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ORIGINAL RESEARCH

A Hospital Based Prospective Study to Evaluate the Correlation Between Serum Magnesium Levels and Arrhythmias in Patients with Acute Myocardial Infarction at Newly Established Tertiary Care Center

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ABSTRACT

Background: Magnesium deficiency leads to the progression of atheromatous plaques which occurs as a result of hyperlipidemia. Myocardial infarction is one of the most common causes of mortality where its prognosis depends upon various factors. This study is designed to know the contribution of magnesium levels in the serum of acute MI patients to the occurrence of arrhythmias.

Materials & Methods: This observational cross-sectional study was conducted in the Medicine Department, Govt. Medical College, Barmer, Rajasthan, India during one year period. A total of 30 patients of AMI were enrolled in this study. They were diagnosed with AMI on the basis of clinical symptoms, cardiac biomarker levels and/or Electrocardiography (ECG) findings. For all the patients, serum magnesium levels on day 1 and day 5 were measured and its association was observed with the clinical consequences.

Results: In this study group of 30 cases, 25 were males and 5 were female patients with a male-female ratio of 5:1. The mean value of serum magnesium on day-1 those with arrhythmias is 1.62±0.23 those without arrhythmias is 2.03±0.49 ($p<0.001$). There is a significant difference in the magnesium level in patients with arrhythmias and without arrhythmias. The serum magnesium level in patients with arrhythmia on Day-5 is 1.93±0.26 and in those without arrhythmia is 2.52±0.61. The difference between these two is found to be statistically significant with p- value ($p<0.001$).

Conclusion: We concluded that patients with acute myocardial infarction with low magnesium levels are more prone to develop ventriculararrhythmias compared to those who are having normal magnesium levels.

Keywords: Arrythmias, Myocardial Infarction, Serum Magnesium, Hypomagnesemia.

INTRODUCTION

Coronary Artery Disease (CAD) is the major cause of morbidity and mortality in the age group of 45 years or more all over the world including India. Wide variations have been seen in the prevalence rate of CAD in various geographical zones. Various surveys have been carried out in recent years, in various geographical locations and in small population groups

which use different protocols. It has been estimated that the prevalence rate may be about 5% in urban population and a much lower prevalence has been seen in the rural setting.[1]

Myocardial infarction occurs when there is an abrupt reduction in coronary blood flow usually occurring as a result of thrombotic occlusion of the coronary artery already been narrowed by the formation of atherosclerotic plaques which fissures, ruptures or ulcerates and under favourable conditions thrombogenesis may take place.[2]

CAD is seen to develop through the prism of several risk factors along with the major common cardiovascular risk factors such as hypertension, diabetes mellitus (DM), smoking, and hypercholesterolemia.[3] Deficiency of trace elements is also one of the newer risk factors. Among the dietary trace elements, magnesium has been found to be an important cardiovascular cation. It has been found to be one of the important factors in causation of AMI and resulting in complications like arrhythmias.

Various forces such as hemodynamic, electrolyte and other forces act together and contribute to maintaining the normal fluid balance of the body. It is now evident that not only proteins, fats and carbohydrates, but also minerals play an essential role in the normal homeostasis of the body. Intensive investigation is now going on about the importance of trace elements not only of vitamins but also of minerals. Magnesium ions are found to be essential for the maintenance of the normal functional integrity of the myocardium.[4] Several investigations have shown that the serum magnesium level is low in the first 48 hours following a acute myocardial infarction and later on rose gradually to attain the normal level in about three weeks' time. Infarcted myocardium was found to have reduced magnesium concentration.[5]

Hypomagnesemia acts a provoking factor in the occurrence of ventricular fibrillation, which is usually the cause of sudden death in IHD. The coronary vasospasm which occurs as a result of hypomagnesemia has been considered as an important factor in the causation of sudden death in IHD. Magnesium deficiency contributes to the progression of atheromatous plaques occuring as a result of hyperlipidemia.[6]

Myocardial infarction is one of the common causes of death where its prognosis depends on various factors. This study is designed to know the contribution of magnesium levels in the serum of acute MI patients to the occurrence of arrhythmias.

MATERIALS & METHODS

This observational cross-sectional study was conducted in the Medicine Department, Govt. Medical College, Barmer, Rajasthan, India during one year period.

A total of 30 patients of AMI were enrolled in this study. They were diagnosed of AMI on basis of clinical symptoms, cardiac biomarker levels and/or Electrocardiography (ECG) findings. For all the patients, serum magnesium levels on day 1 and day 5 were measured and its association was observed with the clinical consequences.

Exclusion Criteria

1. Patients having hypokalemia.
2. Patients on diuretics

Methods:

Patients were subjected to undergo investigations like complete blood count, urine examination, blood sugar, blood urea, serum creatinine, fasting lipid profile, cardiac enzymes and ECG was done in all cases.

Method of Estimation Serum Magnesium:

The method used was colorimetric end point test with Xylidyl blue as the reagent.

Magnesium Standard: 2.5 mg/dL.

Principle:

Magnesium reacts with xylidyl blue at alkaline pH resulting in the formation of a chelating red colored compound. The increase in the red colour (or) the decrease in blue color are

proportionate to the concentration of magnesium in the serum.
Analysis of non-hemolyzed serum or lithium heparin plasma may be done since the concentration of magnesium inside the red cells is 10 times greater than that in the ECF. Separation of serum from the cell should be done as early as possible and hemolysis should be avoided.
Normal Range for Magnesium: Serum magnesium: 1.6 – 2.4 mg/dl.

RESULTS

In this study group of 30 cases, 25 were males and 5 were female patients with a male-female ratio of 5:1. The maximum Incidence of acute myocardial infarction was seen in the 4^{th} and 5^{th} decades, followed by 6^{th} and 7^{th} decades. 33.33% patients were in the age group of 4^{th} and 5^{th} decade, 23.33% were in the age group of 60- 70 years (table 1).
In the study, smoking is the most common risk factor found in the patients with acute myocardial infarction. 30 patients, 9 (30%) patients were found to be hypertensive. Patients whose blood pressure is more than 130/85 is considered to be hypertensive (table 2).

Table 1: Distribution of patients according to age groups

Age range (years)	Sex		Total
	Male	Female	
30 – 40	6	--	6
40 – 50	9	1	10
50 – 60	3	3	6
60 – 70	6	1	7
70 – 80	1	--	1
Total	25	5	30

Table 2: Risk factors

Risk factors	No. of cases	Percentage
Smoking	21	70.00%
Family history of HTN, DM, IHD, CVA	6	20.00%
Obesity	7	23.33%
Hypertension	9	30.00%
Diabetes mellitus	11	36.66%
Dyslipidemia	4	13.33%

Table 3: Serum magnesium levels in patients with arrhythmias & without arrhythmias

Serum magnesium levels (mg/dL)	Total		With arrythmias		Without arrythmias	
	Day-1	Day-5	Day-1	Day-5	Day-1	Day-5
<1.6			5 (16.66%)	1 (3.33%)	1 (3.33%)	0
1.6 to 2.40			10 (33.33%)	10 (33.33%	10 (33.33%)	8 (26.66%)
>2.4			0	1 (3.33%)	4 (13.33%)	5 (16.66%)
Mean±SD	1.88±0.42	2.23±0.56	1.62±0.23	1.93±0.26	2.03±0.49	2.52±0.61
P- value (At day 1 with and without arrhythmias)	<0.001*					
P- value (At day 5 with and without arrhythmias)	<0.001*					

The mean value of serum magnesium on day-1 those with arrhythmias is 1.62±0.23 those without arrhythmias is 2.03±0.49 (p<0.001). There is a significant difference in the magnesium level in patients with arrhythmias and without arrhythmias. The serum magnesium level in patients with arrhythmia on Day-5 is 1.93±0.26 and in those without arrhythmia is 2.52±0.61. The difference between these two is found to be statistically significant with p- value (p<0.001) (table 3).

DISCUSSION

Magnesium ion has recently been considered as a principle cardiovascular cation. It has many critically significant roles in the maintenance of normal homeostasis of the body. It plays a major role in cardiac homeostasis. Magnesium is essential ATP activation necessary for the maintenance of the sodium-potassium pump. Magnesium deficiency has been attributed to the causation of arrhythmias in acute myocardial infarction patients. In this study group of 30 cases, 25 were males and 5 were female patients with a male-female ratio of 5:1. The maximum Incidence of acute myocardial infarction was seen in the 4^{th} and 5^{th} decades.

In concordance with our study, Yadav et al.[7] showed that AMI is more common in the age group of 51–60 years. On the contrary, Moreno et al. (2013)[8] showed that the average age of subjects with ACS was 60.62 ± 9.2 years. Study by Ralapanawa et al. (2019)[3] also had the mean age of study population as 61.3 ± 12.6 years. Ambali et al.[9] proposed that in AMI, serum magnesium levels decrease with increasing age and the elderly (>60 years) are at high risk for hypomagnesemia due to the decreased intake, stress, and chronic medications.

Smoking is the most common risk factor foundin 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. Study by Akila et al.[10] reported commonest risk factors in AMI as smoking (70%), DM (36%), hypertension (30%), obesity (24%), family history (20%), and hyperlipidemia (12%). Baset et al.[11] reported smoking (70%) as the most common risk factor in AMI, followed by diabetes (36%) and hypertension (30%).

The mean value of serum magnesium on day-1 those with arrhythmias is 1.62±0.23 those without arrhythmias is 2.03±0.49 (p<0.001). There is a significant difference in the magnesium level in patients with arrhythmias and without arrhythmias. The serum magnesium level in patients with arrhythmia on Day-5 is 1.93±0.26 and in those without arrhythmia is 2.52±0.61. The difference between these two is found to be statistically significant with p- value (p<0.001).

Abraham et al[12] found that the concentration of magnesium in serum was noticed to be reduced in patients who were diagnosed with AMI (mean 1.70 mg/dl, p<0.001) or acute coronary insufficiency (mean 1.61 mg/dl, p<0.01), but was not seen in the control group or patients had chest pain of non-cardiac origin (mean 1.91 mg/dl).

Singh A et al[13] investigated magnesium levels in the serumof twenty patients diagnosed of having acute myocardial infarction on the 1^{st}, 7^{th} and 12^{th} day of admission. In most of the cases, there was a marked reduction in the magnesium level of the serum on the first day.

Sachdev et al[14] (1978) found to be 1.83±0.087 mgm%, 1.91±0.149 and 1.97±0.089 whereas in the control group, it was 2.44±0.162 mgm%. The values were reported to be statistically reduced on all the three days and increased thereafter.

Study of A. Akila et al[10] found a significant difference in the magnesium levels in patients with arrhythmias and without arrhythmias. And they have concluded in acute myocardial infarction, patients with low magnesium levels are more prone to get arrhythmias. That's why magnesium treatment can be considered in patients of acute myocardial infarction with low

magnesium levels. Raismusen et al[15] found a significant reduction in the occurrence of ventricular arrhythmia in the magnesium group was noticed when compared to placebo group ($p<0.05$). Bogdan et al.[16] reported lowest serum magnesium levels on day 1 and day 3. Mohan et al. 1994[17] reported low serum magnesium levels within the first 12 h in all cases. Levels increased slowly to near normal value by the 14th day. Serum magnesium levels were apparently lower in patients with complications like arrhythmias as compared to cases who had uneventful recovery. Subramanyam et al.[18] found that serum magnesium levels were lower in AMI cases at presentation. Serum magnesium levels were lower in AMI patients with complications and raised toward normal by day 7. Magnesium improves myocardial metabolism, inhibits calcium accumulation and myocardial cell death.

CONCLUSION

We concluded that patients with acute myocardial infarction with low magnesium levels 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 are having low serum magnesium level may reduce the incidence of arrhythmias.

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