

# Study on Serum Magnesium Levels in Acute Myocardial Infarction

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## Abstract:-

### ➤ *Background of Study*

Magnesium has been implicated in the pathogenesis of myocardial infarction and its complication like arrhythmia. 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 aggregation and adhesion.

### ➤ *Objective*

To know the relationship between the serum magnesium levels and arrhythmias in patients with acute myocardial infarction.

### ➤ *Method*

By using simple random method, 60 cases of acute myocardial infarction admitted in KATURI MEDICAL COLLEGE & HOSPITAL, GUNTUR over a period of 11 months, i.e., between July 2021 to May 2022.

### ➤ *Results*

There is significant difference in Magnesium levels in patients with and without arrhythmias.

### ➤ *Conclusion*

In acute myocardial infarction, patients with low magnesium levels are more prone to get arrhythmias. So magnesium treatment can be considered in patients with acute myocardial infarction with low magnesium levels.

**Keywords:-** Magnesium, Myocardial Infarction, Arrhythmias.

## I. INTRODUCTION

Pasteur (1860) showed that yeast will grow only when the culture medium contains inorganic compounds. In the human body there is a tendency to maintain the proper fluid balance, not only as a whole but between the three compartments of intracellular, interstitial and intravascular spaces. This is maintained by an intricate play of hemodynamic, electrolyte and other forces.

The field of mineral metabolism is at present in a phase of rapid expansion. It has become apparent that not only proteins, fats and carbohydrates, but also minerals are essential to life. Now the significance of traces not only of vitamins and other active organic substances, but also of minerals is under intensive investigation. Magnesium has been implicated in the pathogenesis of Acute Myocardial Infarction and its complications like arrhythmias. It plays a significant role in other cardiovascular diseases as well. Magnesium ions are considered essential for the maintenance of the functional integrity of the myocardium.

Myocardial magnesium concentration in patients with sudden death due to ischemic heart disease was found to be very low. It has been pointed out that magnesium has a vital role in ventricular fibrillation, which causes sudden death in IHD.

Also myocardial infarction is one of the common causes of death at present where prognosis depends on multiple factor of which many still remain unexplained. This study is designed to know the relationship between serum magnesium levels and arrhythmias in patients with acute myocardial infarction.

### ➤ *Aims and Objectives*

To know the relation between level of serum magnesium and arrhythmias in patients with acute myocardial infarction who are presenting with in 12 hours of onset of symptoms.

## II. MATERIALS AND METHOD

### ➤ Data Source

60 Cases of Acute Myocardial Infarction , admitted to Intensive Coronary Care Unit of Thanjavur Medical College Hospital over 11 months ie., between July 2014 to May 2015.

### ➤ Inclusion Criteria For Patients

Patients were diagnosed to have Acute Myocardial Infarction, only if they had 2of the following characteristics:

- Chest Discomfort.
- ECG features of Acute Myocardial Infarction.
- Elevation of Cardiac Enzymes.

Only those patients presenting to the hospital within 12 hours of the onset of symptoms were included in the study.

### ➤ Exclusion Criteria for Patients

Patients with hypokalemia.

Selected patients were subjected to detailed history and thorough physical examination and routine investigations like hemoglobin, Total leucocyte count, Urine examination, blood sugar, Blood urea, Serum creatinine, serum electrolytes , fasting lipid profile, cardiac enzymes and Echocardiography was done in all cases. Serum Magnesium level was done on Day-1 and Day-5.

### ➤ Method of Serum Magnesium Estimation:

#### • Method:

Calorimetric end point test.

#### • Reagent :

Xylidyl blue reagent.

#### • Magnesium Standard: 2.5 mg/dl.

#### • Principle:

At alkaline PH , Magnesium reacts with Xylidyl blue and produces a chelating red compound. The increase in red colour or decrease in blue colour is proportional to magnesium concentration.

#### • Specimen:

Non hemolysed sserum or Lithium Heparin plasma may be analysed since the magnesium concentration inside erythrocytes is 10 times greater than that in ECF, Hemolysis should be avoided and serum should be separated from the cell as soon as possible.

#### • Reference Range for Magnesium:

Serum Magnesium : 1.6 -2.4 mg/dl

## III. RESULTS

Table 1 Age and Sex Distribution of the Study Group

Age Range(Yrs)	Male	Female	TOTAL
30-40	8	1	9
40 – 50	9	5	14
50 – 60	10	5	15
60 – 70	14	4	18
70 – 80	4	-	4

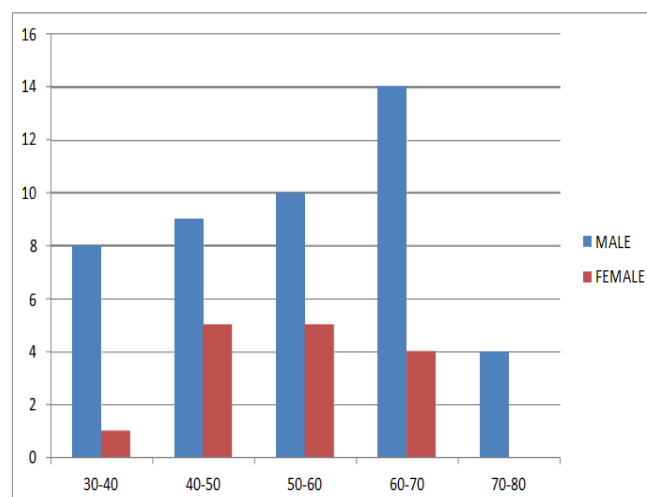


Fig 1 Age and Sex Distribution of Study Group

In this study of 60 cases, 48 were males and 12 were females with male female ratio of 4:1. The maximum incidence of acute myocardial infarction was seen between 6th and 7 th decades of life followed by fifth and sixth decades. 30 % of patients were in the 6 th to 7 th decades and 25 % of patients were in the fifth and sixth decades.

Table 2 Religion Wise Distribution of Cases

Religion	No. Of Cases	Percentage
Hindus	48	80 %
Muslims	12	20%

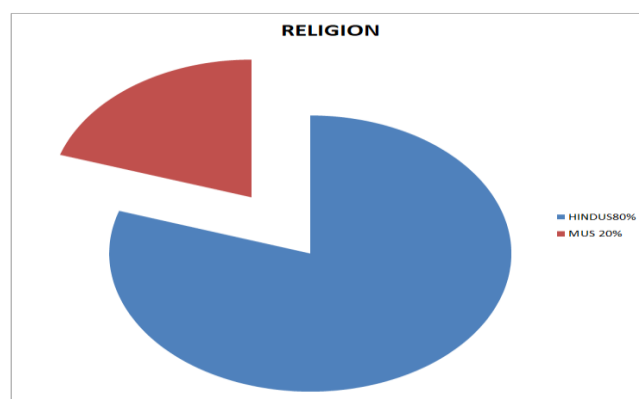


Fig 2 Religion Wise Distribution of Cases

### ➤ Diet

In this study of 60 patients, 25 percentage (15 patients) were vegetarian by diet and 75percentage ( 45 patients ) of patients consumed mixed diet. Non – vegetarians have higher risk for acute myocardial infarction owing to the higher cholesterol content in the diet.

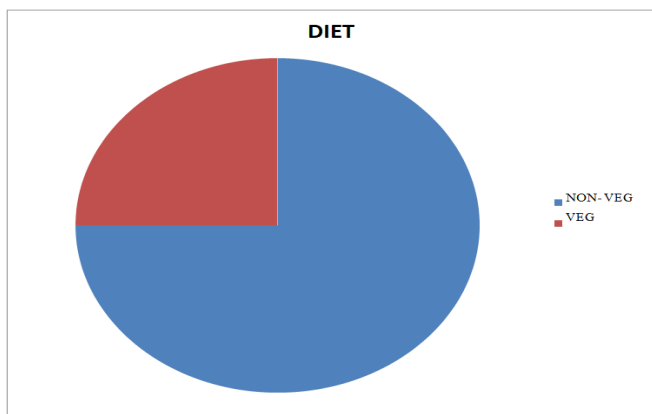


Fig 3 Diet

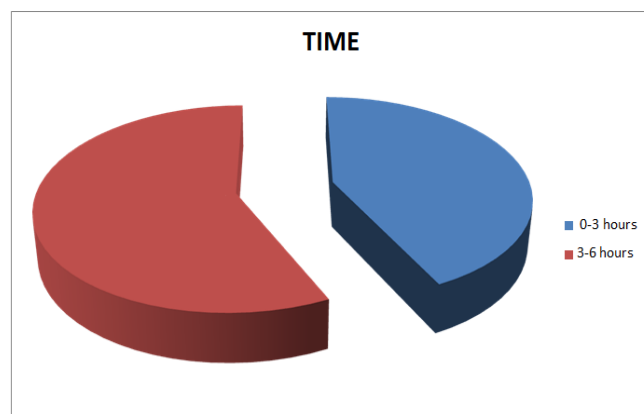


Fig 4 Time of Presentation

Table 3 Risk Factors

Risk Factors	No. Of Cases	Percentage
Smoking	45	75%
Family History Of Htn,Ihd,Dm,Cva	15	25%
Obesity	12	20%
Hypertension	30	50%
Diabetes Mellitus	21	35%
Dyslipidemia	15	25%

➤ *Smoking*

In the study, smoking is the most common risk factor found in the patients with acute myocardial infarction. Cigarette smoking accelerates coronary atherosclerosis in both sexes and at all ages and increases the risk of thrombosis, plaque instability and myocardial infarction. In addition, by increasing myocardial oxygen needs and reducing oxygen supply, it aggravates angina.

➤ *Hypertension*

In the present study, out of 60 patients, 30 patients were found to be hypertensive based on history and blood pressure measurement. In this study Hypertension was found to be the second main risk factor (50%) for the development of acute myocardial infarction. In the present study, out of 60 patients, 21 patients (35%) were found to be diabetic and 15 patients (25%) were found to have dyslipidemia.

Table 4 Time of Presentation

Time At Presentation	No. of Cases	Percentage
0 – 3 Hours	15	25%
3 - 6 Hours	30	50%

In the present study, 30 cases (50% of cases) presented to hospital between 3-6 hours of onset of chest pain and 15 cases (25%) cases presented between 0 – 3 hours.

➤ *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 is associated with sweating 15 (25%) of patients. Chest pain is associated with breathlessness in 15 (25%) of the patients. Palpitation associated with chest pain was present in 6 patient (10%).

➤ *Variation in type of Myocardial Infarction*

In the present study of 60 patients, 25 (41.66%) patients had anterior wall MI, 20 (33%) patients had inferior wall MI and 15 (25%) patients had anteroseptal MI

➤ *Serum Magnesium in Acute Myocardial Infarction in Relation To Arrhythmia*

In this cross sectional study of 60 patients, the mean serum magnesium level on day-1 in all 60 patients was 1.78±0.32 and the mean serum magnesium level on day-5 was 2.32±0.44.

➤ *Mean Serum Magnesium Level in the Group with Arrhythmia on Day-1 and Day-5*

In the present study, out of 60 patients 30 patients had significant ventricular premature contractions/ventricular tachycardia /ventricular fibrillation during their 5-days course in the hospital.

Table 5 Serum Magnesium Levels in Patients with Arrhythmias

Serum Magnesium(Mg/Dl)	Day – 1	Percent	Day - 5	Percent
< 1.6	12	20%	6	10%
1.6 to 2.50	18	30%	24	40%
>2.5	-	-	-	-

Table 6 Serum Magnesium Levels in Patients without Arrhythmias

Serum Magnesium (Mg/Dl)	Day 1	Percent	Day 5	Percent
<1.6	6	10%	-	-
1.6 – 2.5	18	30%	21	35%
>2.5	6	10%	9	15%

Table 7 Mean Serum Magnesium Level

	DAY 1	DAY 5
Mean serum Mg in 60 cases	1.78 +_ 0.32	2.32 +_ 0.44
Mean serum Mg level in patients with arrhythmia (30 patients)	1.58 +_ 0.30	1.96 +_0.32

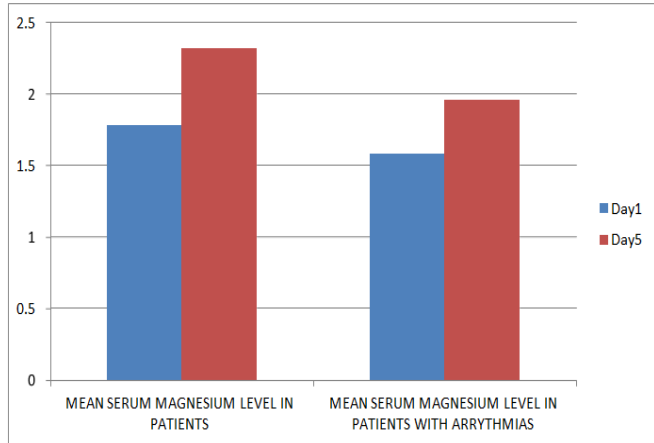


Fig 5 Mean Serum Magnesium Level

Table 8 Comparison of Serum Magnesium Level in Patients with Arrhythmias and without Arrhythmias (Day – 1)

	No of Cases	Serum Magnesium (Day 1)	P-Value
Mean serum Mg in patients with arrhythmia	30	1.58 +_ 0.30	<0.001
Mean serum mg level in patients without Arrhythmia	30	2.10 +_0.50	

The above table shows that out of 60 patients, 30 patients had arrhythmias. The mean value of serum magnesium on day-1 those with arrhythmias is 1.58±0.26 those without arrhythmias is 2.10±0.4 (p<0.001). There is a significant difference in the magnesium level in patient with arrhythmias and without arrhythmias.

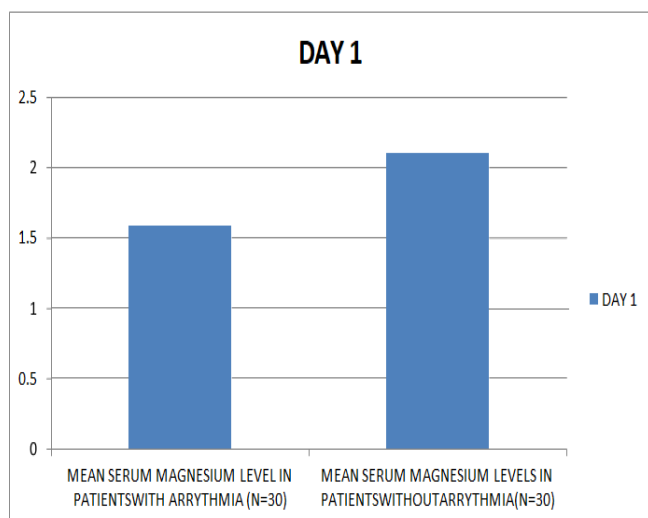


Fig 6 Comparison of Serum Magnesium Level in Patients with Arrhythmias and without Arrhythmias (Day – 1)

Table 9 Comparison of Serum Magnesium Level in Patients with Arrhythmias and without Arrhythmias (Day – 5)

	No of Case	Serum Mg Day-5	P- Value
Mean serum magnesium levels in patients with arrhythmia	30	1.96+_0.32	<0.001
Mean serum Mg levels in patients without arrhythmia	30	2.56+_0.48	

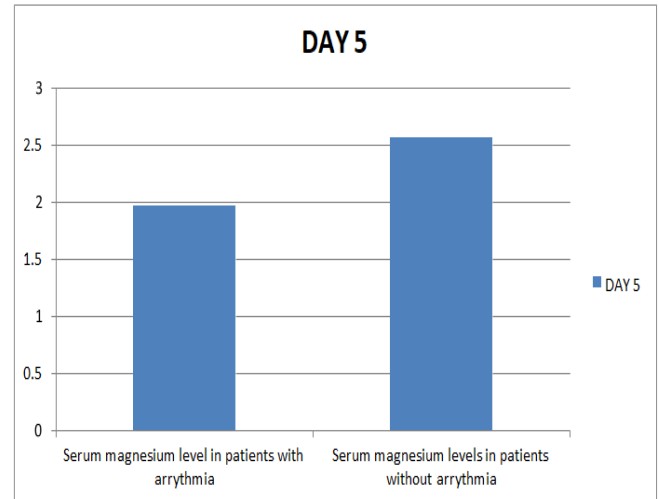


Fig 7 Comparison of Serum Magnesium Levels in Patients with Arrhythmias and without Arrhythmias (Day-5)

➤ **Mortality:**

In the above study of 60 patients, 12 patients died during their 5 days hospital course. 8 patients were died of ventricular tachycardia or ventricular fibrillation, 4 patients died of cardiogenic shock. Mortality percentage was 20%.

**IV. DISCUSSION**

Magnesium ion has emerged as a premier cardiovascular cation during the decade. It has been implicated in the pathogenesis of acute myocardial infarction and complication like arrhythmias. Magnesium is essential for activation of ATP, which maintains the sodium-potassium pump and also because of calcium blocking action magnesium has been implicated in relation to arrhythmias after acute myocardial infarction.

In the study group of 60 patients, 45 were males and 15 were females with a male-female ratio of 4:1. The maximum incidence of acute myocardial infarction was seen in the 6<sup>th</sup> and 7<sup>th</sup> decades. In the present study of 60 patients, the mean serum magnesium level on day-1 in all 60 patients was 1.78±0.32 and the mean serum magnesium level on day-5 was 2.32±0.44.

Abraham et al(13) 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).

Singh A et al(60) checked serum magnesium levels of twenty patients of acute myocardial infarction on the 1st, 7th and 12th day of admission. In all the cases, there was a significant fall of serum magnesium on the first day. Dimtruk[63] in his series of 67 patients of ischemic heart disease showed a distinct reduction of plasma magnesium during the first 3 days following onset of disease, the level normalized by 15-25 days from onset of the disease.

Sachdev et al(64) (1978) in 30 patients of myocardial infarction determine the magnesium levels within 24 hours, 5th and 8th day and reported as  $1.83 \pm 0.087$  mgm%,  $1.91 \pm 0.149$  and  $1.97 \pm 0.089$  as against control of  $2.44 \pm 0.162$  mgm%. The values were statistically lower on all the three days showing a progressive rise.

In the present study, the serum magnesium level on day-1 was significantly lower in patients with arrhythmias than those without arrhythmia ( $p < 0.001$ ). There was an increase in serum magnesium from Day-1 to Day-5 in both those with arrhythmias and those without arrhythmias. Ceremuzynski et al (65) assigned 48 patients with acute myocardial infarction over 24 hours infusion of magnesium or placebo. The incidence of ventricular tachycardia (3 or more consecutive premature ventricular contraction at a rate faster than 120/min) recorded by Holter monitoring was significantly reduced ( $p < 0.001$ ), but the incidence of other ventricular arrhythmias was not statistically different.

Raismusen et al(21) randomized 273 patients with suspected acute myocardial infarction to intravenous magnesium or placebo. There is a significant decrease in the ventricular arrhythmia in the magnesium group compared to placebo ( $p < 0.05$ ). Shecter et al (66) randomized 103 patients with documented acute myocardial infarction to 48 hours infusion of magnesium or placebo. There is a significant decrease in mortality ( $p < 0.01$ ). There was also a non-significant decrease in the number of tachyarrhythmias requiring treatment (10/50) in the magnesium group compared to control (24/53).

Smith et al (67) randomized 400 patients with suspected AMI to a 4 hours infusion of magnesium sulphate or placebo. Two hundred patients had confirmed acute myocardial infarction. The difference in mortality and incidence of ventricular dysarrhythmia requiring treatment between magnesium and placebo groups were not statistically significant.

Abraham et al[68] randomly assigned 94 patients with acute myocardial infarction to receive a daily magnesium bolus of 30 mmol or placebo for 3- days. There was no significant difference in mortality or lethal arrhythmias between patients treated with magnesium and those treated with placebo. Felstedt et al(69) randomized 298 patients with suspected acute myocardial infarction to 24 hours infusion of magnesium or placebo. Myocardial infarction was documented in 162 patients. During the mean observation period of 245 days, there was no difference in the incidence of

tachyarrhythmias, magnesium infusion was associated with a significant increase in bradyarrhythmias. Singh et al[70] randomized 264 patients with suspected acute myocardial infarction to magnesium, potassium, 10% glucose or 2% glucose infusion. Myocardial infarction was confirmed in 228 patients and ventricular tachycardia or fibrillation did not differ significantly between the magnesium group and placebo group.

Morton et al(71) randomized 76 patients to receive either magnesium infusion 0.38 mmol/l per kg every 12 hours or placebo over the first 36 hours of hospital, there was no difference in the incidence of ventricular tachycardia.

Dyckner T et al (7) during their 1½ years, 905 admission, 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.

## V. CONCLUSION

This study was carried out in 60 patients of acute myocardial infarction who are admitted to the ICCU of KATURI MEDICAL COLLEGE & HOSPITAL, GUNTUR.

- The male to female ratio in the study group was 4:1 and the maximum incidence of acute myocardial infarction was seen in 6<sup>th</sup> and 7<sup>th</sup> decade.
- In the study Hindus were 80% and Muslim were 20%.
- In the study, the most common presentation symptom was chest pain and is associated with sweat in 25% of patients and breathlessness in 25% of patients and 6) palpitation in 10%.
- In the study, the most common risk factor found was smoking followed by hypertension and diabetes.
- In the study group mean serum magnesium level in 60 patients on day-1 is  $1.78 \pm 0.32$  and on Day-5 is  $2.32 \pm 0.44$ .
- In the study group mean serum magnesium level in 30 patients with arrhythmia is  $1.58 \pm 0.30$  on day-1 and  $1.96 \pm 0.32$  on day-5.
- In the study group, mean serum magnesium level in 30 patients without arrhythmia is  $2.10 \pm 0.50$  on day-1 and  $2.56 \pm 0.48$  on day-5

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