



Research Article

A Study of Correlation Between Level of Serum Magnesium and Arrhythmias in Patients with Acute Myocardial Infarction

Dr. T. Gopalakrishnan¹; Dr. J. Sivakumar²

¹ Associate Professor, Department of Biochemistry, Melmaruvathur Adhiparasakthi Institute of Medical Sciences and Research, Melmaruvathur-603319, Tamil Nadu, India.

² Professor & Head, Department of Biochemistry, Arunai Medical College & Hospital, Tiruvannamalai-606603, Tamil Nadu, India.

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Corresponding Author:

Dr. T. Gopalakrishnan

Associate Professor, Department of Biochemistry, Melmaruvathur Adhiparasakthi Institute of Medical Sciences and Research, Melmaruvathur-603319, Tamil Nadu, India.

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ABSTRACT

Background: Magnesium has been implicated in the pathogenesis of acute 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 function including 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, 50 cases of acute myocardial infarction, admitted in Melmaruvathur Adhiparasakthi Institute of Medical Sciences and Research. Over a period of 2 years between October 2024 to March 2025. **Results:** There is a significant difference in the magnesium levels in patients with arrhythmias 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 of acute myocardial infarction with low magnesium levels.

Keywords: Magnesium; Myocardial infarction; Arrhythmias.

INTRODUCTION

It has long been known that for normal growth and function inorganic salts must be supplied to all biological forms. Thus, Pasteur (1860) showed that yeast will grow only when the culture medium contains inorganic compounds¹. 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 investigation².

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 infarction³.

Investigations revealed that magnesium level in the blood is decreased in the first 48 hours following a acute myocardial infarction and then increased steadily to reach the normal level in about three weeks time. The heart muscle subjected to myocardial infarction was found to contain a low magnesium concentration. These findings directly correlated with the resultant complications of myocardial infarction, such as arrhythmias.

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. The coronary vasospasm resulting from magnesium deficiency has been suggested as another important factor in the sudden death of IHD. Magnesium deficiency was also postulated to have role in the genesis of atheromatous plaques in that it leads to hyper lipidemia. Also myocardial infarct ion is one of the common causes of death at present where prognosis depends on multiple factor of which many still remain unexplained⁴. This study is designed to know the relationship between serum magnesium levels and arrhythmias in patients with acute myocardial infarction.

MATERIALS AND METHODS

By using simple random method, 50 cases of acute myocardial infarct ion, admitted over a period of 2 years between October 2024 to March 2025. Those patients presenting to the hospital within 12 hours of onset of symptoms were taken. Patients were considered to have acute myocardial infarct ion including History of chest discomfort, ECG changes of acute myocardial infarct ion and rise of cardiac enzymes. Cases selected were subjected to a detailed history and thorough physical examination, routine investigation like hemoglobin, blood count , urine examination, blood sugar, blood urea, serum creatinine, serum electrolytes, fasting lipid profile, cardiac enzymes and echocardiography was per formed in all cases. Serum magnesium level were estimated on day-1 and day-5.

RESULTS

Age wise Distribution of Patients

Table.1 showed that the study group of 50 cases, the maximum incidence of acute myocardial infarct ion was seen above 5th decade, followed by 4th decade. 52% patients were in the age group of more than 5th decade, 32% were in the age group of 40-49.

Table 1. Age wise Distribution of Patients

Age	No. of Subjects	Percentage
20-29	1	2.0
30-39	7	14.0
40-49	16	32.0
50 and Above	26	52.0

Sex wise distribution of Patients

Table 2 indicated that the study group of 50 cases, 33 was males and 17 were female patients with ratio of 1.63: 1. The study group contains 66% of male and 34% of females.

Age	No. of Subjects	Percentage
Female	17	34
Male	33	66
Total	50	100

Risk Factors

In this study, smoking is the most common risk factor found in patients with acute myocardial infarct ion. Cigarette smoking accelerates coronary atherosclerosis in both sexes and at all ages and increases the risk of thrombosis, plaque instability and myocardial infarct ion. In addition by increasing myocardial oxygen needs and reducing oxygen supply it aggravates angina. In our study group 40% of subjects are smokers.

In the present study out of 50 patients, 28 (56%) were found to be obese based on National cholesterol education program. Circumference was measured in all patients, men whose waist circumference is more than 102 cm and females whose waist circumference is more than 88cms were considered to be obese.

In the present study of 50 patients, 34 (68%) were found to be hypertensive. Patients whose blood pressure is more than 130/85 are considered to be hypertensive.

In the present study of 50 patients, 30 (60%) patients were found to be diabetic and 32 (64%) patients were found to be dyslipidemic. (Table.3)

Table.3. Risk Factors of acute myocardial infarction

Risk Factors	No. of Cases	Percentage
Smoking	20	40
Family History	30	60

Obesity	28	56
SHTN	34	68
Diabetes Mellitus	30	60
Dyslipidemia	32	64

Type of Myocardial Infarction:

In this present study of 50 patients, 22 (44%) had Anterior wall MI, 21(42%) patients had Inferior wall MI and 7 (14%) patients had Anteroseptal MI. **(Table.4)**

ECG Diagnosis	No of Subjects	Percentage
Anterior wall MI	22	44.0
Antero Septal MI	7	14.0
Inferior wall MI	21	42.0

Serum Magnesium levels in Acute Myocardial Infarction in relation to Arrhythmia

Table.5 observed that the cross sectional study of 50 patients, the mean serum magnesium level on day-1 in all 50 patients was 1.88 ± 0.26 and mean serum magnesium level on day-5 was 1.98 ± 0.47 . In the present study, out of 50 patients 28 patients had significant ventricular premature contractions/ Ventricular tachycardia during their 5-days course in the hospital.

Table.6. Serum Magnesium levels in Acute Myocardial Infarction

Particulars	No. of Cases	Mean $\pm$ Standard Deviation
Day – 1 Magnesium Level	50	1.88 ± 0.26
Day – 2 Magnesium Level	50	1.98 ± 0.47

Arrhythmias in study group

In our study group of 50 subjects, 28 (56%) of patients developed arrhythmias and 22 (44%) of patients recovered without any complications. Arrhythmias included occasional VPCs and Ventricular tachycardia. The mean value of serum Magnesium levels on day -1 in those with arrhythmias is 1.70 ± 0.16 , those without arrhythmias is 2.10 ± 0.19 ($p < 0.001$). There is significant difference in patient with arrhythmias and without arrhythmias. The above table shows that serum magnesium in patients with arrhythmias on Day 5 is 1.76 ± 0.51 , those without arrhythmias is 2.26 ± 0.20 . There is a significant difference between these two ($p < 0.001$).

Table.7 Comparison of mean magnesium level in patients with and without Arrhythmias

Particulars	Complication	No. of Cases	Magnesium Level	Significance
Day 1 Magnesium level	With Arrhythmias	28	1.70 ± 0.16	0.000
	Without Arrhythmias	22	2.10 ± 0.19	0.000
Day 2 Magnesium level	With Arrhythmias	28	1.76 ± 0.51	0.000
	Without Arrhythmias	22	2.26 ± 0.20	0.000

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 AP, 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 50 patients, 31 were males and 19 were females with a male- female ratio of 1.63:1. The maximum incidence of acute myocardial infarction was seen in the population more than 5th decades.

In the present study of 50 patients, the mean serum magnesium level on day-1 in all 50 patients was 1.88 ± 0.26 and the mean serum magnesium level on day-5 was 1.98 ± 0.47 . Abraham et al¹³ 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 al⁷⁵ 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 et al⁵ 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 al⁶ (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 mgs/dL, 1.91 ± 0.149 and 1.97 ± 0.089

as against control of 2.44 ± 0.162 mgs/dL. 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 significant 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 al⁷ 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 al²¹ 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 ($p < 0.05$).

Shechter et al⁸ 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 tachy arrhythmias requiring treatment (10/50) in the magnesium group compared to control (24/53).

Smith et al⁹ randomized 400 patients with suspected AMI to a 24 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 al¹⁰ 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.

Liu et al¹¹ 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 al¹² randomized 264 patients with suspected acute myocardial infarction to magnesium, potassium, 10% glucose or 2% glucose infusion. Myocardial infarction was confirmed in 228 patients. Mortality and ventricular tachycardia or fibrillation did not differ significantly between the magnesium group and placebo group.

Morton et al¹³ randomized 76 patients to receive either magnesium infusion 0.38 mmol / 1 per kg every 12 hour or placebo over the first 36 hours of hospital, there was no difference in the incidence of ventricular tachycardia.

Dyckner T et al¹⁴ 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 hypo magnesemic patients with acute myocardial infarction.

CONCLUSION

In the present study we conclude that the Serum Magnesium concentration were one of the prognostic and diagnostic biochemical marker for the acute myocardial infarction with and without Arrhythmias patients.

Declaration:

Conflicts of interests: The authors declare no conflicts of interest.

Author contribution: All authors have contributed in the manuscript.

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REFERENCES

1. Rosique-Esteban N., Guasch-Ferre M., Hernández-Alonzo P., Salas-Salvado J. Dietary magnesium and cardiovascular disease: A review with emphasis in epidemiological studies. *Nutrients*. 2018;10:168.
2. Kupetsky-Rincon E.A., Uitto J. Magnesium: Novel applications in cardiovascular disease—A review of the literature. *Ann. Nutr. Metab.* 2012;61:102–110.
3. Crawford T. Prevalence and pathological changes of ischemic heart disease in a hard water and in a soft water area. *Lancet*. 1967; 1: 229.
4. Vernal et al. Magnesium metabolism. *Recent Advances in Clinical Biochemistry*. 1978; 1:3.
5. Dmitruk. Magnesium and calcium blood plasma content in patients with ischemic heart disease. *Vrach Delo*. 1977; 2 (14) :7.

6. Sachadeva et al . Serum magnesium and platelet adhesiveness in acute myocardial infarct ion. JIMA. 1978; 71: 165.
7. Ceremuzynski L, Jurgiel R et al . Threatening arrhythmias in acute myocardial infarct ion are prevented by intravenous magnesium sulphate. Am Heart J. 1989; 118: 1333 -1334.
8. Shechter M, Mark N et al . Beneficial effects of magnesium sulphate in acute myocardial infarct ion. Am J Cardiol . 1990; 66:271-274.
9. Smith LF, Heagerty AM. Intravenous infusion of magnesium sulphate after acute myocardial infarct ion: Effects on arrhythmias and mortality. Int J Cardiol . 1986; 12: 175 -180.
10. Abraham AS, Rosenmann D. Magnesium in the prevent ion of lethal arrhythmias in acute myocardial infarct ion. Arch. Intern Med.1987; 147:753-755.
11. Liu H., Wang R. Associations between the serum magnesium and all-cause or cardiovascular mortality in chronic kidney disease and end-stage renal disease patients. Medicine. 2021;100:e27486.
12. Singh RB, Sircar AR et al . Magnesium and potassium administration in acute myocardial infarct ion. Magnesium Trace Elem. 1990; 9:198-204.
13. Morton BC, Nair RC et al . Magnesium therapy in acute myocardial infarct ion: A double blind study. Magnesium. 1984;3: 346-352.
14. Dyckner T. Serum magnesium in acute myocardial infarct ion : Relation to Arrhythmias. Acta med scan 1980;207:59-66.