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SERUM MAGNESIUM LEVEL IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION AND ITS RELATION WITH ARRHYTHMIA

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Introduction: Magnesium (Mg) is the second most common intracellular cation after potassium (K). Mg is a cofactor in many enzyme systems in human cells and it has a predominant role in normal myocardial physiology. The role of magnesium in cardiovascular disease has received widespread attention. Magnesium has been implicated in the complications like arrhythmias in acute myocardial infarction. **Objective:** To know the serum magnesium level in patients with acute myocardial infarction and its relation with arrhythmia. **Methods:** A descriptive cross sectional study was conducted in the Department of Cardiology, Sheikh Fazilatunnessa Mujib Memorial KPJ Specialized Hospital, Gazipur, Bangladesh from January, 2020 to Jun, 2020. 50 patients with acute myocardial infarction were admitted. Data was collected from patients of any age and both sexes with acute myocardial infarction as determined by clinical features, ECG evidence and biochemical report. Blood sample for estimation of serum magnesium level was collected as early as possible within 24 hours of admission and 5th day of admission. After admission to CCU every patient was under continuous cardiac monitoring to see and record any arrhythmia within 5 days' onset of symptoms. **Results:** A total of 50 patients of acute myocardial infarction were included during the study period. The male to female ratio in the study group was 3.17:1 and the maximum incidence of acute myocardial infarction was seen in 5th and 6th decade. The most common presenting symptom was chest pain which was present in all patients and was associated with sweat in 60% of patients and breathlessness in 64% of patients and palpitation in 50%. In the study, the most common risk factor found was smoking (70%) followed by diabetes (36%) and hypertension (30%).

Anterior wall MI was found to be the most common type of MI (42%). Arrhythmia developed in (52%) patients and in majority (57.7%) of with anterior wall MI. In the study group mean serum magnesium level in 50 patients on day-1 is 1.86±0.39 and on Day-5 is 2.26±0.5. Mean serum magnesium level in 26 patients with arrhythmia was 1.65±0.26 on day-1 and 1.98±0.25 on day-5. In the study group, mean serum magnesium level in 24 patients without arrhythmia was 2.05±0.41 on day-1 and 2.48±0.52 on day-5. The difference between the magnesium level in patients with arrhythmia and without arrhythmia is statically significant on both day- 1 and day-5 ($p<0.001$). PVC was the most common type (42.5%) of arrhythmia. **Conclusion:** serum magnesium levels are significantly low in patients who develop arrhythmia in acute myocardial infarction.

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I INTRODUCTION

Coronary artery disease (CAD) is the highest killer in developed countries and is now an emerging epidemic in developing countries including Bangladesh. During recent years, more than six million people worldwide died of Ischemic heart disease, which was predicted to be the leading cause of deaths all over the world[1]. A study showed that acute myocardial infarction (AMI) is the leading cause of death in Bangladesh in the 4th decade of life[2]. So, in our population myocardial infarction emerged as a major killer and in the long run a major cause of morbidity also are becoming a significant burden on health care services in Bangladesh. In Bangladesh, the prevalence of CAD was estimated as 13/1000 in 2004.[3]. The role of magnesium in cardiovascular disease has received widespread attention. The relationship between hypomagnesemia and arrhythmias has been well documented. Several investigators have also noted the association between magnesium deficiency and coronary artery disease[4,5]. Magnesium (Mg) is the second most common intracellular cation after potassium (K)[6]. Mg is a cofactor in more than 300 enzyme systems in human cells and it has a predominant role in normal myocardial physiology. Magnesium improves myocardial metabolism, inhibits calcium accumulation and myocardial cell death. It improves vascular tone, peripheral vascular resistance, after load and cardiac output, reduces cardiac arrhythmias and improves lipid metabolism. Magnesium also reduces vulnerability to oxygen derived free radicals, improves endothelial function and inhibits platelet function including platelet aggregation and adhesion[7]. Myocardial magnesium concentration in patients with sudden death due to ischemic heart disease was found to be very low [8]. These findings directly correlated with the resultant complications of myocardial infarction, such as arrhythmias. The reduction of infarct size with magnesium has profound research and clinical implications[9]. Hypomagnesemia is an important risk factor for post AMI complication. It has been reported in various international studies that the serum Mg level is not only low at admission in cases of AMI but also continues to fall even for days after the onset of AMI [10,11,12]. It is unknown however, if the low cardiac content precedes the myocardial infarction or is result of it. Hypomagnesemia is present in acute myocardial infarction (AMI) as shift of magnesium from extra cellular to intracellular compartments occur[13].A number of clinical studies have shown a fall in the serum magnesium concentration within first 24 to 48 hours after

myocardial infarction[14]. A study from Rajasthan tried to determine the prognostic significance of serum magnesium levels in acute MI. Serum magnesium was found to be significantly lowered on the first day and it gradually rose to normal value by the twenty first day[15]. One study of Dhaka showed that there is a significant lower serum Mg and K level in AMI than chronic IHD and fall of serum Mg immediately after AMI may be due to the catecholamine induced high FFA which causes bindings and precipitation of Mg into the cells, resulting in a sudden decrease in total plasma Mg level[16]. As reported recently, intracellular magnesium levels are reduced in patients with AMI. This deficiency is not adequately reflected in serum measurements, since magnesium is predominantly an intracellular ion and less than 1% of total body magnesium is found in the intravascular compartment[17,18,19]. Some studies also found no significant change of serum magnesium. In the last decade several reviews have been concerned with the relevance of Mg in cardiac disease. Nevertheless, the role of Mg qualitatively and quantitatively is not fully appreciated by most physicians. Serum Mg measurements are not routinely performed. The consequence is that essential data are often lacking. To the best of my knowledge, very few studies have been made on serum magnesium level in acute myocardial infarction in Bangladesh. But it seems to be essential to measure the serum level of Mg in AMI to improve the management.

II MATERIALS AND METHODS

A descriptive cross sectional study was conducted in the Department of Cardiology, Sheikh Fazilatunnessa Mujib Memorial KPJ Specialized Hospital, Gazipur, Bangladesh from January, 2020 to Jun, 2020. 50 patients with acute myocardial infarction were admitted. Data was collected from patients of any age and both sexes with acute myocardial infarction as determined by clinical features, ECG evidence and biochemical report. Blood sample for estimation of serum magnesium level was collected as early as possible within 24 hours of admission and 5th day of admission. After admission to CCU every patient was under continuous cardiac monitoring to see and record any arrhythmia within 5 days' onset of symptoms.

Selection criteria: Those patients presenting to the hospital within 12 hours of onset of symptoms were taken.

Inclusion criteria:

Patients were considered to have acute myocardial infarction, only if they had two of the following criteria:

i. History of chest discomfort.
ii. ECG changes of acute myocardial infarction.
iii. Rise of cardiac enzymes.

Exclusion criteria:

i. Patients presenting 12 hours after the onset of chest pain.
ii. Patients with hypokalemia.
ii. Those who are taking diuretics.

Procedure of data collection: Data were collected from patients of any age and both sexes with acute myocardial infarction as determined by clinical features, ECG evidence and biochemical report. Blood sample for estimation of serum magnesium level was collected as early as possible within 24 hours of admission and 5th day of admission. After admission to CCU every patient was under continuous cardiac monitoring to see and record any arrhythmia within 5 days' onset of symptoms. Detailed history and thorough clinical examination was performed in a prefixed questionnaire form or data collection sheet after taking informed consent of the patients. They were then subjected to a battery of investigations necessary for the patients with acute myocardial infarction and arrhythmia.

Data analysis: Socio-demographic and clinical variables: Data for socio- demographic and clinical variables were obtained from all participants by the use of a pre- designed and

easily understandable questionnaire. After collection of all the data it was entered in the SPSS 16.0 statistical software.

III RESULTS

A total of 50 patients of acute myocardial infarction were included during the study period. The male to female ratio in the study group was 3.17:1 and the maximum incidence of acute myocardial infarction was seen in 5th and 6th decade.

Table-1: Age distribution of the study patients (n=50)

Age in years	Frequency	Percentage (%)
30-39	4	8.0
40-49	14	28.0
50-59	24	48.0
60-69	5	10.0
70-80	3	6.0
Total	50	100.0

[Table-1] showed the age distribution of the study respondent. Out of 50 cases the maximum incidence of acute myocardial infarction was seen in the 5th and 6th decades 14(28.0%) and 24(48.0%), followed by 7th and 8th decades 5(10%) and 3(6%). 4(8%) patients were in the age group of 4th decade.

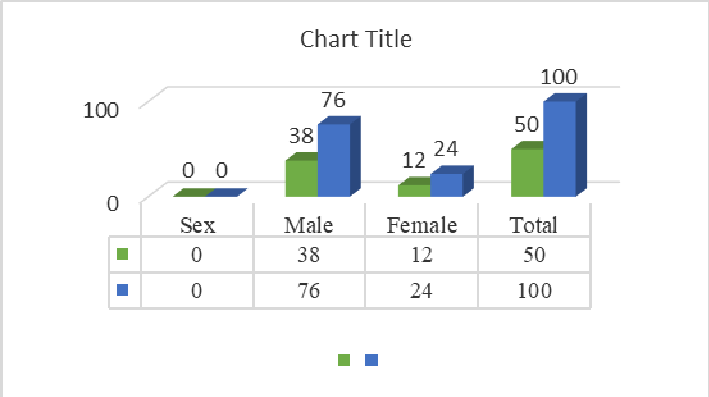

Figure-1: Sex distribution of the study patients (n=50)

Above table showed the sex distribution of the study respondent. In this study group of 50 cases, 38(76.0%) were males and 12(24.0%) were female patients with a male-female ratio of 3.17:1 [Figure 2].

Table-2: Occupational distribution of the study respondents (n=50)

Occupation	No. of cases	Percentage
Farmer	19	38.0
Businessman	10	20.0
Service	9	18.0
Housewife	12	24.0
Total	50	100.0

[Table-2] showed the occupational distribution of the study respondent. Among them 19(38%) patients were farmer, 12(24%) were housewife, 10(20%) were businessman and 9(18%) were service holder.

Table-3: Distribution of the study respondent according to risk factors (n=50)

Risk factors	No. of cases	Percentage
Smoking	35	70.00
Family history of premature coronary artery disease	10	20.00
Obesity	12	24.00
Hypertension	15	30.00
Diabetes mellitus	18	36.00
Dyslipidemia	6	12.00

In the study, smoking is the most common 70% risk factor found in the patients with acute myocardial infarction. In the present study, out of 50 patients, 12 (24%) were found to be obese based on criteria of National Cholesterol Education Programme. Waist circumference was measured in all patients, men whose waist circumference is more than 102 cm and females whose waist circumference is more than 88cm were considered to be obese. In the present study, of 50 patients 15 (30%) patients were found to be hypertensive. Patients whose blood pressure is ≥ 140/90 are considered to be hypertensive. In the present study, of the 50 patients, 18(36%) patients were found to be diabetics and 12 (24%) patients were found to be dyslipidemic. Family history of coronary artery disease found in 10(20.0%) patients [Table-3].

Table-4: Time of presentation of the study patients (n=50)

Time at presentation	No. of cases	Percentage
0 – 6 hours	27	54.00
7 – 12 hours	23	46.00
Total	50	100.0

In the present study, 27 (54%) cases presented to the hospital between 0-6 hours of onset of symptoms and 23 (46%) cases presented between 7-12 hours [Table-4].

Table-5: Presenting symptoms of study patients (n=50)

Features of presentation	No. of cases	Percentage
Chest pain	50	100.0
Sweating	30	60.0
Breathlessness	32	64.0
Palpitation	25	50.0

Above [Table-5] showed the features of presentation to the Hospital. Chest pain was the commonest symptom and was present in all of the patients in the present study (100%). In this study chest pain was associated with sweating in 30 (60%) of patients. Chest pain was associated with breathlessness in 32

(64%) patients. Palpitation associated with chest pain was present in 25 patients (50%).

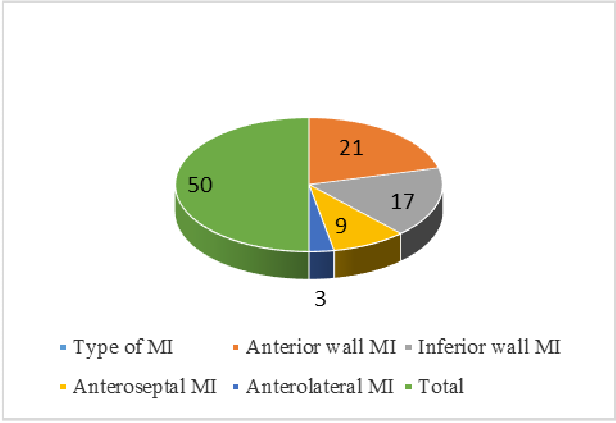

Figure-2: Types of Myocardial Infarction of the study patients (n=50)

Among 50 patients, 21 (42%) patients had anterior wall MI, 17 (34%) patients had inferior wall MI, 9 (18%) patients had anteroseptal MI and 3 (6%) patients had anterolateral MI [Figure-2].

Table-6: Distribution of patients with arrhythmia in acute myocardial Infarction (n=50)

Type of MI	Patients with AMI (n=50) No. (%)	Patients with arrhythmia (n=26) No (%)
Anterior wall MI	21 (42%)	15 (57.7%)
Inferior wall MI	17 (34%)	6 (23.1%)
Anteroseptal MI	9 (18%)	3(11.5%)
Anterolateral MI	3 (6%)	2(7.7%)
Total	50 (100.0%)	26(100.0%)

Among 50 of acute myocardial infarction, 21(42.0%) had anterior wall MI of which 15(57.7%) developed arrhythmia. 17(34%) patients had inferior wall MI of which 6(23.1%) developed arrhythmia. Of 9(18%) anteroseptal MI patients 3(11.5%) had arrhythmia and of 3(6%) anterolateral MI patients 2(7.7%) developed arrhythmia. Above table showed out of 50 patients of acute myocardial infarction 26(52%) developed arrhythmia [Table-6].

Table-7: Serum magnesium levels in patients with arrhythmias (n=26)

Serum magnesium levels (mg/dL)	Day-1 (n=26)	Percent	Day-5 (n=21)	Percent
<1.6	9	34.6	2	9.5
1.6 to 2.40	17	65.4	17	81.0
>2.4	-	-	2	9.5

Among 26 patients with arrhythmia 9(34.6%) had serum magnesium level <1.6 mg/dl and 17(65.4%) had serum magnesium level in between 1.6-2.40 mg/dl on day-1. Out of 21 patients who developed arrhythmia 2(9.5%) had serum magnesium level < 1.6

mg/dl, 17(81.0%) had level in between 1.6-2.40 mg/dl and 2(9.5%) had serum magnesium level > 2.40mg/dl on day-5 [Table-7].

Table-8: Serum magnesium levels in patients without arrhythmias (n=24)

Serum magnesium levels (mg/dL)	Day-1 (n=24)	Percent	Day-5 (n=23)	Percent
<1.6	3	12.5	-	-
1.6 to 2.40	19	79.2	14	60.9
>2.4	2	8.3	9	39.1

Among 24 patients without arrhythmia 3(12.5%) had serum magnesium level <1.6 mg/dl, 19(79.2%) had serum magnesium level in between 1.6-2.40 mg/dl and 2(8.3%) had level > 2.4 mg/dl on day-1. Out of 23 patients without arrhythmia 14(60.9%) had serum magnesium level in between 1.6-2.40 mg/dl and 9(39.1%) had level > 2.40 mg/dl on day-5 [Table-8].

Table-9: Mean serum magnesium level in Day 1 and Day 5 (n=50)

	Day-1	Day-5
Mean serum magnesium in 50 cases	1.86±0.39	2.26±0.50
Mean serum magnesium level in patients with arrhythmia	1.65±0.26	1.98±0.25

In this cross sectional study of 50 patients, the mean serum magnesium level on day-1 in all 50 patients was 1.86±0.39 and the mean serum magnesium level on day-5 was 2.26±0.5. In the present study, out of 50 patients 26 patients had significant ventricular premature contractions/ ventricular tachycardia/ ventricular fibrillation during their 5-days course in the hospital. The mean serum magnesium level in this group on day-1 was 1.65±0.26 and day-5 was 1.98±0.25 [Table-9].

Table-10: Comparison of Serum Magnesium level in patients with Arrhythimas and without Arrhythmias (Day-1) (n=50)

	No. of cases	Serum magnesium Day-1	t- value	p-value
Mean serum magnesium level in patients with arrhythmia	26	1.65±0.26	4.28	<0.001*
Mean serum magnesium level in patients without arrhythmia	24	2.08±0.41		

Data were analyzed by using independent student t-test, * = Significant

The above [Table-10] shows that out of 50 patients, 26 patients had arrhythmias. The mean value of serum magnesium on day-1 those with arrhythmias is 1.65±0.26 those

without arrhythmias is 2.08±0.41 (p<0.001). There is a significant difference in the magnesium level in patient with arrhythmias and without arrhythmias.

Table-11: Comparison of Serum Magnesium level in patients with Arrhythimas and without Arrhythmias (Day-5) (n=44)

	No. of cases	Serum magnesium Day-5	t- value	p-value
Mean serum magnesium level in patients with arrhythmia	21	1.98±0.25	4.14	<0.001
Mean serum magnesium level in patients without arrhythmia	23	2.48±0.52		

Data were analyzed by using independent student t-test, * = Significant

The above [Table-11] shows that serum magnesium in patient with arrhythmia on Day-5 is 1.98±0.25 those without arrhythmia is 2.48±0.5. There is a significant difference between these two (p<0.001). Mortality: In the above study out of 50 patients, 6 patients died during their 5 days hospital course. 4 patients died of ventricular tachycardia and ventricular fibrillation, 2 patients died of cardiac arrest. Mortality percentage was 12%.

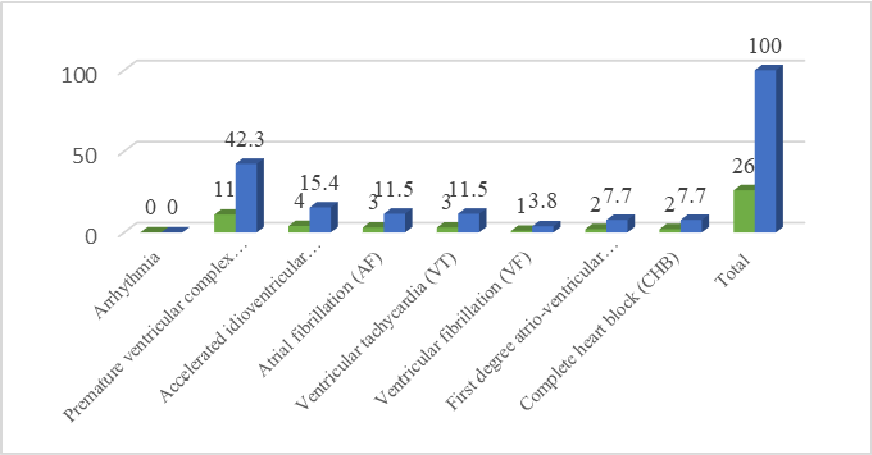

Figure-3: Distribution of pattern of arrhythmia in patients with acute myocardial infarction (n=26)

Study showed PVC occurred in 11 patients which was the most common (42.3%) arrhythmia among 26 acute MI patients who developed various arrhythmias during their 5-day course in hospital [Figure 3].

IV DISCUSSION

Heart disease is the lethal cause of death and is more common in adult male. In the present study maximum number of cases of acute myocardial infarction were in the age group 50 to 59 (48%) and the cases were predominately male (76%) suggesting that it is predominately a disease of men. Yadav P et al[21] showed that Acute MI is more common in 51-60 (32%) age group & in male (72%) which is similar to this study. There are many modifiable and non-modifiable risk factors of coronary heart disease. The role and relative

importance of many risk factors for the development of coronary, peripheral and cerebrovascular disease have been defined in experimental animal studies, epidemiological studies and clinical interventional trials. The effect of risk factors is multiplicative rather than additive. People with a combination of risk factors are at greatest risk and so assessment should take account of all identifiable risk factors. The present study showed that commonest risk factors in Acute MI were smoking (70%), DM (36%), hypertension (30%), Obesity (24%), hyperlipidemia (12%). In Steg PG[21] study they found that commonest risk factors in Acute MI were smoking (62%), hypertension (50%), DM (21%), Prior infarction (19%), hyperlipidemia (35%) which is very close to the current study. Kelly A.M. et al[22] showed that family history contributes 25% risk of ACS. Whereas present study showed 20% reflecting the similar risk. Pain is the cardinal symptom of an acute myocardial infarction but breathlessness, sweating, vomiting, and collapse, palpitation are also common features. The pain occurs in the same sites as angina but is usually more severe and lasts longer; it is often described as a tightness, heaviness or constriction in the chest. In acute MI, the pain can be excruciating, and the patient's expression and pallor may vividly convey the seriousness of the situation. The present study showed that among the acute MI patients the commonest symptoms were chest pain (100%), sweating (60%), breathlessness (64%), and palpitation (50%). Yadav P et al[23] showed the commonest symptoms were chest pain (94%), sweating (78%), breathlessness (67%), and palpitation (58%) which is very similar with the present study. Complications are commonly seen in all forms of acute myocardial infarction, although the frequency and extent vary with the severity of ischemia and infarction. Major mechanical, structural and electrical complications are seen with significant, often transmural infarction. Misiriya R.K.J et al[24] found that among the patients with acute MI, 50% had inferior wall, 43.97% had anterior wall infarctions, 6.03% had lateral wall and isolated posterior wall infarctions. The present study showed 42% had anterior wall infarctions, 34% had inferior wall infarctions, 18% had anteroseptal wall infarctions and 6.0% had lateral wall infarction. Present study showed of 57.7% of the total anterior wall MI patients developed arrhythmia in their 5 days stay in hospital. Arrhythmia developed in 23.1% of inferior wall MI patients, 11.5% and 7.7% of anteroseptal and anterolateral MI patients respectively. In the present study of 50 patients, the mean serum magnesium level on day-1 in all 50 patients was 1.86±0.39 and the mean serum magnesium level on day-5 was 2.26±0.5. Abraham et al[25] reviewed magnesium level of 65 consecutive patients with an admission diagnosis of acute myocardial infarction. Serum magnesium concentration were low in patient who had AMI (mean 1.70 mg/dl, $p<0.001$) or acute coronary insufficiency (mean 1.61 mg/dl, $p<0.01$), but not in the control group or patients with non-cardiac chest pain (mean 1.91 mg/dl). Sachadeva et al[26] (1978) in 30 patients of myocardial infarction determine the magnesium levels within 24 hours, 5th and 8th day and reported as 1.83±0.087 mgm%, 1.91±0.149 and 1.97±0.089 as against control of 2.44±0.162 mgm%. The values were statistically lower on all the three days showing a progressive rise which is similar to the present study. In the present study, the serum magnesium level on day-1 was significantly lower (mean1.65±0.26) in patients with arrhythmias than those without arrhythmia (mean2.08±0.41) ($p<0.001$). There was an increase in serum magnesium from Day-1 to Day-5 in both those with arrhythmias (mean 1.98±0.25) and those without arrhythmias (mean2.48±0.52) and the difference in both group is significant ($p<0.001$). Misiriya R.K.J et al[24] found that in

STEMI commonest arrhythmia encountered was premature ventricular complex (PVC) 40.04%. Other arrhythmias observed were accelerated idioventricular rhythm (AIVR) 18%, ventricular tachycardia (VT) 13.98%. Misiriya R.K.J et al[24] found that in acute MI commonest arrhythmia encountered was atrial fibrillation (AF) 8.05% and ventricular fibrillation (VF) 5.36% patients. The present study showed commonest arrhythmia were PVC 42.3%, AF and VT 11.5%, AIVR 15.4% and CHB 7.7%. Dyckner T et al[27] during their 1½ years, 905 admissions, 342 with acute myocardial infarction, 563 other diagnoses were treated in the CCU on admission both acute myocardial infarction and non AMI group had significantly lower serum magnesium level than as reference group. The incidence of serious ventricular premature beats, ventricular tachycardia and ventricular fibrillation on admission was significantly higher in the hypomagnesemic patients with acute myocardial infarction which is similar to the present study.

VI CONCLUSION

In the study, the most common presentation symptom was chest pain and is associated with sweat in 60% of patients and breathlessness in 64% of patients and palpitation in 50% patients. In the study, the most common risk factor found was smoking followed by diabetes and hypertension. Anterior wall MI was found to be the most common type of MI (42%) and arrhythmia occurred in 57.7% patients with anterior wall MI. In the study group mean serum magnesium level in 50 patients on day-1 is 1.86±0.39 and on Day-5 is 2.26±0.5. Mean serum magnesium level in 26 patients with arrhythmia was 1.65±0.26 on day-1 and 1.98±0.25 on day-5. In the study group, mean serum magnesium level in 24 patients without arrhythmia was 2.05±0.41 on day-1 and 2.48±0.52 on day-5. The difference between the magnesium level in patients with arrhythmia and without arrhythmia is statically significant on both day- 1 and day-5($p<0.001$). PVC was the most common type (42.5%) of arrhythmia.

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