e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(3); 1080-1084

Original Research Article

Study of Association of Serum Magnesium Level with the Glycemic Status of Type 2 Diabetes Mellitus Patients

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Received: 25-01-2023 / Revised: 25-02-2023 / Accepted: 22-03-2023
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Conflict of interest: Nil

Abstract

Introduction: Diabetes Increases the excretion of minerals and other nutrients like most of other chronic diseases. Magnesium is the second most abundant intracellular cation, and its concentration remains remarkably constant in healthy individuals. It activates enzymes and acts as important cofactor in many biochemical reactions. Magnesium is required for insulin secretion and proper insulin functioning through tyrosine kinase activity at the receptor level. Current study has been undertaken to evaluate the association of serum levels of magnesium with glycemic status of type 2 DM patients.

Materials and Methods: Sample size calculated to be 100. 100 eligible patients are selected from diabetic OPD from July 2021 to December 2021. It is a cross sectional study. Our aim is to evaluate the association of hypomagnesemia with HbA1c level in type 2 DM patients. Patients were subjected to history and examination, investigations and analyzed using simple statistical methods. In this study HbA1c>7% was taken as poor glycaemic control. The mean level of magnesium is to be determined in both the groups of HbA1c > 7 and HbA1c< 7 and their statistical association.

Observation: The present study included 100 numbers of type 2 diabetes patients. Out of these 56% were male and 44% were female. The maximum number of patients were from >60 years age group. HbA1c>7% was taken as poor glycemic control and the mean magnesium level in the group was 1.6±0.25. HbA1c<7% was taken as good glycemic control and the mean magnesium level was 1.8±0.22. The P value was found to be significant (0.047%).

Conclusion: The level of magnesium was lower in patients with poor glycemic status. Hypomagnesaemia was more in high HbA1c group of patients. Therefore, it can be said that magnesium level can act as an indicator of the glycemic status of diabetic patients.

Keywords: HbA1c, FBS, S. Magnesium.

Introduction

The prevalence of type 2 diabetes mellitus (T2DM) has been increasing exponentially with high rates of diabetes morbidity and mortality due to complications.

Hypomagnesemia is one of the conditions that can accelerate complication in patients with T2DM. Magnesium, the second most abundant divalent cation in the intracellular fluid, serves as a cofactor for about 250 cellular enzymes which are involved in energy metabolism. [1] It also plays an important role in protein and nucleic acid synthesis within the cell1The serum magnesium concentration is about 0.3% of total body magnesium [2]. So, serum magnesium concentration is an insensitive but specific indicator of low magnesium status. Magnesium deficiency may be due to, its decreased uptake and intestinal absorption, mobilization of bone magnesium, urinary leakage and insulin resistance. Magnesium in aging largely results from various pathologies like diabetes and treatment with hypermagnesuric diuretics in elderly persons. Osmotic diuresis caused due to glucosuria in diabetes mellitus results in urinary loss of magnesium. Among the endocrine and metabolic disorders associated with magnesium deficiency diabetes mellitus is the most common. [3] Literatures have shown the presence of hypo-magnesemia in nearly 25% of the diabetic patients. [4] In the healthy subjects, insulin has shown to stimulate erythrocyte magnesium uptake. Studies have shown that insulin regulates the intracellular magnesium concentration by stimulating the plasma membrane ATPase pump. The intracellular magnesium deficiency may be due to the insulin resistance. Low levels of magnesium can reduce secretion of insulin by the pancreas. Hence low serum levels of magnesium can be responsible for onset or worsening of DM and even DM can induce hypomagnesemia. [4] Several studies have been conducted in past which have revealed significant low magnesium levels in DM as compared to non-diabetic healthy controls. Current study has been undertaken to evaluate the association of serum levels of magnesium with glycemic status of type 2 DM patients.

Materials and Methods

It is an observational analytic study conducted at Agartala Government Medical College, Agartala, Tripura at department of Medicine. The aim of this study is to evaluate the association of hypomagnesemia with HbA1c level in Type2 DM patients.

Inclusion criteria

- Patients with T2DM more than 18 years,
- Body mass index (BMI) < 30 Kg/m.

Exclusion criteria

- Impaired renal function with serum creatinine > 1.2 mg/dl for women and > 1.5 mg/dl for men,
- Pregnant or lactating women,
- Acute infections or inflammation,
- Chronic liver diseases,
- History of drinking alcohol or smoking,
- Taking diuretics, aminoglycoside drugs, amphotericin B, steroids and
- History of getting therapy of cetuximab, erlotinib, cisplatin, carboplatin, cyclosporine or tacrolimus.

Sample size calculated to be 100. 100 eligible patients are selected from diabetic OPD of Medicine department of AGMC & GBP Hospital from July 2021 to December 2021. It is a cross sectional study. Patients were subjected to history, examination and investigations.

5 ml of blood was collected, after overnight fasting of 10 hours in two vacuum evacuated tubes, one with additives EDTA and Sodium fluoride for estimating plasma glucose and other tube free from trace element. FBS was estimated using Hexokinase method11 and Serum magnesium levels were estimated using complexometric photometric method 12 based on bichromatic end point technique on the Siemens fully automated Dimension EXL 200 clinical chemistry system in National Accreditation Board for testing and calibration Laboratories (NABL)

certified laboratory with all the Quality control procedures in place. In this study HbA1c>7% was taken as poor glycaemic control. The mean level of magnesium is to be determined in both the groups of HbA1c > 7 and HbA1c< 7 and their statistical association. Descriptive and inferential statistical analysis has been carried out in the present study. The Statistical software namely SPSS 22.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Results

The present study included 100 numbers of type 2 diabetes patients. Out of these 56% were male and 44% were female. The maximum number of patients were from >60 years age group. HbA1c>7% was taken as poor glycemic control. 93% patients were found to be HbA1c > 7% and only 7% patients had good glycaemic control. Hypomagnesaemia defined as S. Mg level <1.8 mg /dl. 70% patients had Hypomagnesaemia in this study.

Table 1: Age in years –Frequency distribution of patients studied.

Variables	No. of Patients	%
Age in Years		
<50	19	19.0
50-60	35	35.0
>60	46	46.0
Gender		
Male	56	56.0
Female	44	44.0
S.HBA1c		
GOOD CONTROL (<7)	7	7.0
POOR CONTROL (>7)	93	93.0
S.Mg2+(meq/l)		
<1.8 meq/l	70	70.0
>1.8 meq/l	30	30.0
Total	100	100.0

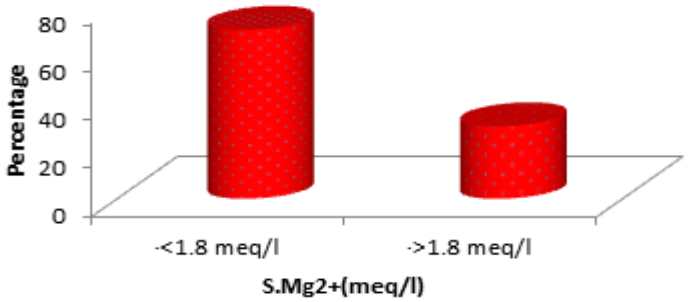

Figure: 1 Hypomagnesemia percentage in studied population

The mean magnesium level in the poor glycaemic control group was 1.6±0.25. HbA1c<7% was taken as good glycemic control and the mean magnesium level was 1.8±0.22. The P value was found to be significant (0.047).

Table 2: Comparison of clinical variables according to HbA1c of patients studied.

Variables	S. HBA1c		Total	P Value
	Good Control (<7)	Poor Control (>7)		
Age in Years	60.43±9.29	59.48±10.01	59.55±9.92	0.809
S.Mg2+(meq/l)	1.8±0.22	1.6±0.25	1.62±0.26	0.047*
S.FBS(mg/dl)	131.43±30.24	159.32±40.29	157.37±40.19	0.076+
S.PPBS(mg/dl)	309.86±196.77	308.45±85.27	308.55±95.41	0.970

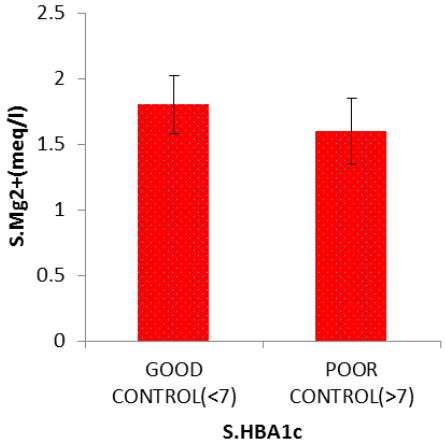

Figure 2: Association of HbA1c and Mg level

Discussion

Magnesium is an intracellular cation that plays an important role in cellular metabolism. Hypomagnesemia in DM has been reported in many studies [5,6,7]. In our study there is significant hypomagnesemia in Type 2 DM in poor glycaemic status patients.

Similar findings have been reported in studies done in serum magnesium status in Type 2 DM. [8,9]] There is negative correlation between serum magnesium levels with fasting and postprandial blood glucose level. This has been reported in a study done by Diwan, et al. Tripath, et al., Naila Masood, et al. Diabetes Mellitus is one of most common causes of magnesium deficiency although is related to poor metabolic control [10]. In type 2 DM patients, hypomagnesemia can be a consequence or a cause of increased insulin resistance. The reason for high prevalence may be attributed to increased urinary loss (osmotic dieresis), low dietary intake or impaired absorption of magnesium compared to healthy individuals [11]. Intracellular magnesium plays a key role in regulating insulin action, insulin-mediated glucose uptake and vascular tone Reduced intracellular magnesium concentrations result in defective tyrosine kinase activity, impede phosphorus bond dependent reactions of the many enzymes related to glucose metabolism, impair insulin receptor function through increased microviscosity of the plasma membrane and thus decrease insulin sensitivity and worsening of insulin resistance in diabetic patients [12]. The influence of magnesium on cell membrane ATPase activity and consequently on intracellular sodium, calcium, potassium metabolism may also play a role in diabetic complication. Hypomagnesemia when it is chronic, it increases the risk of macro and microvascular complications of DM [13]. Low levels of magnesium promote endothelial cell dysfunction and thrombogenesis by increasing platelet aggregation and vascular complication. Magnesium has been shown to inhibit platelet activation by inhibiting thromboxane A2 & interfering with the IIb-IIa receptor complex formation [14]. The

influence of magnesium on cell membrane ATPase activity, consequently on intracellular Ca2+, Na+, K+ metabolism may also play a role in diabetic complications. Hypomagnesemia when it is chronic, increases the risk of macro and microvascular complications of DM [8,13]. Based on this study, it can be said that magnesium levels can be taken as an indicator of the glycaemic status in the diabetics. Oral magnesium supplementation can be advised in such patients.

Conclusion

The level of magnesium was lower in patients with poor glycemic status. Hypomagnesaemia was more in high HbA1c group of patients. Therefore, it can be said that magnesium level can act as an indicator of the glycemic status of diabetic patients.

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