Correlation between Serum Magnesium Levels and Arrhythmias in Patients with Acute Myocardial Infraction

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Abstract
Magnesium deficiency leads to the progression of atheromatous plaques which ocurs 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 performed to know the effect of magnesium levels in the serum of acute MI patients to the occurrence of arrhythmias.

Methodology: *50 patients diagnosed of having acute myocardial infarction, admitted to PMCH, Patna medical college and hospital, over a period of 1 year i.e., between August 2018 to July 2019 were selected by using simple random method.Estimation of serum magnesium level was done on day 1 and day 5.*

Results: *In this study group of 50 cases, 34 were males and 16 were female patients with a male-female ratio of 2.125;1. The maximum Incidence of acute myocardial infarction was seen in the 4th decades. mean serum magnesium level in 50 patients on day-1 is 1.86±0.39 and on day-5 is 2.26±0.5.The difference between the magnesium level in patients with arrhythmia and without arrhythmia is statistically significant on both day-1 and day- 5.*

Conclusion: *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.*

Introduction

Magnesium is the fourth most abundant cation in the human body and is the second most prevalent cation in intracellular tissues[1].It is an essential transmembrane and intracellular modulator of cellular electrical activity. Myocardial cell action potentials are mediated by voltage-dependent Na^+, K^+, and Ca^{2+} channels which, when their function is altered, can lead to the genesis of cardiac dysrythmias. Magnesium regulates the movement of ions through these channels within myocardial tissues. Magnesium has been known to have an influence in the causation of acute myocardial infarction and its sequelae like arrhythmias[1]. It plays a major role in the pathogenesis of other cardiovascular diseases as well. Magnesium ions are found to be essential for the maintenance of the normal functional integrity of myocardium[2]. Several investigations have shown that the serum magnesium level is low in the first 48 hours following a acute myocardial infarction and later on rise gradually to attain the normal level in about three weeks time. Infarcted myocardium was found to have reduced magnesium concentration. The above said findings correlated directly with the associated complications of acute

myocardial infarction, such as arrhythmias.

In patients with sudden death as a result of ischemic heart disease, magnesium concentration in the cardiac muscle was found to be decreased. Hypomagnesium acts as a provoking factor in the occurrence of ventricular fibrillation, which is usually a considered as a cause of sudden death in IHD. The coronary vasospasm which occurs as a result of hypomagnesemia has been contemplated as an important factor in the causation of sudden death in IHD.

Materials & Methods

50 patients diagnosed of having acute myocardial infarction, admitted to PMCH, Patna Medical College and Hospital, over a period of 1 year i.e., between August 2018 to July 2019 were selected by using simple random method.

Selection of Patients

Inclusion Criteria

Patients presented to the hospital within 12 hours of onset of symptoms were included in the study.

The following criteria have been used to diagnose acute myocardial infarction. The presence of any of the two criteria has been considered:

- History of discomfort in the chest.
- Changes in the ECG which is suggestive of acute myocardial infarction
- Patients with risen cardiac enzymes.

Exclusion Criteria

- Patients having hypokalemia.
- Patient aged below 30yrs.

After the selection of study participants through random allocation, after obtaining informed written consent from all the patients included in the study, relevant history and physical examination was performed. 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 performed in all the cases.

Estimation of serum magnesium level was done on day 1 and on day 5.

Method of Estimation of Serum Magnesium

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

Magnesium standard: 2.5 mg/dL.

Results

Age and Sex Distribution of the Study group

Age range (years)	Sex		Total
	Male	Female	
30 – 40	8	2	10
40 – 50	10	6	16
50 – 60	6	4	10
60 – 70	8	4	12
70 – 80	2	--	2

In this study group of 50 cases, 34 were males and 16 were female patients with a male-female ratio of 2.125;1. The maximum Incidence of acute myocardial infarction was seen in the 4th decades.

Risk Factors

Risk factors	No. of cases	Percentage
Smoking	10	20.00
Family history of HTN, DM, IHD, CVA	35	70.00
Obesity	15	30.00
Hypertension	18	36.00
Diabetes mellitus	12	24.00
Dyslipidemia	6	12.00

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.

Obesity

In the present study, out of 50 patients, 15 (30%) were found to be obese based on 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 88cms were considered to beobese.

In the present study of 50 patients, 18 (36%) patients 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, 12(24%) patients were found to be diabetics and 6 (12%) patients were found to be dyslipidemic.

Presentation to the Hospital

Chest pain was the commonest symptom and was present in all of the patients in the present study (90). In this study chest pain is associated with sweating 23(46%) of patients. Chest pain is associated with breathlessness in 11 (22%) of the patients. Palpitation associated with chest pain was present in 1 patient (2%).

Variation in type of Myocardial Infarction

In the present study of 50 patients, 23 (46%) patients had anterior wall MI,

9 (18%) patients had inferior wall MI and 14 (28%) patients had anteroseptal MI and 4 (8%) patients had anterolateral MI.

Serum magnesium level in acute myocardial infarction in relation to arrhythmia. In this cross sectional study of 50 patients, the mean serum magnesium level on day-1 in all 50 patients was 1.82 ± 0.43 and the mean serum magnesium level on day-5 was 2.27 ± 0.40.

Mean serum magnesium level in the group with Arrhythmia on Day- 1and Day-5

In the present study, out of 50 patients 25 patients had significant ventricular premature contractions or ventricular tachycardia or ventricular fibrillation during their 5-days course in the hospital.

Serum magnesium level in patients with arrhythmias

Serum magnesium levels (mg/dL)	Day-1	Percent	Day-5	Percent
<1.6	8	16.00	2	4.00
1.6 to 2.40	17	34.00	16	32.00
>2.4	--	--	2	4.00

Mean serum magnesium level

	Day-1	Day-5
Mean serum magnesium level in 50 cases	1.86 ± 0.39	2.26 ± 0.40
Mean serum magnesium level in patients with arrhythmia(25patients)	1.65 ± 0.26	1.98 ± 0.25

Comparison of Serum Magnesium level in patients with Arrhythimas and without Arrhythmias (Day-1)

	No.of Cases	Serum magnesium Day-1	t- value	p-value
Mean serum magnesium level in patients with arrhythmia	28	1.65 ± 0.26	4.63	<0.001
Mean serum magnesium level in patients without arrhythmia	25	2.08 ± 0.41		

The above table shows that out of 50 patients, 28 patients had arrhythmias. The mean value of serum magnesium on day-1 those with arrhythmias is 1.65 ± 0.29 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

Comparison of Serum Magnesium Level in Patients with Arrhythimas and without Arrhythmias (Day-5)

	No. of cases	Serum magnesium Day-5	t- value	p-value
Mean serum magnesium level in patients with Arrhythmia	23	1.98±0.25		
Mean serum magnesium level in patients without Arrhythmia	21	2.48±0.52	4.17	<0.001

The above table shows that serum magnesium level in patients with arrhythmia on Day-5 is 1.98±0.25 and in those without arrhythmia is 2.48±0.52. The difference between these two is found to be statistically significant with p- value (p<0.001)

In the above study of 50 patients, 6 patients died during their 5 days hospital course. 4 patients were died of ventricular tachycardia or ventricular fibrillation, 2 patients were died of cardiogenic shock. Mortality percentage was 12%

Discussion

Magnesium ion has recently been contemplated as a principle cardiovascular cation. It has significant roles in the maintenance of normal homeostasis of the body. It plays a major role in cardiac homeostasis. Magnesium is an essential ATP activation which is necessary for the maintenance of the sodium-potassium pump. Magnesium deficiency has been considered as an attribution to the causation of arrhythmias in acute myocardial infarction patients.

In the study group comprising of 50 patients, 34 were males and 16 were females with a male-female ratio of 2.125:1. The maximum incidence of acute myocardial infarction was seen in the 4th and 5th decades.

In the present study of 50 patients, the mean serum magnesium level on day-1 in all 50 patients was 1.82±0.43 and the mean serum magnesium level on day-5 was 2.27±0.4.

Abraham et al[3] studied the level of serum magnesium in 65 patients admitted and diagnosed to have acute myocardial infarction. 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[4] investigated magnesium levels in the serum of twenty patients diagnosed of having acute myocardial infarction on the 1st, 7th and 12th 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[5] (1978) selected 30 patients, diagnosed with myocardial infarction and monitored the magnesium levels within 24 hours, 5th and 8th day and it was 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.

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[6] selected 48 patients with acute myocardial infarction of duration over 24 hours and infused magnesium or placebo. The occurrence ofventricular tachycardia (3 or more subsequent premature ventricular beats with a rate more than 120/ min) was significantly decreased (p<0.001), but the occurrence of other ventricular arrhythmias was unaffected.

Shecter et al[7] subjected 103 patients diagnosed of having acute myocardial infarction to magnesium infusion or placebo for 48 hours. A significant fall in mortality rate (p<0.01) was found. The occurrence of tachyarrhythmias in need of treatment (10/50) has been very low in the

magnesium group when compared to the placebo group (24/53).

Abraham et al[8] randomly allocated 94 patients diagnosed of having acute myocardial infarction and administered a daily bolus of magnesium of about 30 mmol or placebo for 3-days. No significant variation was noticed in the mortality rate or life threatening arrhythmias among patients on magnesium treatment and with placebo.

Morton et al[9] assigned 76 patients to get either magnesium infusion.

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.

Conclusion

Coronary artery disease is the major cause of morbidity and mortality throughout the world. Major cause of death in coronary artery disease may be due to complications like arrhythmias.

In the present study, 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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