	<0.001
DBP 10 mins	67.70 (4.01)	86.20 (11.26)	9.7898	78	<0.001
DBP 20 mins	68.25 (3.18)	84.95 (10.67)	9.4875	78	<0.001
DBP 30 mins	68.75 (3.81)	83.70 (10.44)	8.5070	78	<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	24 (60.0%)	16 (40.0%)	40 (100.0%)
Control group	24 (60.0%)	16(40.0%)	40 (100.0%)
Total	**48 (60.0%)**	**32 (40.0%)**	**80 (100.0%)**

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

Chi-square= 0.00, Degree of Freedom= 1, P value= 1.00. There was no significant difference in the sedation in both groups.

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 CO_2 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 al[14] 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 catecholamine release and attenuated haemodynamic changes during laparoscopy.

Another study by Ishizaki et al[5] 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, Doyle[15] 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.

Yosry[16] 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.

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.

Moreover, it is found that vasodilatory effects of magnesium sulfate could provide haemodynamic stability during pneumoperitoneum. Magnesium sulfate can be recommended to avoid pressor response during the induction and maintenance.

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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