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Original Research Article

A Hospital-Based Study to Evaluate the Association Serum Magnesium and Blood Glucose in Type II Diabetic Population

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Abstract

Aim: The aim of the present study was to correlate the levels of serum magnesium and blood glucose in type II diabetic population in a tertiary care hospital.

Methods: The present study was conducted in the Department of Medicine, Nalanda medical College and Hospital, Patna, Bihar, India and 150 cases all new and old cases of Type 2 diabetes mellitus patients, aged between 35 to 60 years attended were included in the study for the period of 12 months.

Results: In our study, mean and std deviation of all the 3 groups were 54.66±13.7, 57.94±11.8 and 52.68±9.8 respectively. In gender area which was not significant in our study. There was a positive Correlation between the parameters of glycemic status i.e., HbA1C, fasting and post prandial blood glucose but no significant correlation with magnesium. The fasting and post prandial blood glucose values are inversely correlated with magnesium. There was no significance r and p-values between the sr.mg and HbA1C.

Conclusion: Serum magnesium levels were lower in DM2 patients when compared with non-diabetic controls. Because of this low level of Mg2+, which reduces insulin sensitivity and may increase risk of secondary complications like retinopathy, hypertension and dyslipidaemia, it may be prudent in clinical practice to periodically investigate plasma Mg2+ concentrations in diabetic patients. If plasma Mg2+ is low, an intervention to increase dietary intake of magnesium may be beneficial.

Keywords: Diabetes mellitus, hypomagnesemia, insulin sensitivity, blood sugar and serum magnesium

Introduction

Magnesium (Mg), the second most predominant intracellular cation, is one of the many essential micronutrients in the human body that has an important role as a cofactor in more than 300 enzyme systems that regulate diverse human biochemical reactions. [1,2] Thus, deficiency of Mg has been found to be linked with significant clinical consequences, thereby raising an interest in estimating serum Mg levels in various disease conditions. Among the many such diseases, type 2 diabetes mellitus (T2DM) and its related cardiometabolic complications are known to be associated with Mg deficiency. [2,3] Stroke is one such deadly complication of T2DM and is also a major cause of mortality worldwide, especially among the elderly.

Many studies have reported that Mg intake has a significantly inverse association with T2DM and stroke [3,4] and increasing the dietary intake may likely prevent the occurrence of stroke in a dose-dependent manner. [5] For instance, Larsson et al conducted a study using the mendelian randomisation approach, which revealed that genetically higher serum Mg concentrations (rather than serum calcium concentrations) are associated with a reduced risk of cardioembolic stroke. [6] Furthermore, serum Mg concentrations could likely predict the type of stroke where patients with ischaemic stroke have higher levels of Mg compared with those with haemorrhagic stroke. [7] There is also evidence that serum Mg levels are significant predictors of complications in patients who had a stroke. These include, but are not limited to, Mg deficiency (below 0.88 mmol/L) increasing the risk of haemorrhagic transformation in patients with ischaemic stroke on intravenous thrombolysis, [8] being independently associated with in-hospital mortality during the acute phase [9] and even being

associated with post-stroke cognitive impairment among those who recovered. [10]

Microalbuminuria (MA) was first described in diabetic patients in 1982. [11] It was shown to be associated with increased risk of cardiovascular morbidity and mortality in diabetic patients. [12-14] At the same time, it is accepted as an indicator for the presence of diabetic retinopathy/neuropathy, cardiovascular and peripheral vascular disease and increased mortality. [12,13] The presence of MA and overt proteinuria in non-insulin dependent diabetes mellitus (NIDDM) is an indicator of poor glycemic control. As well as poor glycemic control; insulin resistance and low Mg level strongly associated with increased the prevalence of MA. [15] There have been controversial views on the relationship between MA and Mg deficiency. Some studies demonstrated that MA and overt proteinuria do not affect plasma Mg level. [16]

The aim of the present study was to correlate the levels of serum magnesium and blood glucose in type II diabetic population in a tertiary care hospital.

Materials and Methods

The present study was conducted in the Department of Medicine, Nalanda medical College and Hospital, Patna, Bihar, India and 150 cases all new and old cases of Type 2 diabetes mellitus patients, aged between 35 to 60 years attended were included in the study for the period of 12 months.

Group 1 - control subjects – 50

Group 2 – Type 2 DM less than 5 years – 50

Group 3 – Type 2 DM more than 5 years – 50

Inclusion Criteria: All new and old cases of Type 2 diabetes mellitus patients, aged between 35 to 60 years attended

Exclusion Criteria: Patients with nephropathy. Patients who suffered coronary artery diseases in last six months. Patients on drug therapy-diuretics. Patients with history of alcoholism. Patients on magnesium supplementation. GIT problems-Malabsorption and Chronic diarrhoea.

Methods

Overnight fasting, venous blood sample (after at least 10 hours) was collected for the measurements of serum magnesium and blood glucose. Estimation of blood glucose; Fasting and postprandial (2 hour) blood sugar (FBS and PPBS) were estimated by Glucose Oxidase- Peroxidase (GOD-POD) enzymatic end point method. Glycated haemoglobin(HbA1C) were estimated by immunoturbidity method. Estimation of Serum Magnesium;-It is an enzymatic end point method. Normal fasting is 70-110mg/dl and post prandial is 110- 140mg/dl. The normal serum magnesium level is ranging from 1.8 mg /dl to 3.6 mg /dl. Serum magnesium levels < 1.5 mg/dl is considered as low mg level in this study. Urine examination done for benedict test and proteinuria. Statistical Analysis: The data were collected, recorded and analyzed statistically to determine the significance of different parameters by using SPSS package for windows version 17.0. Scientific research committee and ethical committee clearance were obtained from the concerned committees from our institution.

Results

Table 1: Clinical and Biochemical characteristics of the subjects

	Group-1 (n=50)	Group-2 (n=50)	Group-3 (n=50)	p value
Age (Year)	54.66±13.7	57.94±11.8	52.68±9.8	0.3238
Gender (F/M)	18/32	28/22	17/33	0.5476
Blood sugar level fasting (70-110 mg /dl)	98.82±10.5	186.84±68.2	198.52±93.5	0.0001
Blood sugar level -				
Postprandial (110-140 mg /dl)	124.66±9.4	294.76±76.4	299.51±64.8	0.0001
HbA1c <6%	4.84±0.6	6.78±3.4	6.80±3.6	0.0044
Sr. Mg (mg/dl) 1.6-2.6	1.98±0.5	1.95±0.8	2.05±0.5	0.8432

In our study, mean and std deviation of all the 3 groups were 54.66±13.7, 57.94±11.8 and 52.68±9.8 respectively. In gender area which was not significant in our study. There was a positive Correlation between the parameters of glycemic status i.e., HbA1C, fasting and post prandial blood glucose but no significant correlation with magnesium.

Table 2: Correlation between HbA1c with Sr. Mg (mg/dl)

Cases	r value	P Value
Group 1	-0.316	0.082
Group 2	-0.886	0.001
Group 3	-0.842	0.001

There was no significance r and p-values between the sr.mg and HbA1C in group 1, it found significant in group 2& 3.

Discussion

Magnesium(Mg) is one of the major intracellular cation and is an important cofactor for various enzymes, transporters, and nucleic acids that are essential for normal cellular function, replication, and energy metabolism. [17] It has been suggested that hypomagnesaemia may induce altered cellular glucose transport, reduced pancreatic insulin secretion, defective post receptor insulin signalling, and/or altered insulin–insulin receptor interactions. [18] Type 2 diabetes mellitus (DM2) is often accompanied by alteration of Mg status. An increased prevalence of Mg deficits have been identified in DM2 patients, especially in those with poorly controlled glycemic profiles, with longer duration of the disease and with the presence of micro- and macrovascular chronic complications. [19]

In our study, mean and std deviation of all the 3 groups were 54.66±13.7, 57.94±11.8 and 52.68±9.8 respectively. In gender area which was not significant in our study. There was a positive Correlation between the parameters of glycemic status i.e., HbA1C, fasting and post prandial blood glucose but no significant correlation with magnesium. The fasting and post prandial blood glucose values are inversely correlated with magnesium. There was no significance r and p-values between the sr.mg and HbA1C. Serum magnesium of diabetic patients showed significant negative correlations with duration of disease, and glycemic control as measured by HbA1c, and near significant negative correlation with FBS. No significant correlations were found between magnesium level and BMI or age. [20] One more study done by De Valk HW found that patients with severe retinopathy have a lower plasma magnesium level compared to patients without retinopathy and a prospective study has shown the plasma magnesium level to be inversely related to occurrence or progression of retinopathy. [21] In a recent Study conducted by Senthil et al. stated that a significant inverse relationship between Serum Mg and HbA1C values in South India. [22] Causes for the low Mg levels in DM2 are a low Mg intake and an increased Mg urinary loss [23] and the use of loop and thiazide diuretics, often prescribed in diabetic patients with hypertension and/or cardiovascular diseases, also promote Mg loss. [24]

Conclusion

Serum magnesium levels were lower in DM2 patients when compared with non-diabetic controls. Because of this low level of Mg2+, which reduces insulin sensitivity and may increase risk of secondary complications like retinopathy, hypertension and dyslipidaemia, it may be prudent in clinical practice to periodically investigate plasma Mg2+ concentrations in diabetic patients. If plasma Mg2+ is low, an intervention to increase dietary intake of magnesium may be beneficial. Oral Mg supplements appear to be useful in persons with DM2 to restore Mg deficiencies, to improve insulin resistance, oxidative stress, and systemic inflammation and have been shown to improve fasting and postprandial glucose levels and insulin sensitivity in hypomagnesemic DM2 patients.

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