

Frequency of Low Serum Magnesium Level in Diabetic and non- Diabetic Patients compared with other Risk Factors of Cardiovascular Diseases

1. Surraiya Shaikh 2. Akhtar Hussain Makhdoom 3. Kiran Mehtab
4. Muhammad Saeed Talpur

1. Asstt. Prof. of Biochemistry, SMC, DUHS, Karachi 2. Assoc. Prof. of Biochemistry, SMC, DUHS, Karachi
3. Asstt. Prof. of Community Medicine, SMC, DUHS, Karachi 4. Assoc. Prof. of Pathology, National Institute of Cardiovascular Diseases, Karachi

ABSTRACT

Objective: To assess the frequency of serum magnesium level in heart failure patients with and without diabetes mellitus.

Study Design: Cross Sectional Study.

Place and Duration of Study: This study was conducted at Basic Medical Sciences Institute (BMSI), Jinnah Postgraduate Medical Centre (JPMC), Karachi, in collaboration of National Institute of Cardiovascular Diseases (NICVD) Karachi, from April 2003 to December 2003.

Materials and Methods: A sample size of 45 was drawn through convenient sampling, between the age group of 35-65 years. Serum magnesium, glucose levels were estimated, using Kit method, data was analyzed on the SPSS 11 for statistical significance.

Results: Out of 45 cases of heart failure, 15 were diabetic with low level of serum magnesium (1.67mg/dl) as compared to 30 non-diabetics with significantly high level of serum magnesium (1.75mg/dl)

Conclusion: This study concluded, in heart failure patient with diabetes mellitus had low serum magnesium level and was at increased risk of complications related to magnesium.

Key Words: Diabetes Mellitus, Heart Failure, Magnesium, Risk Factors.

INTRODUCTION

Magnesium is very important, necessary for mechanism of glucose transport through the cell membranes, cofactor of various enzymes involved in carbohydrate oxidation^(1,2,3). Magnesium is second most plentiful cation present in serum, normal level is 1.8 to 3.0 mg/dl^(4,5). Diabetes mellitus is declared when fasting blood glucose level is 126mg/dl or more random blood glucose level is 200 mg/dl, in already diagnosed cases or taking hypoglycemic drugs⁽⁶⁾. Diabetes mellitus is the most common chronic disease associated with secondary magnesium deficit. In humans insulin is responsible for transfer of magnesium through the cellular membrane, regulates intracellular magnesium. Increased insulin resistance has been found in patients with compressed free magnesium levels. Increased glucagon stimulation, decreased insulin secretion, reduced insulin uptake with magnesium deficiency have also shown in animal studies. Insulin-dependent, non-insulin-dependent diabetic patients have low serum, intracellular levels of magnesium, due to increased urinary losses of magnesium caused by osmotic diuresis⁷. Cardiovascular diseases risk factors such as smoking, diabetes mellitus are threat factors of the progress of heart failure⁽⁸⁾. Fewer intakes of dietary magnesium, abnormalities in magnesium metabolism play important roles in different types of heart diseases such as ischemic heart disease, congestive heart failure,

atherosclerosis, ventricular complications in diabetes mellitus⁽⁹⁾. Plenty of magnesium is available on the earth and in living tissue, it is extremely easy to build up a magnesium deficiency due to comparatively poor magnesium absorption, fast turnover of the magnesium pools, related to the continued life reliant biochemical pathways⁽¹⁰⁾. People with diabetes mellitus are at larger risk for cardiovascular disease (CVD) comparative to those devoid of diabetes mellitus⁽¹¹⁾. The aim of this study was to determine the serum magnesium level in heart failure patients with diabetes mellitus to diagnose deficiency, maintain magnesium status by supplementation.

MATERIALS AND METHODS

The study comprised 45 diagnosed cases of heart failure with, without diabetes mellitus between the age group of 35-65 years. Study included the patients with major risk factors of heart failure; hypertensive, diabetics, smokers, family history of heart diseases. Patients receiving drugs diuretics, digoxin along with other cardiovascular medication were included. Samples were collected with antiseptic measures. Serum glucose level was determined by enzymatic colorimetric (GOD PAP) method, using kit, Lot No. B02868. Serum magnesium was determined by colorimetric method using kit Cat No.0137. The results were calculated as frequencies, percentages for qualitative data whereas mean and standard deviation was used for quantitative data. For

comparison between diabetic and non diabetic, test of proportion was used for qualitative data and student t-test was used for Quantitative data. In all statistical analysis p-values < 0.05, 0.01, and 0.001 were considered significant.

Data Analysis

The study was completed in nine months from 1st April 2003 to 31st December, 2003. The significance of the data was determined by using Statistical Package of Social Sciences software (SPSS, Version 11.0). Confidence interval of 95% was taken with margin of error 5% and p-value of 0.05.

RESULTS

The study compared the demographic distribution of diabetic and non-diabetic with heart failure. patients with diabetes were seen to be of a significantly older age. It was assessed that female patients with diabetes were significantly ($P < 0.01$) higher in percentage.

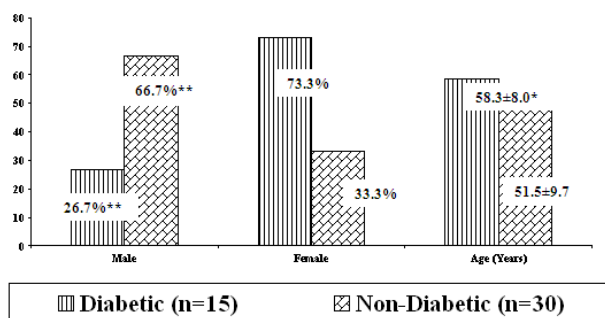


Fig. 1. Distribution of Diabetic and Non-Diabetic in Heart Failure Patients

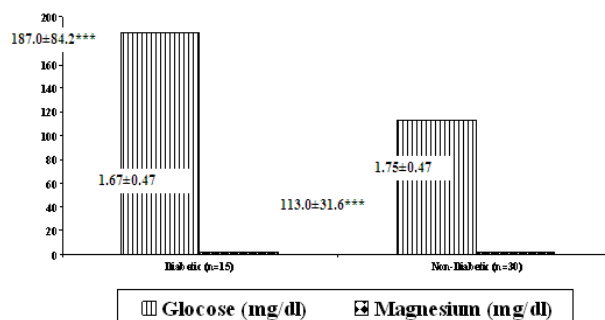
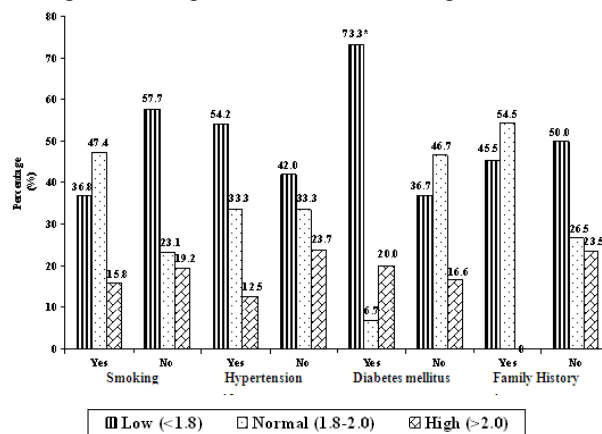


Fig.2: Glucose (mg/dl) and Magnesium (mg/dl) Level in Diabetic and Non-Diabetic Heart Failure Patients.

In Biochemical comparison of diabetic, non-diabetic patients it was assessed that patients with diabetes had a significantly higher serum glucose level (187 ± 84.2). The serum magnesium in diabetics was lower than the non-diabetics.

The values of serum magnesium were compared with other risk factors of heart failure, Patients were classified on the basis of their serum magnesium level, as low magnesium group was defined as having a level (< 1.8 mg/dl), and the high magnesium group was

defined as having a level (> 2.0 mg/dl) and normal having serum magnesium of ($1.8 - 2.0$ mg/dl).



* $P < 0.05$ = Significant when compared Diabetes mellitus with other risk factors

Fig. 3. Comparison of Risk Factors in Heart Failure Patients with Serum Magnesium Level (mg/dl)

DISCUSSION

Magnesium is the next (after calcium) plentiful intracellular cat ion acting a key role in cellular metabolism⁽¹²⁾. Curiosity in this element drives from its key function in glucose metabolism, insulin homeostasis, hypertension, inflammation, cardiovascular disease. In recent times, biochemical function, effect of trace elements in preventing, treating disease is extensively studied. Its insufficiency has a negative effect on post receptor signaling of insulin, impair insulin-mediated glucose uptake, glucose-induced insulin secretion, and produce hyperglycemia. In human, sugar load causes loss of magnesium in urine, possibly converting a marginal intake to a scarce one. Previous studies showed magnesium metabolism is distorted in patients with diabetes mellitus. In type II diabetic patients, hypomagnesaemia can be a result or reason of increased insulin resistance. The constant magnesium supplements in diabetic patients improve both islets beta cell response, insulin resistance in these patients⁽¹³⁾. Domanski et al (2003)⁽¹⁴⁾, reported diabetes mellitus is related with increased unfavorable cardiovascular transactions with myocardial infarction (MI), chronic heart failure (CHF) stroke. Diabetes is also linked with structural, metabolic abnormalities that can harmful effect on myocardial function. Diabetes has been related with reduced serum, tissue magnesium myocardial magnesium concentration. The study of Shafique M., Fayyaz KM, Nazir S. accomplished magnesium supplementation improves metabolic homeostasis and useful adjuvant to the standard hypoglycemic agents in the treatment of non insulin reliant subjects. The interrelationship among magnesium, carbohydrate metabolism has regained significant attention more than the previous years.

Magnesium deficiency results in impaired insulin secretion magnesium substitute restore insulin secretion. Experimental magnesium insufficiency reduces the tissues sensitivity to insulin. Sub clinical magnesium insufficiency is common in diabetes. It results from both insufficient magnesium intakes, increase magnesium losses; in the urine ⁽¹⁵⁾. Grundy et al. (1999) ⁽¹⁶⁾ noticed that cigarette smoking is a leading risk factor of cardiovascular disease. Diabetes mellitus is single most endocrine disorders associations with disturbance in electrolytes metabolism. Magnesium scarcity is a disorder of metal metabolism in diabetes mellitus. In this study, hypomagnesaemia, alterations biochemical homeostasis in diabetic heart failure patients have been evaluated. Prelude proof insulin sensitivity, hyperglycemia, diabetes mellitus, left ventricular hypertrophy, and dyslipidemia may be better with amplified magnesium intake ⁽¹⁷⁾. Gottlieb et al. study (1990) ⁽¹⁸⁾ aberration of serum magnesium concentration are not laboratory interest but have significant clinical implications.

CONCLUSION

This study concluded patients with diabetes mellitus had low serum magnesium level and were at increased risk of complications related to magnesium. In light of these impending complications, periodic determination of serum magnesium levels and appropriate magnesium replacement should be considered.

REFERENCES

1. Simona BO, Pisu E. Role of dietary magnesium in cardiovascular disease prevention, insulin sensitivity and diabetes. *Curr opin in lipido* 2008; 19: 50-56.
2. Shafique M, Fayyaz KM, Nazir S. Diabetes mellitus; Role of magnesium. *The Professional* 2002; 9(3):191-195.
3. Purvis JR, Movahed A. Magnesium disorder and cardiovascular disease: Review. *Clin Cardio* 1992; 5:556-68.
4. Ahsan SK. Magnesium in health and disease. *J Pak Med Assoc* 1998; 48:246-50.
5. Arsenian MA. Magnesium and cardiovascular disease. *Progress in Cardiovascular Disease* 1993; 35(4):271-310.
6. Lee CD, Folsom AR, Pankow JS, Brancati FL. For the Atherosclerosis Risk in Communities (ARIC) Study Investigators. Cardiovascular Events in Diabetic and Nondiabetic Adults with or without history of myocardial infarction. *Circulation* 2004; 109:855-860.
7. Ahmed M. Magnesium status in vascular complications of diabetes mellitus. Thesis. Library JPMC Karachi 1994; pp 1-97.
8. Lip GHY, Gibbs CR, Beevers DG. ABC of heart failure etiology. *BMJ* 2000; 320: 104-7.
9. Chakarabarti S, Chakarabarti T, Mandal M, Mandal A, Das, S, Ghosh S. Protective role of magnesium in cardiovascular diseases: a review. *Mol and Cell Biochem* 2002; 238(1-2):163-79.
10. Zeiba A, Kata R, Dudek D, Zawadzka MS, Nowak G. Serum trace elements in animal models and human depression: Part III Magnesium. Relationship with copper. *Hum Psychopharmacol Clin Exp* 2000; 15:631-635.
11. Preis SR, Pencina MJ, Hwang SJ, D'Agostino RB, Sarage PJ, Levy D, et al. Trends in cardiovascular disease risk factors in individuals with and without diabetes mellitus in the Framingham Heart Study. *Circulation* 2009; 120:212-220.
12. Seyoum B, Siraj ES, Saenz C, Abdulkadir J. Hypomagnesium in Ethiopians with diabetes mellitus. *Ethn Dis* 2008; 18(2):147-51.
13. Seeling M. Cardiovascular consequences of magnesium deficiency and loss: Pathogenesis, prevalence and manifestations – Magnesium and Chloride loss in refractory potassium repletion. *Am J Cardiol* 1989; 63:4G-21G.
14. Domanski M, Krause-Steinrauf H, Deedwania P, Follmann D, Ghali JK, Gilbert E, et al. The effect of diabetes on outcomes of patients with advanced heart failure in the best Trial. *J Am Coll Cardiol* 2003; 42(5):914-22.
15. Lefebvre PJ, Paolisso G, Scheen AJ. Magnesium and glucose metabolism. *Therapie* 1994; 49(1):1-7.
16. Grundy SM, Benjamin CIJ, Burke GL, Chait A, Eckel RH, Howard BV, et al. Diabetes and cardiovascular disease. A statement for healthcare professionals from the American Heart Association. *Circulation* 1999; 100: 1134-46.
17. Houston M. The role of magnesium in Hypertension and Cardiovascular disease. *J Clin Hypertens (Greenwich)* 2011;13(11):843-7.
18. Gottlieb SS, Brauch L, Kukin ML, Bernstein JL, Fisher ML, Packer M. Prognostic importance of the serum magnesium concentration in patients with congestive heart failure. *JACC* 1990; 16:827-31.

Address for Corresponding Author:

Dr. Kiran Mehtab,

Assistant Professor of Community Medicine,
Sindh Medical College, DUHS, Karachi.
E-mail: kiranalisyed@yahoo.com
Cell #: 0333-3188237