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ACUTE MYOCARDIAL INFARCTION;
HYPOMAGNESEMIA IN PATIENTS

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ABSTRACT… Objective: This descriptive case series study evaluates the frequency of hypomagnesemia in patients with acute myocardial infarction. **Patients and methods:** This multidisciplinary conducted at Liaquat University Hospital Hyderabad and a private hospital Hyderabad from May 2010 to October 2010. All patients diagnosed as acute myocardial infarction were further evaluated for type of myocardial infarction and serum magnesium level. **Results:** Out of 100 diabetic patients, 77 were males and 23 patients were females. The mean age and standard deviation of patients of male and female was 54.78 ± 8.82 (SD) and 53.64 ± 10.82 (SD), respectively. The mean ± SD for serum magnesium in overall subjects was 1.24 ±0.48. Regarding the type of AMI inferior wall in 22 (29%), lateral wall in 17 (22%), anteroseptal in 12 (16%), anterolateral -V1 in 07(09%), right ventricular in 10 (13%) and posterior wall in 07 (09%). The mean duration of acute MI in male and female population was 8.71±6.73 hours and 17.70±14.57 hours (p<0.01) where as the mean duration of acute MI in hypomagnesemic and normomagnesemic patient was 5.16±2.49 hours and 26.60±8.27 (p = 0.02) respectively. The mean serum magnesium level in male as well as female population was 1.32 ±0.21 mg/dl and 1.46± 0.53 mg/dl p = 0.05, respectively. Regarding the hypomagnesemia in male and female population was 34(75.6%) and 16(53.3%) p=0.04, respectively. The hypomagnesemia was more predominant in inferior 18(36.0%) and lateral 16 (32.0%) wall MI. **Conclusions:** The hypomagnesemia was observed in patients with acute myocardial infarction with statistical significance

Key words: Myocardium, infarction, magnesium, heart attack, trace metals, hypomagnesemia

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INTRODUCTION

Ischemic heart disease (IHD) is the leading cause of morbidity and mortality world wide[1]. Atherosclerotic coronary artery disease (CAD) causing myocardial ischemia may manifest itself either as acute myocardial infarction (AMI), unstable angina or effort angina[2]. Among these the most life threatening is AMI and is one of the most common life threatening disease in emergency hospital admissions[3]. The mortality rate after admission for myocardial infarction has declined by about 30% over the last two decades but it still remains high[4]. The cardiovascular risk factors for AMI are on the rise in Pakistan, 18% of adult population suffers from hypertension, smoking and tobacco use has increased and obesity is increasing[5]. 16.2% men and11.7% women have diabetes mellitus while another 8.2% men and 11.7% women have impaired glucose tolerance[6]. With increasing affluence and facilities of life, there is a definite change in life style and there is more and more tendency for sedentary habits. As a consequence, cardiovascular diseases like myocardial infarction and stroke have become the leading causes of morbidity and mortality in Pakistan[5].

The magnesium (Mg) is present in greatest concentration within the cell and is the second most abundant intracellular cation after

potassium. It is the 11th most abundant element by mass in the human body and its ions are essential to all living cells, whereas they play a major role in manipulating important biological polyphosphate compounds.7The disturbance in serum magnesium level i.e. hypomagnesemia has been reported to occur among patients with acute myocardial infarction[8].

Hypomagnessemia is present in acute myocardial infarction (AMI) as shift of magnesium from extra cellular to intracellular compartments occur as it is taken up by adipocytes after catecholamine induced lipolysis and combined with soaps formed by free fatty acids. Although the total body Mg contents may not change with the onset of AMI, extra cellular Mg declines markedly, especially over the first 24 to 48 hours after the onset of AMI. Hypomagnessemia in the initial phase of post AMI period is very critical, as ventricular tachyarrhythmia sudden cardiac death and re-infarction are the usual outcome.9, 10Magnesium has been suggested as a possible intervention to be used in AMI since the early 1960s mainly because it was thought to be an antiarrhythmic agent, although no studies have conclusively shown this to be the mechanism of action for magnesium in reducing mortality

Therefore, keeping all relevant discussion in mind, the present study was conducted in a tertiary care teaching hospital of Hyderabad. This study focused on the disturbance in serum magnesium level (hypomagnesemia) in patients with acute myocardial infarction. The present study opened new forum of discussion and provide new ideas, knowledge, and protocol regarding the medical workup and management plan for the patients with acute myocardial infarction.

PATIENTS AND METHODS

This descriptive case series multidisciplinary study was conducted at Liaquat University Hospital Hyderabad and a private hospital Hyderabad from May 2010 to October 2010 on the patients with acute myocardial infarction. The diagnosis of acute myocardial infarction was confirmed on the presence of any two of the following:

(A) Onset of typical retrosternal pain or discomfort of recent onset lasting for 20-30 minutes.

(B) Electrocardiogram (ECG) evidence of persistently ST segment elevation of >2mm in two or more contiguous chest leads or >1mm in Limb leads, followed by T wave inversion. The appearance of Q waves of more than 0.045 sec duration or > 4mm depth. Localization based on distribution of electrocardiographic (ECG) abnormalities i.e.
   (I). inferior wall - II, III, aVF,
   (ii). lateral wall -I, aVL, V_4 through V_6.
   (iii). anteroseptal - V_1 through V_3.
   (iv). anterolateral – aVL, V_1 through V_6,
   (v). right ventricular - RV_4, Rv_5.
   (vi). posterior wall - R/S ratio greater than 1 in V_1 and V_2; T-wave changes (i.e. upright) in V_1, V_8, and V_9.

(C). Rise and fall of serum cardiac biomarkers such as creatine kinase (CK MB) fraction, lactate dehydrogenase (LDH) and Troponin. The serum CK-MB Activity > 24U/Litre, serum LDH > 170/Litre, troponin T (was identified through Trop T kit) i.e. one line (control line) = negative and two lines (control & signal line) = positive

The patients with acute myocardial infarction, of either sex were recruited and enrolled in the study. The history was taken; relevant clinical examination and all routine / baseline investigations were performed. Depending on severity every patient was put on a cardiac monitor and vital signs was recorded every four hours for the first three days then thrice daily. An informed consent was taken from every patient or attendant of the patient after explaining the purpose of the study.

Following investigations were performed in every relevant patient: a). ECG, on arrival in cardiology department and six hourly for one day, then once daily by me or ECG technician. b). Cardiac enzymes; on arrival of the patient then at two, four, eight, twelve and twenty four hours on first day and then once daily for seven days by taking 2cc

venous blood sample in a 5cc disposable syringe. c). Troponin T rapid assay which is a qualitative immunological test for the detection of Troponin T in the blood was performed on bed side. The final diagnosis of acute myocardial infarction was made within 48 hours of admission on the basis of above mentioned criteria. All such patients who meet the inclusion criteria were evaluated for the serum magnesium level by taking 3 cc venous blood sample in a disposable syringe and sent to laboratory for analysis. The normal serum magnesium level considered was 1.8 - 2.5 mg /dl so the value < 1.8 mg /dl was labeled as hypomagnesemia.

The exclusion criteria of they study were: patients with history of diabetes mellitus, chronic renal failure, diarrhea, vomiting and nasogastric suction, gastrointestinal fistulas and ostomies, patients on diuretics, antimicrobials (amphotericin B, aminoglyco-sides, pentamidine, capreomycin, viomycin, and foscarnet), chemotherapeutic agents (cisplatin), immunosuppressants (tacrolimus and cyclosporine) and proton-pump inhibitors. The serum magnesium level was estimated by Calmagite dye method. The data was collected on predesigned proforma and then entered, save and analyze in SPSS version 10.00. The frequency and percentage was calculated for hypomagnesemia in acute myocardial infarction as well as for gender distribution. The chi-square test was applied between categorical variables at 95% confidence interval while independent t-test was also applied as far as mean ± SD concerned. The p-value = 0.05 was considered as statistically significant. The stratification was done between gender, hypomagnesemia and duration of AMI where as the mean ± standard deviation (SD) calculated for age.

RESULTS

Out of 100 diabetic patients, 77 were males and 23 patients were females. The mean age and standard deviation of patients of male and female was 54.78 ± 8.82 (SD) and 53.64 ± 10.82 (SD), respectively. The mean ± SD for serum magnesium in overall subjects was 1.24 ±0.48. The frequency of hypomagnesemia in relation to gender in patients with acute myocardial infarction is shown in table 1. Regarding the demographical distribution 76% patients were belonged to rural populations. Regarding the type of AMI inferior wall in 22 (29%), lateral wall in 17 (22%), anteroseptal in 12 (16%), anterolateral - V1 in 07(09%), right ventricular in 10 (13%) and posterior wall in 07 (09%). The type of acute MI in relation to gender and serum magnesium is presented in table 02-03. The creatine kinase and lactate dehydrogenase (LDH) was raised in 62 (83%) and 15 (20%) patients respectively whereas the Troponin T was positive in all patients with acute myocardial infarction. The mean duration of acute MI in male and female population was 8.71±6.73 hours and 17.70±14.57 hours (p<0.01) where as the mean duration of acute MI in hypomagnesemic and normomagnesemic patient was 5.16±2.49 hours and 26.60±8.27 (p = 0.02) respectively. The mean serum magnesium level in male as well as female population was 1.32 ±0.21 mg/dl and 1.46± 0.53 mg/dl p = 0.05, respectively.

DISCUSSION

Small trials reporting the use of magnesium in acute myocardial infarction have been identified intermittently for 20 years. The rationale for these studies came partly from observations of

	Gender		Total	P-value
Magnesium	Male	Female	Total	
Hypomagnesemia	34(75.6%)	16(53.3%)	50 (66.7%)	0.04*
Normal	11 (24.4%)	14 (46.7%)	33 (75%)	
Total	45(100%)	30 (100%)	75(100.0%)	

Table-I. Hypomagnesemia in relation to gender **P value is statistically significant* X^2 *value = 4.00; df = 1*

	Gender		Total	P-value
Acute M.I	Male	Female	Total	
Inferior wall	17(37.8%)	05(16.7%)	22 (29.3%)	
Lateral wall	10 (22.2%)	07 (23.3%)	17 (22.7%)	
Anteroseptal	05(11.1%)	07 (23.3%)	12(16.0%)	0.29*
Anterolateral	03 (6.7%)	04 (13.3%)	07 (9.3%)	
Right Ventricular	05 (11.1%)	05 (16.7%)	10 (13.3%)	
Posterior wall	05 (11.1%)	02(6.7%)	07(9.3%)	
Total	45(100%)	30(100%)	75(100%)	

Table-II. Gender distribution in relation to type of myocardial infarction **P value is statistically non significant* X^2 *value = 6.08; df = 5*

Magnesium				
Acute M.I	**Hypomagnesemia**	**Normal**	**Total**	**P-value**
Inferior wall	18(36.0%)	04(16.0%)	22 (29.3%)	
Lateral wall	16 (32.0%)	01 (4.0%)	17 (22.7%)	
Anteroseptal	07(14.0%)	05 (20.0%)	12(16.0%)	
Anterolateral	02 (4.0%)	05 (20.0%)	07 (9.3%)	<0.01*
Right Ventricular	04 (8.0%)	06 (24.0%)	10 (13.3%)	
Posterior wall	03 (6.0%)	04 (16.0%)	07(9.3%)	
Total	50 (100%)	25 (100%)	75(100%)	

Table-III. Hypomagnesemia in relation to type of acute myocardial infarction **P value is statistically significant* X^2 *value = 17.97; df = 5*

differences in heart attack rates associated with geographical variations in magnesium and partly from laboratory studies showing that magnesium had cardioprotective effects during ischaemia and that myocardial magnesium concentrations were relatively low during acute ischaemia[11].

An informal review of the results of the early clinical trials in acute myocardial infarction indicated a trend towards a lower mortality with intravenous magnesium, with this difference being statistically significant in only one trial[12]. That trial also found a reduction in arrhythmias. These impressions were subsequently confirmed by a formal metaanalysis[13]. The data came, however, from only 1300 patients with a total of 78 deaths; the analysis found a 55% reduction in the odds of death (P=0.001), with 95% confidence intervals ranging from about 30% to about 65%.

In our study the serum magnesium in cases of AMI has been significantly decreased (p=0.04). It has been observed in various international studies that the serum magnesium 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[14]. In our series the mean serum magnesium level was low in both gender and it is consistent with the study published in 2010[15]. Magnesium is an important cofactor for many enzymatic reactions and intracellular ATPase activity and may be important in cellular recovery after an ischemic period. Haigney et al[16]. Recently reported that magnesium levels were significantly reduced in patients with

ST elevation during AMI. Previous reports have suggested that magnesium may interfere with calcium uptake and thus limit the extent of the infarction. Our study did not evaluate the uptake of radioactive calcium and to state this as the mechanism would be purely speculative. LIMIT-2, based on 2316 patients, is perhaps one of the best double-blind clinical trials published to date. The results of the LIMIT-2 study showed a statistically significant lower incidence of mortality and a reduction in LV failure in the magnesium-treated groups[14]. The results of the LIMIT-2 trial suggested that the ability of magnesium to reduce mortality is comparable to that achieved with thrombolytic drugs and aspirin[14]. Schechter et al[17]reported in 1990 that intravenous magnesium significantly reduced in-hospital mortality compared with placebo in a controlled double-blind randomized trial. More recently, Schechter, et al[18] reported that magnesium administered to AMI patients (70 years of age and older) who were not candidates for thrombolytic therapy was more effective in reducing in-hospital mortality compared with a randomized double-blind placebo control population.

It is however, apparent from this study that serum magnesium plays an important role in the cardiac homeostasis and its deficiency is capable of producing myocardial injury and post AMI arrhythmias. There is growing evidence that Hypomagnessemia acts as an important risk factor to cause serious cardiac disturbances and the drug digitals toxicity. There is a clinical need for a good agent that would help preserves myocardium at risk in AMI and magnesium may be such an alternative and provides a low-cost agent for treating AMI. Therefore it is suggested that it is the responsibility of the attending clinician that the use of diuretics should be done carefully and preferably undertaking prior estimation of serum magnesium.

CONCLUSIONS

The hypomagnesemia was observed in patients with acute myocardial infarction with statistical significance. The estimation of serum magnesium level in patients with acute MI should be done as early as possible on arrival of the patients in emergency department.

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