COMPARATIVE ANALYSIS OF SERUM MAGNESIUM LEVEL IN DIABETIC AND NON-DIABETICS PRESENTED WITH ACUTE MYOCARDIAL INFARCTION

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ABSTRACT:

BACKGROUND: Serum concentrations of electrolytes have been shown to change with plasma glucose levels. Magnesium, the second most abundant intracellular cation plays a key role in cellular metabolism. The level of glycemic control is found to be inversely proportional to magnesium deficiency.

AIMS & OBJECTIVE: To assess the changes in serum magnesium level between T2DM and non-diabetic patients presented with acute myocardial infarction.

MATERIAL & METHODS: In this study overall 200 T2DM and non-diabetic patients aged 20-60 years of either gender were inducted via non probability sampling technique. These patients were presented in emergency with acute myocardial infarction within 12 hours from the beginning of symptoms determined by history and medical records. Serum magnesium level between two groups was compared by t-test. The difference was considered significant with p value <0.05.

RESULTS: The mean age among study participants was 52.72±6.24 years. The majority 70% of the participants were male while 30% were female. Group A comprised of 110(55%) type 2 diabetic patients while group B comprised of 90(45%) non diabetic patients with acute myocardial infarction. Mean serum magnesium level of the study participants was 1.56±0.42 mg/dl. Mean serum magnesium level in group A was 1.25-0.42 mg/dl and in group B was 1.84-0.32 mg/dl. Mean serum magnesium level was significantly lowered in group A (diabetics) as compared to group B (non-diabetics) with p-value=0.000. Study found that low serum magnesium level showed significant association with age, gender, glycemic control and diabetes duration with p-value=0.000.

CONCLUSION: In comparison with non-diabetic patients, serum magnesium level was significantly lowered in diabetic patients presented with acute myocardial infarction. Hypomagnesaemia was directly related to age, gender, glycemic control and duration of diabetes.

KEY WORDS: Magnesium level, T2DM, Acute Myocardial Infarction, Glycemic control.

INTRODUCTION:

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder caused by a defect in insulin secretion and action or both. Its prevalence is escalating with rapid pace especially in developing countries. In 2019 approximately 19.4 million (19.9%) people are affected by this chronic metabolic disorder in Pakistan according to International Diabetes Federation. This number will expect to reach to 37.1 million in 2045. This will add significant morbidity and mortality and will put Pakistan under enormous social and economic burden of diabetes.[1]

Cardiovascular disease is one of the leading causes of death in diabetics. CVD is affecting type 2 diabetes more as compared to type 1 diabetes. The risk of atherosclerotic disease in diabetes is almost twice as compared to non-diabetics. Coronary heart disease, peripheral artery disease and heart failure are one of the common manifestation of CVD in T2DM patients.[2] A study revealed that about 32.2% patients with CVD had T2DM in which coronary artery disease is one of the leading causes of death. Obesity, dyslipidemia, insulin resistance, hypertension, subclinical inflammation are important determinants of CVD in T2DM patients.[3]

Magnesium is one of the essential mineral and plays a vital role in human health. Magnesium has a dominant role in modulation of insulin release from beta cells of pancreas and its deficiency leads to insulin resistance. Moreover, magnesium deficiency provokes chronic systemic inflammation that can lead to insulin resistance.[4] A review studies revealed that sub clinical magnesium deficiency is quite common that can lead to cardiac manifestations in the form of atherosclerosis, arterial calcification, thrombosis, hypertension, heart failure and arrhythmias.[5] A study showed that high prevalence of diabetes 41.2% in acute myocardial infarction patients over a decade. Moreover, diabetic's patients had increased risk of electrolyte disturbance such as hypomagnesemia, hyperkalemia, hyperurecemia and hyponatremia leads to increase in hospital mortality.[6]

A lot of studies revealed that hypomagnesemia was strongly associated with T2DM.These studies point out that low magnesium level was quite common in T2DM versus non diabetics.[7-11] Studies postulated that T2DM patients with low magnesium level had an increase risk to develop cardiovascular disease.[12-13] Studies also revealed that hypomagnesemia contribute significantly to diabetes related complication such as insulin resistance, dyslipidemia, accelerated atherosclerosis, inflammation, thrombosis, oxidative stress, micro and micro vascular complications such as neuropathy, nephropathy and retinopathy.[14-15] Studies showed that magnesium supplements significantly reduce blood sugar, insulin resistance and improves insulin sensitivity.[16] Magnesium supplements also have beneficial effects in hypertension, arterial stiffness, endothelial dysfunction and arrhythmias.[17-19]

MATERIAL AND METHODS:

This study was approved by the ethical committee of Institutional Review Board (IRB) of Punjab Institute of Cardiology, Lahore. A total of 200 patients with T2DM and non-diabetic were enrolled in this cross sectional study over a period of six months from June to December 2020. A non-probability sampling technique was used to register subjects on the basis of inclusion and exclusion criteria.

Patients with acute myocardial infarction, aged 20-60 years of either gender diagnosed on the basis of ECG and cardiac enzymes. These patients were presenting to emergency department within 12 hours from the beginning of symptoms determined by history and medical records were included in the study.

The diabetic patients were diagnosed on the basis of WHO criteria of diabetes and medical records. Patients with history of smoking, Body Mass Index > 35 kg/m^2, chronic renal disease, hepatic impairment and respiratory diseases. Patients taking any drugs that can affect magnesium level like diuretic, multivitamins, proton pump inhibitors, immune suppressive drugs, warfarin, and calcium supplements were excluded from study.

History and medical record were checked for presence or absence of diabetes. A 5mL of venous blood sample was taken from medical cubital vein through aseptic technique. An automated clinical chemical analyzer was used to run the samples. HbA1c was measured by HPLC method while serum magnesium level was assessed by the colorimetric method. Normal serum magnesium level was 1.5-2.5mg/dl.

DATA ANALYSIS PROCEDURE:

The sample size of 200 subjects was estimated by keeping confidence interval at 95% and 7% margin of error and taking expected percentage of diabetes i.e. 51% in patients with MI. Statistical package for social science SPSS 20 was used to analyze data. Quantitative variables were expressed as mean $\pm$ standard deviation while

categorical variables were expressed as frequency and percentages. Serum magnesium level between two groups was compared by t-test. The difference was considered significant with p value <0.05.

RESULTS:

All patients completed the study and there were no dropped out. The mean age among study participants was 52.72±6.24 years. The majority 70% of the participants were male while 30% were female. There were 110(55%) diabetic patients with duration of diabetes 3.39±3.80 and most of the patients had poor control of diabetes that is HbA1c level 9.63±3.70. The mean magnesium level 1.56±0.42. (Table-1) Group A comprised of 110(55%) type 2 diabetic patients while group B comprised of 90(45%) non diabetic patients with acute myocardial infarction. Mean serum magnesium level in group A was 1.25-0.42 mg/dl and in group B was 1.84-0.32 mg/dl. Mean serum magnesium level was significantly lower in group A (diabetics) as compared to group B (non-diabetics)

with p-value=0.01. Male diabetic patients had magnesium levels 1.28±0.42 as compared to 1.86±0.27 in non diabetic male. Similarly, there was a significant difference in female diabetic patients vs non diabetic patients. In both age groups there was also a significant difference in magnesium levels. Moreover, study found that low serum magnesium level showed significant association with glycemic control and diabetes duration with p-value=0.01. (Table 2)

DISCUSSION:

This cross sectional research was carried out at cardiac care centre of teaching hospital of Lahore. Our study showed that magnesium level was significantly lowered in diabetics versus non diabetics in patients of acute myocardial infarction. Moreover, hypomagnesemia was strongly associated with age, gender, duration of diabetes and glycemic status in diabetics patients presented with acute myocardial infarction.

In our study low magnesium level was strongly

Table 1: Baeline study charactetiscts of study subjects.	
Parameters	**Frequency/Mean±SD**
Age	52.72±6.24
Male/female ratio	70/30
No of Diabetes cases (%)	110(55%)
Duration of Diabetes	3.39±3.80
HbA1C%	9.63±3.70
Magnesium level(mg/dl)	1.56±0.42

Table 2: Correlation of Magnesium status with different parameters in diabetic and non diabetics patients with Acute Myocardial infarction.			
	Group A (Diabetic s)	**Group B(Non diabetics)**	**p-value (<0.05)**
Number of patients(%)	110(55%)	90(45%)	
Magnesium level(mg/dl)	1.25-0.42	1.84-0.32	0.012
Correlation by gender			
Male	1.28-0.42	1.86-0.27	0.002
Female	1.22-0.36	1.90-0.22	0.0032
Correlation by age			
Age<40 years	1.58±0.34	2.1±0.22	0.006
Age>40 years	1.27±0.43	1.84±0.62	0.042
Correlation by duration of diabetes			
> 5years	1.62±0.32		0.01
> 5years	1.35±0.46		0.01
Correlation by Glycemic status			
Adequate control(HbA1C <7.0%	1.72±0.34		0.0032
Inadequate control(HbA1C >7.0%	1.13±0.52		0.0021

associated with increased HbA1C. This was in line with study conducted on 119 T2DM patients pointed which pointed out that low magnesium levels were strongly associated with increased HbA1c levels, postprandial plasma glucose and body fat mass.[20] In a study low magnesium level was detected in 50% of T2DM patients. They postulated that old age, poor glycemic control, serum creatinine based glomerular filtration rate (eGFRCR) were important predictor of low magnesium level in T2DM Nepalese patients[21]. A study revealed that low magnesium level was greatly related to poor glycemic control and diabetes related micro and macrovascular complications. This study was conducted in 88 T2DM patients with and without diabetic complications [22] Similarly a study conducted by Yossef et al, 2017[23] showed 80% prevalence of hypomagnesemia in T2DM. Low magnesium level was significantly associated with poor glycemic control and diabetes related complication while HbA1C, dyslipidemia, serum creatinine, albuminuria showed significant correlation with low magnesium level. However, in our study we did not analyze these parameters. However, in comparison with our study there was no significant association found between serum magnesium level and HbA1C in a 100 patients T2DM patients. The main reason behind that patient taking drugs affecting magnesium level were not excluded in this study.[24] Similarly Paladiya et al, 2017[25] showed that hypomagnesemia was strongly associated with severity and duration of diabetes in 600 T2DM and non-diabetic subjects. Salhi and Quahabi[26] also revealed that low magnesium level was strongly associated with age, sex, glycosylated hemoglobin and duration of diabetes similar to our study.

A cross sectional population based survey involving 5561 population in Canada pointed out that low magnesium was strongly associated with age, gender, BMI, diabetes duration, HbA1C, serum insulin and HOMA-IR level.[27] However, we did not analyze markers of insulin resistance and BMI. In our low magnesium level was detected in 60% T2DM patients while a study showed the incidence of hypomagnesemia 66% in 100 T2DM patients. In this study serum magnesium level was significantly affected by male gender, long duration of diabetes, poor glycemic control similar to our study. Hypomagnesaemia was also significantly associated with increased cholesterol, increased blood pressure and micro and macro vascular complications in T2DM patients. We did not estimate these parameters. However, no significant association was found regarding age group in comparison with our study. They concluded that low magnesium level is a prognostic factor to diabetes related complications.[28]

A study conducted in Abbottabad by Noor et al, 2017[29] showed 33.89% low magnesium level in 180 T2DM patients while our study showed 60% in 120 T2DM patients. The low magnesium level in T2DM was not strongly associated with age and gender but showed significant association with duration of diabetes similar to our study. Another study conducted in Karachi favored results of Noor et al, 2017[29] in which low magnesium level (38.45% male and 35.39% female) was not strongly associated with age, gender and duration of diabetes but it was significantly associated with HbA1C level and glycemic control like our study.[30] Similarly another study did not found any significant association between low magnesium level age, duration of diabetes but found weak negative correlation between magnesium and HbA1C.[31]

Similarly, serum magnesium level was inversely related with risk of coronary artery disease (CAD) in meta-analysis of 48 studies. These studies were conducted on 60,801 cases of CAD and 123,504 control subjects.[32] The prospective studies of systematic review and meta-analysis showed that dietary and circulatory magnesium are inversely related with cardiovascular disease risk.[33] In our study T2DM patients with acute myocardial infarction had significantly lower magnesium as compared to non-diabetics patients with acute MI supporting these meta-analysis.

CONCLUSION:

In patients with acute myocardial infarction, serum magnesium level was significantly lowered in diabetics versus non diabetics. Hypomagnesaemia was directly related to age, gender, glycemic control and duration of diabetes.

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