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ORIGINAL ARTICLE

ASSOCIATION OF SERUM MAGNESIUM LEVEL AND DEVELOPMENT OF ARRHYTHMIAS IN ACUTE MYOCARDIAL INFARCTION

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ABSTRACT

Background: Magnesium (Mg) is the second most common intracellular cation after potassium (K). Mg is a cofactor in many enzyme systems in human cells and it has a predominant role in normal myocardial physiology. Magnesium has been implicated in the complications like arrhythmias in acute myocardial infarction. **Objective:** To know the serum magnesium level in patients with acute myocardial infarction and its relation with arrhythmia. **Study design:** Descriptive cross sectional study. **Study place & period:** Department of Cardiology, TMSS Medical College & Rafatullah Community Hospital (TMC & RCH), Bogra from July, 2013 to November, 2013. **Subjects:** 50 patients with acute myocardial infarction were admitted to the Department of Cardiology, TMC & RCH, Bogra. **Methods:** Data were collected from patients of any age and both sexes with acute myocardial infarction as determined by clinical features, ECG evidence and biochemical report. Blood sample for estimation of serum magnesium level was collected as early as possible within 24 hours of admission and 5th day of admission. After admission to CCU every patient was under continuous cardiac monitoring to see and record any arrhythmia within 5 days of onset of symptoms. **Results:** A total of 50 patients of acute myocardial infarction were included in the study. The male to female ratio in the study group was 3.17:1 and the maximum incidence of acute myocardial infarction was seen in 5th and 6th decade. Arrhythmia developed in (52%) patients and in majority (57.7%) of patients with anterior wall MI. In the study group mean serum magnesium level in 50 patients on day-1 is 1.86 ± 0.39 and on Day-5 is 2.26 ± 0.5 . Mean serum magnesium level in 26 patients with arrhythmia was 1.65 ± 0.26 on day-1 and 1.98 ± 0.25 on day-5. In the study group, mean serum magnesium level in 24 patients without arrhythmia was 2.05 ± 0.41 on day-1 and 2.48 ± 0.52 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 ($p < 0.001$). PVC was the most common type (42.5%) of arrhythmia. **Conclusion:** Serum magnesium levels are significantly low in patients who develop arrhythmia in acute myocardial infarction.

Key words: Coronary artery disease, acute myocardial infarction, serum magnesium level, arrhythmia.

INTRODUCTION

Coronary artery disease (CAD) is the highest killer in developed countries and is now an emerging epidemic in developing countries including Bangladesh. During recent years, more than six million people worldwide died of Ischemic heart disease, which was predicted to be the leading cause deaths all over the world¹. A study showed that acute myocardial infarction (AMI) is the leading cause of death in Bangladesh in the 4th decade of life². In Bangladesh, the prevalence of CAD was estimated as 13/1000 in 2004³. Several investigators documented an association between magnesium deficiency and coronary artery disease^{4,5}.

Magnesium (Mg) is the second most common intracellular cation after potassium (K)⁶. Mg is a cofactor in more than 300 enzyme systems in human cells and it has a predominant role in normal myocardial physiology. Normal magnesium level is 0.75 - 1.0 mmol/L. Mg 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 adhesion⁷. Myocardial

magnesium concentration in patients with sudden death due to ischemic heart disease was found to be very low⁸. These findings directly correlated with the resultant complications of myocardial infarction, such as arrhythmias.

The reduction of infarct size with magnesium has profound research and clinical implications⁹. Hypomagnesemia is an important risk factor for post AMI complication. It has been reported in various international studies that the serum Mg level is not only low at admission in cases of AMI but also continues to fall even for days after the onset of AMI^{10,11,12}. Hypomagnesemia is present in acute myocardial infarction (AMI) as shift of magnesium from extra cellular to intracellular compartments occur¹³.

A number of clinical studies have shown a fall in the serum magnesium concentration within first 24 to 48 hours after myocardial infarction¹⁴. A study from Rajasthan tried to determine the prognostic significance of serum magnesium levels in acute MI. Serum magnesium was found to be significantly lowered on the first day and it gradually raise to normal value by the twenty first day¹⁵. One study of Dhaka showed that there is a significant lower serum Mg and K level in AMI than chronic IHD and fall of serum Mg immediately after AMI may be due to the catecholamine induced high FFA which causes bindings and precipitation of Mg into the cells, resulting in a sudden decrease in total plasma Mg level¹⁶.

As reported recently, intracellular magnesium levels are reduced in patients with AMI. This deficiency is not adequately reflected in serum measurements, since magnesium is predominantly an intracellular ion and less than 1% of total body magnesium is found in the intravascular compartment¹⁷. Some studies also found no significant change of serum magnesium. In the last decade several reviews have been concerned with the relevance of Mg in cardiac disease.

To the best of our knowledge, very few studies have been made on serum magnesium level in acute myocardial infarction in Bangladesh. But it seems to be essential to

measure the serum level of Mg in AMI to improve the management. With this objective the present study will be conducted.

OBJECTIVES

General:

To know the serum magnesium level in patients with acute myocardial infarction.

Specific:

1. To study the serum magnesium level in patients with acute myocardial infarction
2. To study the pattern of arrhythmia in cases of hypomagnesaemia.
3. To study the incidence of arrhythmia in acute myocardial infarction.

MATERIAL AND METHODS

It was a descriptive cross sectional study carried out in the Department of Cardiology, TMC & RCH, Bogra from July, 2013 to November, 2013. Fifty patients with acute myocardial infarction were admitted in the Department of Cardiology. Data were collected from patients with acute myocardial infarction as determined by clinical features, ECG evidence and biochemical reports of both sexes irrespective of age. Blood sample for estimation of serum magnesium level was collected as early as possible within 24 hours of admission and on 5th day following admission. After admission to CCU every patient was under continuous cardiac monitoring to see and record any arrhythmia within 5 days of onset of symptoms.

Detailed history and thorough clinical examination was performed through a formatted questionnaire with prior informed consent of the patients. Following investigations were done ECG, Echocardiogram, Cardiac Troponin I, Serum electrolytes, Serum magnesium, RBS, Serum creatinine, Serum lipid profile. After collection, all the data were entered in the SPSS 20.0 statistical software and were analyzed.

As facilities for estimation of serum magnesium does not exist in TMSS Medical College & Rafatullah Community Hospital, Bogra, the test was performed using Automatic Analyzer in the Popular Diagnostic Center, Dhaka via Bogra branch of Popular Diagnostic Center.

RESULTS**Table-1:** Types of Myocardial Infarction of the study patients (n=50)

Type of MI	No. of cases	Percentage
Anterior wall MI	21	42.0
Inferior wall MI	17	34.0
Anteroseptal MI	9	18.0
Anterolateral MI	3	6.0
Total	50	100.0

Among 50 patients, 21 (42%) patients had anterior wall MI, 17 (34%) patients had inferior wall MI, 9 (18%) patients had anteroseptal MI and 3 (6%) patients had anterolateral MI.

Table-2: Distribution of patients with arrhythmia in acute myocardial Infarction (n=50)

Type of MI	Patients with AMI (n=50) No. (%)	Patients with arrhythmia (n=26) No (%)
Anterior wall MI	21 (42%)	15 (57.7%)
Inferior wall MI	17 (34%)	6 (23.1%)
Anteroseptal MI	9 (18%)	3(11.5%)
Anterolateral MI	3 (6%)	2(7.7%)
Total	50 (100.0%)	26(100.0%)

Among the 50 acute myocardial infarction patients, 21 (42.0%) had anterior wall MI of which 15(57.7%) developed arrhythmia, 17 (34%) patients had inferior wall MI of which 6 (23.1%) developed arrhythmia, 9 (18%) had anteroseptal MI patients of which 3 (11.5%) presented with arrhythmia and of 3 (6%) anterolateral MI patients, 2 (7.7%) developed arrhythmia. Table No 2 shows, number of patients who developed arrhythmia out of 50 AMI patients.

Table-3: Serum magnesium levels in patients with arrhythmias (n=26)

Serum magnesium levels (mg/dL)	Day-1 (n=26)	Percent	Day-5 (n=21)	Percent
<1.6	9	34.6	2	9.5
1.6 to 2.40	17	65.4	17	81.0
>2.4	-	-	2	9.5

Among 26 patients with arrhythmia 9 (34.6%) had serum magnesium level <1.6 mg/dl and 17 (65.4%) had serum magnesium level in between 1.6-2.40 mg/dl on day-1. Out of 21 patients who developed arrhythmia 2 (9.5%) had serum magnesium level < 1.6 mg/dl, 17 (81.0%) had level in between 1.6-2.40 mg/dl and 2 (9.5%) had serum magnesium level > 2.4 mg/dl on day-5 (Table 3).

Table-4: Serum magnesium levels in patients without arrhythmias (n=24)

Serum magnesium levels (mg/dL)	Day-1 (n=24)	Percent	Day-5 (n=23)	Percent
<1.6	3	12.5	-	-
1.6 to 2.40	19	79.2	14	60.9
>2.4	2	8.3	9	39.1

Among the 24 patients without arrhythmia 3 (12.5%) had serum magnesium level <1.6 mg/dl, 19 (79.2%) had serum magnesium level in between 1.6-2.40 mg/dl and 2 (8.3%) had level > 2.4 mg/dl on day-1.

Out of 23 patients without arrhythmia 14 (60.9%) had serum magnesium level in between 1.6-2.40 mg/dl and 9 (39.1%) had level > 2.40 mg/dl on day-5 (Table 4).

Table-5: Mean serum magnesium level in Day 1 and Day 5 (n=50)

	Day-1	Day-5
Mean serum magnesium in 50 cases	1.86-0.39	2.26-0.50
Mean serum magnesium level in patients with arrhythmia	1.65-0.26	1.98-0.25

In this cross sectional study of 50 patients, the mean serum magnesium level on day-1 in all 50 patients was 1.86–0.39 and the mean serum magnesium level on day-5 was 2.26–0.5.

In the present study, out of 50 patients 26 patients had significant ventricular premature contractions/ ventricular tachycardia/ ventricular fibrillation during their 5-days course in the hospital. The mean serum magnesium level in this group on day-1 was 1.65–0.26 and day-5 was 1.98–0.25 (Table 5).

Table-6: Comparison of Serum Magnesium level in patients with Arrhythmias and without Arrhythmias (Day-1) (n=50)

	No. of cases	Serum magnesium Day-1	t-value	p-value
Mean serum magnesium level in patients with arrhythmia	26	1.65–0.26	4.28	<0.001*
Mean serum magnesium level in patients without arrhythmia	24	2.08–0.41		

Data were analyzed by using independent student t-test,

* = Significant

Table 6 shows that out of 50 patients, 26 patients had arrhythmias. The mean value of serum magnesium on day-1 those with arrhythmias is 1.65–0.26 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.

Table-7: Comparison of Serum Magnesium level in patients with Arrhythmias and without Arrhythmias (Day-5) (n=44)

	No. of cases	Serum magnesium Day-5	t-value	p-value
Mean serum magnesium level in patients with arrhythmia	21	1.98–0.25	4.14	<0.001
Mean serum magnesium level in patients without arrhythmia	23	2.48–0.52		

Data were analyzed by using independent student t-test, * = Significant

Table 7 shows that 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 ($p < 0.001$).

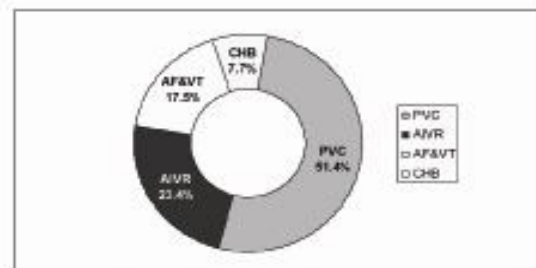


Fig 1: Pattern of arrhythmia in cases of hypomagnesemia

Figure 1 shows that the most common arrhythmia in our study was PVC 51.4% followed by A/V/R 23.4%, AF and VT 17.5%, and CHB 7.7%.

Mortality: In the above study out of 50 patients, 6 patients died during their 5 days hospital course. 4 patients died of ventricular tachycardia and ventricular fibrillation, 2 patients died of cardiac arrest. Mortality percentage was 12%.

DISCUSSION

Heart disease is the lethal cause of death both in developing & developed countries. Complications are commonly seen in all forms of acute myocardial infarction, although the frequency and extent vary with the severity of ischemia and infarction. Major mechanical, structural and electrical complications are seen with significant, often transmural infarction. Misiriya R.K.J et al²¹ found that among the patients with acute MI, 50% had inferior wall, 43.97% had anterior wall infarctions, 6.03% had lateral wall and isolated posterior wall infarctions. The present study shows 42% had anterior wall infarctions, 34% had inferior wall infarctions, 18% had anteroseptal wall infarctions and 6.0% had lateral wall infarction. Present study shows that out of 50 AMI patients 57.7% anterior wall MI patients developed arrhythmia in their 5 days stay in hospital. The findings in other types of AMI are, arrhythmia developed in 23.1% of inferior wall

MI patients, 11.5% and 7.7% of anteroapical and anterolateral MI patients respectively.

In the present study of 50 patients, the mean serum magnesium level on day-1 in all 50 patients was 1.86–0.39 and the mean serum magnesium level on day-5 was 2.26–0.5. Abraham et al²² reviewed magnesium level of 65 consecutive patients with an admission diagnosis of acute myocardial infarction. In our study serum magnesium concentration were found 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).

Sachadeva et al²³ (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 mgm%, 1.91–0.149 and 1.97–0.089 as against control of 2.44–0.162 mgm%. The values were statistically lower on all the three days showing a progressive rise which is similar to the present study.

In the present study, the serum magnesium level on day-1 was significantly lower (mean 1.65–0.26) in patients with arrhythmias than those without arrhythmias (mean 2.08–0.41) ($p < 0.001$). There was an increase in serum magnesium from Day-1 to Day-5 in both those with arrhythmias (mean 1.98–0.25) and those without arrhythmias (mean 2.48–0.52) and the difference in both group is significant ($p < 0.001$).

Misiriya R.K.J et al²¹ found that in STEMI commonest arrhythmia encountered was premature ventricular complex (PVC) 40.04%. Other arrhythmias observed were accelerated idioventricular rhythm (AIVR) 18%, ventricular tachycardia (VT) 13.98%. Misiriya R.K.J et al²¹ found that in acute MI commonest arrhythmia encountered was atrial fibrillation (AF) 8.05% and ventricular fibrillation (VF) 5.36% patients. The present study shows that the most common arrhythmia was PVC 51.4% followed by AIVR 23.4%, AF and VT 17.5%, and CHB 7.7%. Dyckner T et al²⁴ during their 1st 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 which is similar to the present study.

CONCLUSION

This study concluded low magnesium level is an significant cause of cardiac arrhythmia in acute myocardial infarction patients. The study was carried out in a single centre with small sample size. So the conclusion of the study should not be considered as absolute and further multicentre study with large sample size is needed.

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