

A Study of Serum Magnesium Levels in Acute Myocardial Infarction**Arun Thankappan¹, Kiren Thankappan², Anu Jacob^{3*}**¹Assistant Professor, Department of General Medicine, SUT Academy of Medical Sciences, Vencode, Trivandrum, Kerala²Associate Professor, Department of Otorhinolaryngology, Shri Sathya Sai Medical College and Research Institute, Chennai, Tamil Nadu³Assistant Professor, Department of Otorhinolaryngology, PSP Medical College Hospital and Research Institute, Tamil Nadu

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Abstract:**Background:** Magnesium has been implicated in the pathogenesis of acute myocardial infarction and its complication like arrhythmia. Magnesium 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 Narayana Medical College Hospital, Nellore during the study period from January 2014 to August 2015.**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.

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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 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 [1].

Investigations revealed that magnesium level in the blood is decreased in the first 48hrs following acute myocardial infarction and then increased steadily to reach the normal level in about three weeks' time. [3] 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. [3] 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 hyperlipidemia.

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.

Materials & Methods

Source of Data:

Totally 50 patients those were admitted with acute myocardial infarction in Narayana Medical College Hospital, Nellore.

Inclusion Criteria:

Those patients presenting to the hospital within 12 hrs of onset of symptoms were taken. Patients were considered to have acute myocardial infarction, only if they had 2 of the following criteria:

1. History of chest discomfort
2. ECG changes of acute myocardial infarction
3. Rise of cardiac enzymes.

Exclusion Criteria: Patients with hypokalemia.

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 performed in all cases. Serum magnesium levels were estimated on day-1 and day-5.

Method of Serum Magnesium Estimation Method: Colorimetric 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 colored compound. The red increasing (or) the blue decreasing color are proportional to magnesium concentration.

Specimen:

Non-hemolyzed serum or lithium heparin plasma may be analyzed since the magnesium concentration inside erythrocytes is 10 times greater than that in the 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.

Results

In this study group of 50 cases, 42 were males and 8 were female patients with a male-female ratio of 5.25:1. The maximum Incidence of acute myocardial infarction was seen in the 4th and 5th decades, followed by 6th and 7th decades. 28% patients were in the age group of 4th and 5th decade, 22% were in the age group of 60-70 yrs.

In the study of 50 patients, 15 (30%) patients were vegetarian by diet and 35 (70%) of them consumed mixed diet. Non-vegetarian run higher risk of acute myocardial infarction owing to their higher content of cholesterol in their diet compared to the vegetarian.

In the study, smoking is the most common risk factor found in the patients with acute myocardial infarction (70%). Out of 50 patients, 24% were found to be obese, 30% patients were found to be hypertensive, 36% patients were found to be diabetics and 24% patients were found to be dyslipidemic. 46% cases presented to the hospital between 3-6 hours of onset of symptoms and 28% cases presented between 0-3 hours.

Chest pain was the commonest symptom and was present in all of the patients in the present study (100%). Chest pain is associated with sweating 26% of cases. Chest pain is associated with breathlessness in 16% of the patients. Palpitation associated with chest pain was present in 1 patient (2%). 42% patients had anterior wall MI, 34% patients had inferior wall MI and 18% patients had anteroseptal MI and 6% patients had anterolateral MI.

50% patients had significant ventricular premature contractions/ ventricular tachycardia/ ventricular fibrillation during their 5-days course in the hospital.

Table 1: Serum magnesium levels in patients with and without arrhythmias

Serum magnesium levels (mg/dL) in patients with arrhythmias	Day-1	%	Day-5	%
<1.6	8	16.00	2	4.00
1.6 to 2.40	17	34.00	16	32.00
>2.4	--	--	7	14.00
Serum magnesium levels (mg/dL) in patients without arrhythmias				
<1.6	2	4.00	--	--
1.6 to 2.40	17	34.00	14	28.00
>2.4	6	12.00	9	18.00

Mean serum magnesium level was 1.86 ± 0.39 and 2.26 ± 0.50 in day-1 and day-5 in total 50 cases. Whereas

mean serum magnesium level was 1.65 ± 0.26 and 1.98 ± 0.25 in day-1 and day-5 in patients with arrhythmia (n=25).

Table 2: Comparison of Serum Magnesium level in patients with Arrhythmias and without Arrhythmias (Day-1 & Day-5)

	No. of cases	Serum magnesium	t- value	p-value
Day-1				
Mean serum magnesium level in patients with arrhythmia	25	1.65 ± 0.26	4.63	<0.001
Mean serum magnesium level in patients without arrhythmia	25	2.08 ± 0.41		
Day-2				
Mean serum magnesium level in patients with arrhythmia	20	1.98 ± 0.25	4.17	<0.001
Mean serum magnesium level in patients without arrhythmia	23	2.48 ± 0.52		

The mean value of serum magnesium on day-1 those with arrhythmias is 1.65 ± 0.26 those without arrhythmias is 2.05 ± 0.4 ($p < 0.001$). There is a significant difference in the magnesium level in patient with arrhythmias and without arrhythmias. 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 ($p < 0.001$). 7 patients died during their 5 days hospital course. 5 patients were died of ventricular tachycardia or ventricular fibrillation, 2 patients were died of cardiogenic shock. Mortality percentage was 14%.

Discussion

In the study group of 50 patients, 42 were males and 8 were females with a male-female ratio of 5.25:1. The maximum incidence of acute myocardial infarction was seen in the 4th and 5th decades. The most common presentation symptom was chest pain and is associated with sweat in 26% of patients and breathlessness in 16% of patients and palpitation in 2%.

The most common risk factor found was smoking followed by hypertension and diabetes. In the present study, the mean serum magnesium level on day-1 in all 50 patients was 1.86 ± 0.39 mg/dl and the mean serum magnesium level on day-5 was 2.26 ± 0.5 mg/dl. Abraham et al. 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).

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 al [4] 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. Shecter et al [5] 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).

In our study, the mean serum magnesium level in 25 patients with arrhythmia is 1.65 ± 0.26 mg/dl on day-1 and 1.98 ± 0.25 mg/dl on day-5. Mean serum magnesium level in 25 patients without arrhythmia is 2.05 ± 0.41 mg/dl on day-1 and 2.48 ± 0.52 mg/dl 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. Smith et al [6] 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 al [7] 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 [8] 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 [9] 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 al [9] randomized 76 patients to receive either magnesium infusion 0.38 mmol/l 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 al [10] during their 18 months, 905 admission, 342 with acute myocardial infarction, 563 other diagnoses are 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.

Conclusion

In the present study, patients with acute myocardial infarction with lowmagnesium level are more prone to develop ventricular arrhythmias compared to those who are having normal magnesium levels. Magnesium replacement therapy in patients with acute myocardial infarction who is having low serum magnesium level may reduce the incidence of arrhythmias.

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