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Serum Magnesium Level of Newly Detected Patients with Glucose Intolerance and Its Comparison with Serum Magnesium Level of Age and Sex Matched Healthy Volunteers

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Abstract

Background: *Hypomagnesaemia is associated with insulin resistance, diabetes mellitus (DM) and diabetic complications. Diabetic patients, on the other hand, often have low magnesium levels. This study was designed to evaluate serum magnesium level of patients with new diagnosis of any level of glucose intolerance e.g. impaired fasting glucose, impaired glucose tolerance (IGT) or DM and to compare these with serum magnesium level of age and sex matched healthy controls.*

Materials & Methods: *This case-control study was done in out-patient department of BIRDEM General Hospital from July to September 2017. Newly detected patients with glucose intolerance (DM 49, IGT 1) were cases and equal number (50) of age and sex matched healthy volunteers were controls. Serum magnesium level was measures in all study participants and a comparison was made between cases and controls.*

Results: *There was no significant difference between cases and controls regarding age (p=0.875), sex and body mass index (p=0.386). Serum magnesium level was normal in 29 cases and 37 controls and low in 21 cases and 13 controls. Mean serum magnesium was low in cases (0.70±0.14 m.mol/L) than controls (0.85±0.15 m.mol/L) but the difference was not significant (p=0.362). Serum magnesium level was negatively correlated with fasting blood glucose (r -0.526), 2-h post-glucose value (r -0.559) and glycated haemoglobin (r -0.551) among cases.*

Conclusion: *Serum magnesium level was lower among patients with DM and IGT when compared with serum magnesium level of age and sex matched healthy volunteers and serum magnesium level was negatively correlated with glycaemic status.*

Key words: *diabetes mellitus, glucose intolerance, impaired fasting glucose, impaired glucose tolerance, serum magnesium.*

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Introduction

Diabetes mellitus (DM) is a global public health problem. Globally 347 million people are having DM[1] and this number is projected to be double in next 20 years and 150% more in low- and middle-income countries (LMIC).[2-4] Over 90% of all diabetic patients are having type 2 diabetes mellitus (T2DM).[5] Classically these patients pass through pre-diabetes [impaired fasting glucose (IFG) and impaired glucose tolerance (IGT)] states. Insulin resistance is one of the most important contributory aetio-pathogenic factors for T2DM development.

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Low serum magnesium (Mg) has been reported in patients with DM[6-8] and specially south-Asians[9] are at increased risk. Not only that, hypomagnesaemia is associated with insulin resistance[9,10], thus contributing to causation of diabetes.[11] Hypomagnesaemia is also associated with progression of diabetic complications.[6,12] Uncontrolled diabetes leads to osmotic diuresis and hypomagnesaemia[13] thus there occurs a vicious cycle[14] of hypomagnesaemia, diabetes and hypomagnesaemia. Mg supplementation helps in achieving good glycaemic control and may prevent or delay complications.[15,16] If patients with glucose intolerance are investigated and found to have low Mg levels, Mg replacement will help them to achieve better outcome. This study was designed to evaluate serum Mg level of newly detected patients with glucose intolerance, compare these values with serum Mg levels of age and sex matched healthy volunteers and to correlate level of serum Mg with glycaemic status of such patients.

Materials & Methods:

This case-control study was done in out-patient department (OPD) of Bangladesh Institute of Research and Rehabilitation

in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) General Hospital, Dhaka, Bangladesh over a period of three months (July-September 2017). Fifty newly detected (disease duration <3 months) patients with glucose intolerance (DM 49, IGT 1) were taken as cases and 50 age and sex matched healthy volunteers were included in this study as controls. Patients with gestational diabetes mellitus (GDM), type 1 diabetes and other specific types of diabetes, patients on diuretic or laxative treatment, patients with diarrhea or vomiting, malabsorption syndrome, known cases of parathyroid disorders and diagnosed cases of electrolyte imbalance were excluded from the study.

The research protocol was approved by the Ethical Review Committee (ERC) of Bangladesh Diabetic Somiti (BADAS) before commencement of the study. Data were collected consecutively and purposively from patients who were detected as having any degree of glucose intolerance as per eligibility criteria [according to the most recent oral glucose tolerance test (OGTT), done within the last 3 months]. Patients were counseled regarding the purpose of the study in detail and if they agree, after having the informed written consent, they were tested for serum Mg. Mg was tested by The ARCITECT c System family instruments manufactured by Abbott Laboratories, Abbott Park, IL, USA. Other relevant clinical and laboratory data were taken from patients' records which were done as part of routine management. Equal number of age and sex matched healthy volunteers were taken as control.

Data were analyzed by using statistical package for social sciences (SPSS) version 20.0 and appropriate statistical tests were performed. Results were presented in tables and figures as appropriate.

Results:

Total 50 patients with glucose intolerance (cases) and 50 age and sex matched healthy volunteers (controls) were evaluated in this study. Base-line characteristics are shown in Table I. Serum Mg level was normal in 29 cases and 37 controls and low in 21 cases and 13 controls. Mean serum Mg was lower in cases than controls but the difference was not significant (p=0.362). Serum Mg level was negatively correlated with fasting blood glucose (FBG), 2-h post-glucose value and glycated haemoglobin (HbA1c) among cases (r -0.526, -0.559 and -0.551 respectively) (Figure 1, 2, 3 respectively) but there was no significant relation of serum Mg with random blood glucose in control group (r 0.182).

Table I

Base-line characteristics of cases (50) and controls (50).

Characteristics	Cases (N-50)	Controls (N-50)	p value
Age (years)	43.68±11.07	43.26±11.23	0.875
Male:Female	1:1.5	1:1.5	—
BMI (kg/m^2)	27.70±1.98	25.33±2.64	0.386
Systolic BP (mm Hg)	133.10±14.87	122.50±10.06	0.001*
Diastolic BP (mm Hg)	83.00±6.22	76.94±9.71	0.004*
DM:IGT	49:1	—	—
FBG (m.mol/L)	8.98±1.90	—	—
2-h BG (m.mol/L)	14.52±7.22	—	—
RBG (m.mol/L)	—	6.50±0.38	—
HbA1c (%)	7.87±.93	—	—
Mg (m.mol/L)	0.70±0.14	0.85±0.15	0.362
Ca (mg/dL)	8.78±0.28	8.52±1.27	0.004*
S. Creatinine (mg/dL)	0.89±.145	0.81±.096	0.002*
ALT (U/L)	52.46±10.02	41.62±15.48	0.001*

[BMI-body mass index, BP-blood pressure, DM-diabetes mellitus, IGT-impaired glucose tolerance, FBG-fasting blood glucose, RBG-random blood glucose, HbA1c-glycated haemoglobin, ALT-alanine aminotransferase]

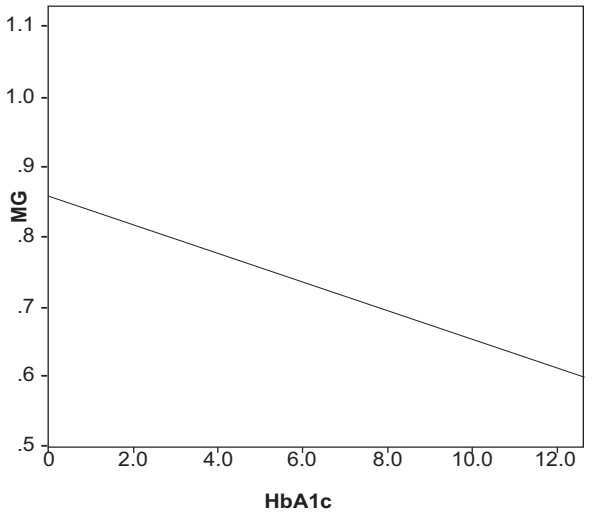

Figure 1. Relationship between HbA1c and serum Mg level among cases.

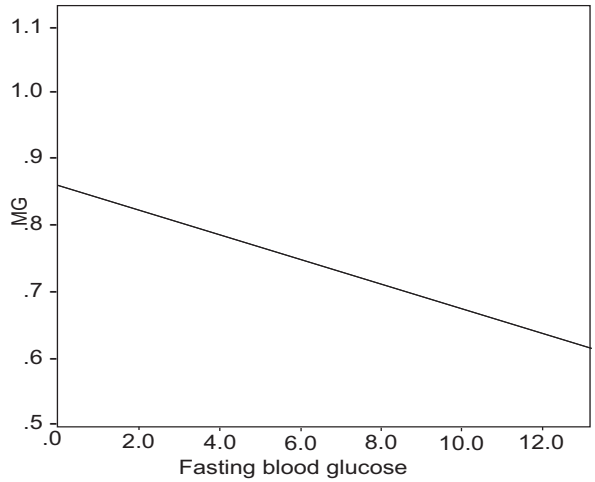

Figure 2. Relationship between FBG and serum Mg level among cases.

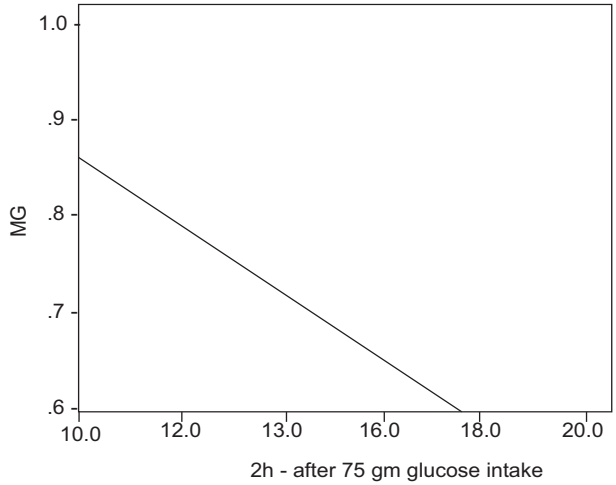

Figure 3. Relationship between 2-h after 75 gm glucose and serum Mg among cases.

Discussion:

Mg is the second most major intracellular cation in the human body. It is the basic composition of many enzymes and acts as a cofactor in over 300 enzymatic reactions.[17] Evidences suggest that low Mg is related to insulin resistance thus contributing to the development of DM.[9,10,18] Dietary Mg supplementation may prevent conversion from prediabetes to diabetes.[16] Hypomagnesaemia in diabetic population is associated with neuropathy and other diabetic complications.[19,20] Among diabetic patients, there is a higher renal Mg excretion caused by reduced tubular Mg reabsorption resulting from glucose-induced osmotic diuresis and possibly resulting from insulin resistance.[13,14]

Results from current study showed that Mg level was low in newly detected patients with glucose intolerance and there was inverse relation of Mg with their glycaemic control. Almost similar findings were observed in one Canadian study.[21] Serum Mg level was negatively correlated with HbA1c in different studies[22-24] and it is a consistent finding.

As correction of hypomagnesaemia have positive impact on glycaemic control, dietary supplementation may help patients with diabetes, though controversies do exist.[17] Newer antidiabetic agent, sodium-glucose co-transporter 2 (SGLT2) inhibitors have been reported to increase serum Mg level in diabetic patients.[25]

Most studies related to serum Mg and diabetes were done among diagnosed diabetic patients. Half of type 2 diabetic patients remain undetected and one-third to half of type 2 diabetic patients have one or more complications during diabetes diagnosis.[26-28] As evidences suggest that correction of hypomagnesaemia improves diabetes control and delay complications, identification and treatment of hypomagnesaemia early in disease course will obviously improve overall patient outcome. Evaluation of Mg level early among patients with glucose intolerance and the case-control design of the present study were the main strengths of our study.

However, the present study had some limitations. It was a single center study with small number of study participants. No patient with IFG was included in this study. A larger multi-center study with increased number of study participants would give a more representative answer in question.

Conclusion:

Though there was no significant difference in serum Mg level among newly detected patients with glucose intolerance with serum Mg level of age and sex matched healthy volunteers in this study, serum Mg level was lower among

patients with glucose intolerance (DM and IGT). Among patients with glucose intolerance serum Mg level was negatively correlated with glycaemic status.

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Conflict of interest: None.

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