Journal of Bangladesh College of Physicians and Surgeons
Vol. 26, No. 1, January 2008

Frequency of Hypomagnesemia in Hospitalized Diabetic Hypokalemic Patients

WMM HAQUE[a], AR KHAN[b], K NAZIMUDDIN[c], AKM MUSA[d], AKMS AHMED[e], RSC SARKER[f]

Summary:

Recent studies suggest that there is strong relationship between serum magnesium and diabetes. Low serum magnesium is one of the risk factors of diabetes mellitus and its complications, at the same time diabetes is one of the common causes of hypomagnesemia. Hypokalemia is also quite common in diabetic patient. When hypokalemia coexists with hypomagnesemia, the chance of 'complications of hypokalemia' increase significantly. In addition, the correction of hypokalemia becomes difficult. However, the exact frequency of hypomagnesemia in diabetic hypokalemic patient is not yet defined. Therefore, the objective of the current study was to find out the frequency of hypomagnesemia in hospitalized diabetic hypokalemic patient. Thirty consecutive diabetic patients with hypokalemia admitted under medical unit 1 BIRDEM were included in this study. There were 20 Female; and 10 male, mean age was 52.33±12.97 years, duration of diabetes was 1 - 20 years, mean serum potassium was 2.37± .36m mol/l, The mean ± SD of serum magnesium was 0.67 ±0.26 m mol/l. Hypomagnesemia was present in 19 patients (63.3%). Fifteen normokalemic diabetic patients were taken as control. Only one subject had Hypomagnesemia in control. Sample mean of serum magnesium has been found significantly lower than general population (P=.001) and control ((P=.034)

Key ward: Hypokalemia, hypomagnesemia, diabetes, frequency

(J Bangladesh Coll Phys Surg 2008; 26: 10-13)

Introduction:

The recent World Health Organization (WHO) report on diabetes prevalence alarmed that diabetes has posed a serious threat to entire population of the world . This trend observed two folds increase in the developed and almost three folds in the developing nations. The increasing prevalence of diabetes in underdeveloped countries is hypothesized that under-nutrition either in terms of trace element or micronutrient deficiency or of chronic energy deficiency (CED) may be a etiologic factor of diabetes in this population. Recent studies identified magnesium as the most important micronutrient associated with diabetes. The incidence of subclinical magnesium deficiency is common in diabetes and cardiovascular disorders. Magnesium deficiency has recently been related with age-related diseases through free-radical mechanism [1]. The existence of oxidative stress has been well documented in diabetes and late diabetic complications. The prevalence of hypomagnesemia has been found to vary widely, depending on the patient's clinical condition. In a general population, 6.9% of patients were shown to be hypomagnesemic.[2] In hospitalized patients on a medical-surgical floor, there was a prevalence of 11%,[3] while in the intensive care unit it was found to be 20%.[4] In a postoperative intensive care unit setting, the prevalence was 60%.[4] A study of diabetic patients established a prevalence of 25%.[5] In a recent study in Bangladesh, Khan LA showed that almost 70% of patients with MRDM had clinically defined hypomagnesemia. Of the patients who had type 2 DM not related to malnutrition, 42% exhibited hypomagnesemia. [6] Hypokalemia is also common in diabetic patients. Diabetes itself can cause hypokalemia or it can result from treatment of diabetes and its complications. Hypokalemia may present as a medical emergency, and in many case it coexists with hypomagnesemia, especially in diabetic

a. Dr. Wasim MD Mohosinul Haque, FCPS, Registrar, Dept of Cardiology, BIRDEM.

b. Major Gen (Retd) Prof. A. R. Khan, MB (CAL), FCPS, MRCP, FRCP, Chief Consultant Physician, BIRDEM

c. Dr. Khwaja Nazimuddin, FCPS, Associate Professor of Medicine, BIRDEM

d. Dr. A.K.M Musa,FCPS,DTCT, MCPS Assistant Professor of Medicine, BIRDEM

e. Dr. A.K.M Shaheen Ahmed, MCPS, FCPS, Registrar, Dept of Internal Medicine, BIRDEM

f. Dr. Rene Suzan Claude Sarker, Assistant Registrar, Medicine, BIRDEM

Address of correspondence: Dr.Wasim Md Mohosinul Haque, Registrar, Dept of Nephrology, BIRDEM, Dhaka, Tel-01915472750, 9128158, email- arko.amit@gmail.com

Received: 06 June, 2006 **Accepted:** 05 June, 2006

patients. Hypomagnesemia is present in about 40% of diuretic treated hypokalemic patients.[7] When both exist together not only the correction of hypokalemia become difficult, the chances of acute complications also increase significantly.[8] Therefore, this study was carried out to evaluate the prevalence of hypomagnesemia in hospitalized diabetic hypokalemic patients.

Hypothesis

Prevalence of hypomagnesemia is significantly higher in hospitalized diabetic hypokalemic patients than normal population.

Aims and Objectives:

1. To find out frequency of hypomagnesemia in 'hospitalized diabetic hypokalemic patients.
2. To correlate the frequency of hypomagnesemia in 'hospitalized diabetic hypokalemic patients with that of normal population.

Subjects

Sample size 30

Place of study- medical unit-1, BIRDEM

Diabetic patients with general medical illness.

Inclusion criteria: Known diabetic patients with serum potassium less than 3mmol/l on admission, under medical unit 1 of BIRDEM Hospital during the period of August 2003 to January 2004' were recruited in the study.

Exclusion criteria: Patients admitted with diabetic ketoacidosis and hyperosmolar non-ketotic coma.

Controls:

Fifteen diabetic normokalemic age matched adult, both male and female patients admitted under medical unit-1 were randomly selected (eight from female ward and seven from male ward) as control.

Methods:

Laboratory procedures: All tests were done in BIRDEM biochemistry lab. For magnesium Roche Diagnostic GmbH, D-68298 Mannheim, Germany, supplied assay reagent. Reference range of Serum magnesium - 0.65-1.05 m mol/l. Serum potassium was assayed by ion probe method. Reference range of Serum potassium - 3.5-5.2 m mol/l

Statistical methods: Data were entered into and analyzed with 'Statistical Packages for Social Sciences' (SPSS) version 11.0 program. Value was expressed as frequency, percentage, ratio, mean ± standard deviation (SD), median, and range. Serum magnesium values were analyzed using The One-Sample T Test. Population mean of serum magnesium 0.85-m mol/l was used as specified constant [9].

Results:

Total 30 patients were included in this study. male female ratio were 1:2.minimam age was 30 years and maximum was 79years.the mean age was 52.33years(SD 12.97).Duration of diabetes were 1 to 20 years, mean 8.85 years (SD 5.13), four patients were only on diet control, seven patients were on oral hypoglycemic agent, and 19 patients were on insulin. Micro vascular complications were present in 22 patients. Diabetic retinopathy was in 18 patients, Diabetic nephropathy was in 14 patients and Diabetic neuropathy was in 8 patients (Table-1). Macro vascular complications were present in eight patients (Table-2). Hypertension was present in 16 patients (53.3%). ECG changes typical of hypokalemia was present in 17 patients (56%), most of them had hypomagnesemia.(Table-3) Out of 19 patients with hypomagnesemia, 14 had typical ECG changes (73.7%) whereas only three patients (27.3%) out of 11 with normal magnesium level had ECG changes. Only moderate to severe hypokalemic patients (serum potassium less than 3mmol/L) were included in this study. Mean potassium level of selected subjects was 2.37mmol/L with standard deviation of ± 0.36. Minimum and maximum values were 1.80mmol/L and 2.90mmol/L respectively. (Table-4)Seventeen patients (56.7%) were severely hypokalemic (serum potassium<2.5m mol/l) and 13 patients (43.3%) moderately hypokalemic (serum potassium <3.0mmol/l-2.5mmol/l). Magnesium level was checked in all cases. The mean ± SD was 0.67mmol/l ± 0.26.(Table-4) Hypomagnesemia was present in 19 patients (63.3%).(Figure-1) The lowest and highest values of serum magnesium level were 0.40 m mol/L and 1.40 m mol/L respectively(table-4). The sample mean was analyzed against population mean (0.85m mol/l) and controls mean by using one sample test and found significantly lower, (P =.001) and (P=.034) respectively(table-5,6). Serum magnesium level had no relationship with duration of DM, (P=0.211) (Figure - 2). In Hypomagnesemic patients, Mg level did not

correlate with K level (P=0.829).(Figure-3) Out of fifteen controls, eight were female and seven were male. The Mean ± SD of serum potassium & serum magnesium level of control were respectively 4.5±0.556 m mol/l and 0.78±0.120 mmol/l. The lowest and highest values of serum potassium level were respectively 3.9 m mol/l and 5.9 m mol/l. The lowest and highest values of serum magnesium level were 0.6 m mol/l and 1.1 m mol/l respectively. (Table-7) Hypomagnesemia was present in one subject in control.

Table-I

Frequency of microvascular complications (n =30)

Microvascular complications	Frequency	Percent
Diabetic retinopathy	18	60%
Diabetic nephropathy	14	46.7%
Diabetic neuropathy	8	26.7%

Table-II

Frequencies of macro vascular complications (n =30)

Macro vascular complications	Frequency	Percent
IHD	5	16.7%
CVD	4	13.3%
PVD	0	0%

Table-III

ECG change (n =30)

Hypomagnesemia		Frequency	Percent
Present	Yes	14	73.7
	No	5	26.3
	Total	19	100
Absent	Yes	3	27.3
	No	8	72.7
	Total	11	100

Table-IV

Serum potassium and serum magnesium in sample (n =30)

	Lowest value	Highest value	Mean	SD
Serum Potassium	1.80 mmol/L	2.90 mmol/L	2.90 mmol/L	± 0.36
Serum Magnesium	0.40 mmol/L	1.40 mmol/L	0.67 mmol/L	± 0.26 mmol/L

Table-V

Correlation of serum magnesium between sample and general population

	Mean	
Sample(n=30)	0.67mmol/l	(P=.001)
General population (n=15)	0.85mmol/L	

Table-VI

Correlation of serum magnesium between sample and control

	Mean	SD	
Sample(n=30)	0.67mmol/l	± 0.26	(P=.034)
Control(n=15)	0.78mmol/L	±0.120	

Table –VII

Serum potassium and serum magnesium in control (n =15)

	Lowest value	Highest value	Mean	SD
Serum Potassium	3.9 mmol/L	5.9 mmol/L	4.5 mmol/L	± 0.556
Serum Magnesium	0.6 mmol/L	1.1 mmol/L	0.78 mmol/L	± 0.120 mmol/L

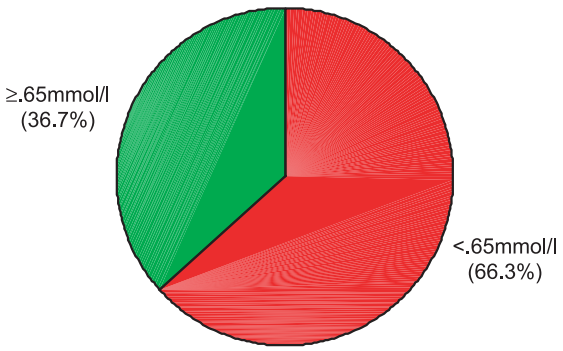

Fig.-1: *Magnasium status of study population*

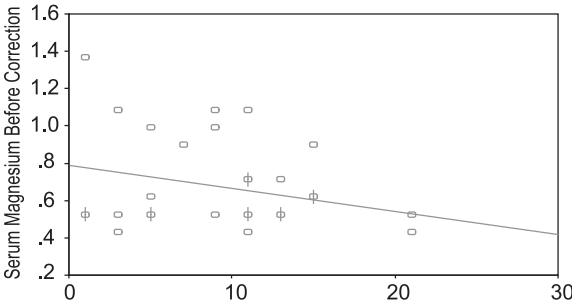

Fig.-2: *Correlation between serum magnesium &duration of diabetes*

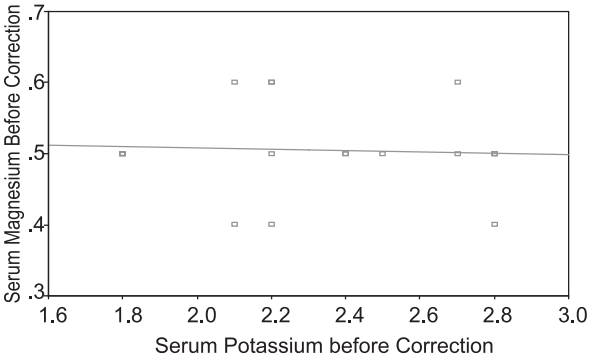

Fig.-3: *Correlation between serum magnesium & serum potassium*

Discussion:

Age and sex distribution in this study reflects age and sex distribution of patients admitted into medical unit 1 of BIRDEM. It has nothing to do with serum magnesium or serum potassium level. Mean diabetic duration of the study population was 8.85 years. Serum magnesium level has no direct relationship with diabetic duration if the DM is well controlled. Hypomagnesemia occurs in DM subjects due to loss of magnesium through urine because of glycosuria. In hypomagnesemic patients, no correlation was observed between serum potassium and serum magnesium level (Pearson's correlation co-efficient, r = -0.053, P=0.829). (Figure-3) As there is no other study on this topic, non-relationship observed here cannot be explained. However, there may be some non-linear relationship between them, which cannot be commented using Pearson's test. The frequency of hypomagnesemia is high in this study (63.3%) compared to other studies. However, subjects were different in those studies. So far no study has been found through journal search involving diabetic hypokalemic subjects. In a general population, 6.9% of patients were shown to be hypomagnesemic.[2] In hospitalized patients on a medical-surgical floor, there was a prevalence of 11%,[3] while in the intensive care unit it was found to be 20%.[4] In a postoperative intensive care unit setting, the prevalence was 60%.[4] A study of diabetic patients established a prevalence of 25%.[5] In a recent study in Bangladesh. Khan LA showed that almost 70% of patients with MRDM had clinically defined hypomagnesemia. Of the patients who had type 2 DM not related to malnutrition, 42% exhibited hypomagnesemia. [6] Sample mean of serum magnesium has been found significantly lower than general population (P=0.001) and control (P=.034). It is expected, as because, DM is a direct cause of hypomagnesemia and hypomagnesemia can be a cause of DM. Moreover, as the study subjects were all hypokalemic, many of these hypokalemia might have been the consequence of hypomagnesemia.

Conclusion:

Hypomagnesemia is a frequent finding in hospitalized diabetic hypokalemic patients & needs controlled clinical trial to see the 'effect of magnesium supplementation in correcting potassium level in diabetic hypokalemic patients' without checking magnesium level.

References:

1. Saito N, Nishiyama S. Aging and magnesium. Clin Calcium 2005; 15(11):29-36.
2. Whang R, Hampton EM, Whang DD.(Guerrero-Romero and Rodriguez-Moran 2006) Magnesium homeostasis and clinical disorders of magnesium deficiency. Ann Pharmacother 1994; 28:220-225
3. Wong ET, Rude RK, Singer FR. A high prevalence of hypomagnesemia in hospitalized patients. Am J Clin Pathol 1983; 79:348-352
4. Ryzen E, Elbaum N, Singer FR. Parenteral magnesium tolerance testing in the evaluation of magnesium deficiency. Magnesium 1985; 4:137-147
5. Mather HM, Nisbet JA, Burton JH. Hypomagnesemia in diabetes. Clin Chim Acta 1979; 95:235-242
6. Khan LA. Serum and urinary magnesium in young diabetic subjects in Bangladesh. Am J Clin Nutr 1999;69:70-3.
7. Kramer, B.K. and D. Endemann. Cardiac risks of hypokalemia and hypomagnesemia. Ther Umsch, 2000. 57(6): p. 398-9.
8. Hannedouche, T. and A. Delgado.Hypokalemia, hypomagnesemia and ventricular arrhythmia during diuretic treatment of arterial hypertension. Arch Mal Coeur Vaiss, 1988. 81(6): p. 819-24.
9. Wester Po. Magnesium, Am J Clin Nutr 1987; 45: 1305-1312