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EFFECTS OF INFUSION OF MAGNESIUM SULPHATE ON HEMODYNAMIC PARAMETERS, OCCURRENCE OF ARRHYTHMIAS, ANAESTHETIC REQUIREMENT, POST OPERATIVE OUTCOME IN CORONARY ARTERY BYPASS GRAFTING

Anaesthesiology

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ABSTRACT

Introduction:- Patients undergoing off pump Coronary bypass surgery are prone to have hemodynamic instability,intraoperative and postoperative arrythmias and myocardial infarction. So, many agents are used to overcome this response. Magnesium is one of them,it is an important determinant of resting membrane potential of cardiac cell membrane. Objective:-This study was aimed to determine the efficacy of magnesium sulphate on hemodynamic parameters, occurrence of arrythmias, anaesthetic requirement and postoperative outcome in OPCABG. Methodology:- 80 patients of either sex(25-60 yr of age)undergoing elective off pump coronary artery bypass grafting were randomly allocated to 2 groups(40 in each group).Patients of group A received infusion of magnesium sulphate 50mg/kg in 100ml saline over 15 min before induction and then 15mg/kg/hr till end of surgery while group C patients received infusion of normal saline of same calculated volume as of drug infusion. Results:- Pulse rate and blood pressure in patients of group A were significantly low from baseline compared to group C at all study point. Similar BIS value were achieved at lower fentanyl dose, both during induction and intraoperatively in patients of group A compared to group C and analgesic dose requirement was also low in group A. Conclusion:-Magnesium sulphate is effective in stabilizing the hemodynamics of patients during surgery,less incidences of ST segment elevation and ventricular arrythmias, reduced anaesthetic drug consumption and improved postoperative recovery.

KEYWORDS:

Magnesium Sulphate, off pump coronary artery bypass grafting, arrythmia, postoperative recovery, analgesic requirement,

Introduction

Patient with CAD are particularly prone to have hyperdynamic cardiovascular responses. Perioperative hypertension occurs in patients with history of hypertension. Patient with chronic heart failure are known to have increased vascular resistance & higher level of circulating epinephrine.Extracellular Magnesium deficiency results in the loss of cellular Potassium & gain of cellular Sodium, leading to an increase in myocardial excitability.(1)

The presence of hypomagnesemia following cardiac surgery results in higher atrial myocardial excitability and increased incidence of postoperative atrial fibrillation.(2) Magnesium Sulphate also produces dose dependant sedation and analgesia and also possesses antiarrhythmic properties.

Aim of the Study

This study was conducted to observe effects of Magnesium Sulphate infusion on hemodynamic parameters, occurrence of arrhythmia, BIS guided anaesthetic drug consumption and postoperative extubation time in off pump coronary artery bypass graft surgery.

Methodology

This double blinded,randomised ,prospective , placebo control study was conducted in the Department of Anaesthesiology, S.M.S Hospital and attached group of Hospitals, Jaipur with due permission from

the institutional ethical committee and a written informed consent. 90 patients between the age of 25-65 years with triple vessel disease and left ventricular ejection > 45% presenting for elective CABG surgery were taken and randomly allocated to one of the two groups (45 patients in each group). Sample size was calculated at 80%study power and 0.5%alpha error assuming 29% reduction in ST sgement elevation.sample size thus obtained in each group was 44.it was decided to take 40 patients in each group.

Group 'A' (Magnesium Sulphate Group): Received infusion of Magnesium Sulphate 50mg/kg in 100ml saline over 15 minutes before induction and then 15mg/kg/hr intraoperative till the end of surgery.

Group 'C' (Control Group): Received infusion of normal saline of same calculated volume as of drug infusion.

Patients with valvular dysfunction, kidney or liver insufficiency, severe respiratory disorder, preoperative left bundle branch block were excluded from the study. All patients were visited on the day prior to surgery and explained about the anaesthetic technique and perioperative course. written and informed consent obtained for performance of anaesthesia after complete explanation about the study and procedure. Patients were advised not to consume anything 8 hr prior to surgery and randomly divided(by chit in box method) in 2 groups.

On the day of surgery fasting status ,consent and PAC were checked. In the OT 18 gauge peripheral cannula was inserted and RL started. 5 lead ECG were put and then femoral artery cannulation was done. Invasive blood pressure monitoring ,pulse oxymeter, BIS electrodes were attached .Baseline parameter were recorded after 3 min.of femoral line insertion. central venous catheter was inserted in right IJV and pulmonary artery catheter was placed through this.Central venous and pulmonary artery pressure,spO2,heart rate,systoloic and diastolic blood pressure recorded before starting study drug.Drug infusion then commenced in double blinded manner. In premedication diazepam(0.2mg/kg)i.v.was given.Patient preoxygenated with 100% oxygen then fentanyl was given until patient become unresponsive to voice commands and tactile stimuli and BIS reaches to 60 then rocuronium 1mg/kg was given and positive pressure ventilation was done with 100% oxygen, endotracheal intubation was done and patients were ventilated to normocarbia with 100% O2 . Foley' s catheter and ryle's tube were inserted .For maintenance of anaesthesia according to BIS score target of 40-60 fentanyl was given and was maintained with diazepam and vecuronium at fixed interval.

Mechanical ventilation was adjusted to maintain end tidal co2 35-45.At the end of the surgery infusion was stopped and patients were transferred to ICU.

Intraoperative Assessment:

Patient heart rate, systolic and diastolic blood pressure, central venous pressure , pulmonary artery pressure, SpO2, end tidal CO2 were recorded at intubation, after skin incision, after sternotomy, and then after every 15 minutes. Arterial blood gas analysis every 45 minutes till end of surgery.BIS monitoring was done continuously. Need of fentanyl intraoperative was recorded. Urinary output was measured.

Postoperative assessment:

SBP, DBP, HR, CVP, PAP, SpO2 recorded every hour till time of extubation from end of operation . Time of response and carry out simple verbal commands and extubation was noted. Criteria for extubation was standard those used in surgical I.C.U.

Statistical Analysis: All data are analysed by paired 't' test within the group & student 't' test in between the group.

Results:
The two groups were comparable in terms of demographic data(age,sex,weight) as there were no statistically significant differences between these groups.(p value>0.05) (Figure -1)

FIGURE-1

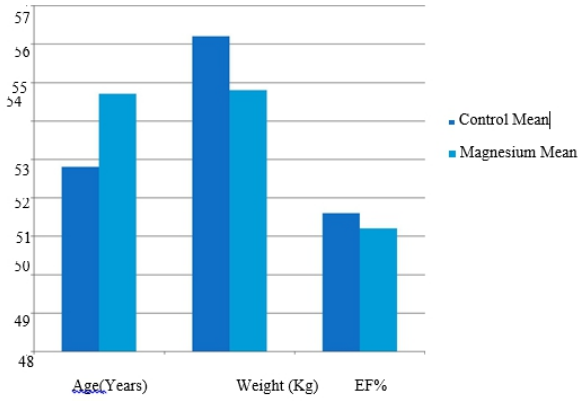

Table 1
HAEMODYNAMIC VARIABLES ON DIFFERENT TIME INTERVAL

Observation time	Mean pulse rate		Mean SBP		Mean DBP		Mean CVP		Mean PAP	
	A Group	C Group	A Group	C Group	A Group	C Group	A Group	C Group	A Group	C Group
Baseline	83	86.7	132.4	133.8	82.5	88	9.2	10.2	20.7	18.1
After infusion	73.3	87.2	121.1	134.7	79.2	88.5	8.9	10	19.9	18.1
After intubation	70.2	91.6	124.3	137.9	80.1	92.1	9.5	10.9	20.4	18
After skin incision	70.8	101.9	122.7	142	79.6	85.4	8.8	9.8	20.6	18
After sternotomy	73.8	99.9	123	145.7	80.4	93.6	8.7	9.9	20.6	18.1
Every 15 min.(intraop. Mean)	70.2	88.1	109.8	136.4	72.4	89	11	11.6	20.4	18
End of surgery	72.2	91.7	113.3	129.1	73.7	84.7	11.4	11.1	18.5	17.5
Every 1 hour(mean)	76.5	88.8	120.3	132.9	78.2	86.2	10.7	11	17.8	16.7
At extubation	80	91.7	122.3	134.3	80	87.8	10.7	11	17.5	16.5

Pulse rate was significantly low in group A compared to group C at all study point except baseline(table 1)

Systolic blood pressure was significantly decreased in group A compared to baseline while it was increased in group C.(table 1)
Diastoilic blood pressure was significantly low intraoperatively compared to baseline in group A while in group C no change was observed intraoperatively.(table 1)
No change was observed in Mean CVP in group A compared to baseline while in group C it was raised significantly(table 1)
Both group was comparable regarding PAP at all study point except just after infusion.

Table No.2
Comparison of Mean± SD of average dose of Fentanyl required in both the group

	A Group	C Group	P Value
Average dose of fentanyl for induction(microgram)	441.30±48.80	546±77.8	<0.001
Total amount of fentanyl(microgram)	1139±143.10	1474.80±246.10	<0.001

There was statisticaly significant difference in both groups in requirement of fentanyl dose for induction and total in both the groups. (p value <.05) (table 2)
Duration of surgery was comparable in both groups.

Time between end of surgery and extubation in A group was less than group C.There was statisticaly significant difference in both groups in extubation time.

Table No.3
Elevation of ST segment and ventricular arrythmias

		A-Group	C-Group	P-Value
ST Segment Elevetion	Present	4(10%)	10(25%)	<0.05
	Absent	36(90%)	30(75%)	
	Total	40	40	
Ventricular Arrythmia	Present	2(10%)	10(25%)	<0.05
	Absent	38(90%)	30(75%)	
	Total	40	40	

The elevation of ST segment was significantly less(10%)in magnesium group compared to control group(25%).Venticular arrythmias were also significantly less in the magnesium group(5%)as compared to the patients of control group(25%).(table 3)

Table No.4
Use of β blocker and calcium channel blockers

		A GROUP	C GROUP	P VALUE
	YES	2(5%)	18(45%)	
Beta blockers	NO	38(95%)	22(55%)	<.001
	TOTAL	40	40	
	YES	2(5%)	10(25%)	
Calcium channel blockers	NO	38(95%)	30(75%)	<.001
	TOTAL	40	40	

Patients requiring β blockers intraoperatively were less(5%)in the magnesium group as compared to control group(45%).Difference was statisticaly significant..Requirement of calcium channel blockers intraoperatively were also less(5%)in group A compared to group C(25%).Difference was statisticaly significant.(table no.4)

Discussion:
Temporary occlusion of the target artery and subsequent reduction in coronary flow during OPCAB may lead to hemodynamic instability , arrhythmias , ST segment elevation and depression .

In A group mean baseline pulse rate was 83±11.4. The pulse rate in A-group was significantly low from baseline at all times of recording including at the time of extubation. This fall in pulse rate may be attributed to the negative inotropic & by direct & indirect inhibitory effects of Magnesium on the sinoatrial node. Nakaigawa Y et al(3) and Yavuz Besogul et al(4) also reported significant dose dependant fall in pulse rate.While in control group, induction of anaesthesia and intubation resulted in significant increase in pulse rate that was statisticaly significant.These finding are consistent with the finding of Superto et al and Ferdi Menda et al.

The mean systolic blood pressure and diastolic blood pressure in A-group after infusion fell and change was statistically significant (p-value <0.05). The fall may be attributed to magnesium induced reduction in arteriolar tone & reduction in systemic vascular resistance. It remain low as compared to baseline at all time of study till extubation, while in control group, there was a statistically increase in blood pressure at all points of study .The findings were similar to Yavuz Besogul et al(4), Elsharnouby et al(7) and G.D Puri et al(8)

The mean change in central venous pressure was not significant in two groups at all recorded times.CVP was maintained between 12-15 cm of water intraoperatively. p value>0.05. Increase in CVP after intubation

may be due to effect of intubation.

The mean pulmonary artery pressure 15 minutes after start of infusion in A-group decreased significantly but not changed in C-group. It was comparable at all other points of study.The finding is consistent with those of SchechterM et al(9) who also described a decrease in pulmonary vascular resistance in the Magnesium group.

The adjuvant anaesthetic effect of Magnesium were highly significant(p value<0.05) because similar BIS value were achieved at lower fentanyl dose both during induction and intraoperatively in A-group compared to C-group.This finding could be explained by the sedative and analgesic effects of magnesium.Mechanism of analgesic action of magnesium is its antagonism of NMDA receptors. The finding coincided with the study done by Herbert Koinig et al(10) . The mean duration of surgery was 6.2±0.8 in A group and 6.4±0.6 in C group.There was no statisticaly significant difference in both the groups.

Time from end of surgery to extubation in A group was significant less than group C.Herbert koinig et al concluded the same result.

The use of beta blockers drug such as esmolol intraoperatively was significantly less in Magnesium group (5%) as compared to the control group. Our finding coincided with the study done by Yavuz Besogul et al(4.).

The intraoperative use of Calcium channel blocking drugs such as diltiazem was significantly less in Magnesium group (5%) as compared to the Control Group which further shows the hemodynamic stabilityprovided by magnesium sulphate in patients undergoing cardiac surgery.

There was a reduction in myocardial ischaemia in Group A compared to Group C as Magnesium improved myocardial oxygen balance by reducing the oxygen consumption through a decrease in heart rate and contractility. This finding coincided with a study done by Yavuz Besogul et al(4) and Ravn et al(13) .

The incidence of ventricular arrhythmias was significantly less in Group A (5%) as compared to Group C(25%) in the period of distal anastomosis in offpump CABG. which suggests the hemodynamic stability and efficacious mean arterial pressure as provided by Magnesium Sulphate in cardiac surgery.This finding coincided with the studies done by Yavuz Besogul et al(4) and Balser et at(14) .

Conclusion

To conclude ,our study result show that Magnesium Sulphate as an anaesthetic adjuvant was effective in stabilizing the haemodynamic of patients during and after surgery. Reduced the need of drugs such as beta blockers and Calcium Channel Blockers. Resulted in reduced incidence of ST segment elevation and ventricular arrhythmias. Effective in decreasing anaesthetic drug consumption and improve postoperative recovery without significant increase in incidence of side effects.

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