

Frequency Of Hypomagnesemia In Patients With Diabetes Mellitus: An Analytical Cross-Sectional Study

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Abstract

Aim: To determine the frequency of Hypomagnesemia in Patients with Diabetes Mellitus

Study design: An analytical cross-sectional study Study

Place and Duration: This study was conducted at Sabah Al Ahmad E Clinic MOH Kuwait from March 2021 to March 2022

Methodology: A total of 110 patients participated in the study. A total of 31 (28.18%) patients had type 1 diabetes (T1DM) and 47 (42.72%) had type 2 diabetes (T2DM). The remaining 32 (29.09%) were non-diabetic individuals and they had been allocated to the control group. The diagnosis and classification of diabetes mellitus were done according to the criteria of the World Health Organization. The patients included in the study were available for other laboratory investigations too.

Results: The mean age of the patients in the control, T1DM and T2DM were 29.64 ± 1.94 , 30.64 ± 1.41 , and 52.33 ± 1.51 , respectively. The age, body mass index (BMI), and basal C-peptide level were greater in the patients with T2DM compared to T1DM patients ($p=0.001$). The mean of the magnesium levels in the diabetic patients was 0.83 ± 0.13 mmol/L and it was 1.04 ± 0.14 mmol/L in the non-diabetic individuals ($p=0.001$). The level of magnesium was lower in the diabetic patients compared to the non-diabetic individuals in the control group. Hypomagnesemia was detected in 64% of diabetic patients.

Conclusion: Diabetic patients are more likely to have a lower level of serum magnesium. Therefore, the risk of developing complications related to hypomagnesemia is more in diabetic patients. Periodic investigation of the magnesium levels and replacement of magnesium if necessary is recommended in diabetic patients.

Introduction

Magnesium is abundantly present within the cell and it is also the second most abundant cation that is present inside a cell after potassium. The ions of magnesium are vital for all living cells. For the manipulation of polyphosphate compounds, magnesium plays a major role [1]. A disturbance in the level of magnesium has been reported in diabetic individuals. Hypomagnesemia is common in diabetic patients [2]. Hypomagnesemia results in increased serum glucose levels, increased glucosuria, and insulin resistance [3]. It can also lead to cardiovascular abnormalities [4].

Over a population of 300 million people in the World are suffering from T2DM. The prevalence would increase to 600 million soon [5]. Insulin resistance and insulin deficiency, both are featured in T2DM. Another explanation is that the production of insulin in the body is lower than the demand for insulin in the body leading to insulin resistance [6]. It has been reported by various studies that hypomagnesemia is strongly associated with T2DM [7]. Hypomagnesemia has a direct and rapid effect on the functions of the kidneys. The effect can be permanent [8]. It has also been seen in some studies that an appropriate intake of magnesium through diet can potentially decrease the risk of the development of T2DM. Both factors have an inverse relation [9].

Magnesium is important for energy homeostasis, DNA stability, and protein synthesis in the body. Due to these important functions of magnesium, the level of serum magnesium has to be regulated strictly between 0.7 to 1.05 mmol/L. Other common factors that can lead to hypomagnesemia are the wasting of magnesium from the kidneys and the malabsorption of magnesium from the intestines [10]. The present study is focused on the determination of the level of magnesium in the blood of patients with diabetes mellitus and its comparison with healthy non-diabetic individuals.

Methodology

The present study includes a total of 110 participants. A total of 32 (29.09%) were non-diabetic, 31 (28.18%) patients had T1DM and 47 (42.72%) had T2DM. The diagnosis and classification of diabetes mellitus were done according to the criteria of the World Health Organization. The patients included in the study were available for other laboratory investigations too. On the day when the examination was done, all the patients were directed not to take their insulin dose in the morning and other oral hypoglycemic drugs. None of the patients was a smoker. Common comorbidity found in diabetic patients was hypertension. Data regarding the diabetes type, age, duration, and treatment taken for diabetes, was collected. Height and weight were recorded for all the participants. The height was taken in centimeters and the weight was taken in kilograms. Blood pressure was measured for all the patients from the right arm through a mercury sphygmomanometer.

All the patients were described in the clinical trial and written informed consent was taken from all the participants of the study. The ethical review committee permitted this study. A total of 5-10 mL of blood from the peripheral vein was taken from the participants. The collection of the blood was done in a fasting state. The blood was centrifuged, isolated, and frozen. The sera were frozen at -20 degrees Celsius. After that, the sera were analyzed for the lipid values (low-density lipoproteins (LDL), triglycerides, high-density lipoproteins (HDL), and total cholesterol level) and the level of Magnesium. The reference value of Magnesium considered in the present study was 0.70 to 1.00 mmol/L. The data were analyzed in IBM SPSS version 26.

Results

The patients with T2DM were older than the patients with T1DM and non-diabetic individuals. The systolic blood pressure in the patients with T2DM was higher, whereas, there was no significant difference in diastolic blood pressure in all the groups. Moreover, the values of BMI and the level of Basal C-peptide were also significantly different in the T2DM group and the other two groups. The characteristics of the participants are shown in table 1.

Similarly, the variables of lipid profile (HDL, LDL, cholesterol, and triglycerides) are also higher in the group of T2DM compared to the two other groups. The level of magnesium was lower in both the T1DM and T2DM groups compared to the control group. However, the level of magnesium is similar in the patients with diabetes in both the diabetic groups. The values have been given in table 2.

The prevalence of hypomagnesemia noted was 64% in diabetic individuals. After the comparison of different characteristics, it has been observed that the lowest level of magnesium was present in patients with T1DM. Other variables were not significantly different in the categories of magnesium level. The lipid profile was also similar in the magnesium level categories. The categories of magnesium levels are shown in table 3.

Variables	T1DM (n=31)	T2DM (n=47)	Non-diabetic Control group (n=32)	P value
Age	30.64±1.41	52.33±1.51	29.64±1.94	<0.001
Systolic BP	116.64±3.64	133.72±2.78	119.32±2.67	<0.001
Diastolic BP	78.63±3.7	82.67±1.67	79.87±1.95	NS
BMI	20.78±0.6	24.1±0.4	20.5±0.7	<0.001
Basal C-Peptide	0.16±0.04	0.7±0.05	0.53±0.05	<0.001

Variables (mmol/L)	T1DM (n=31)	T2DM (n=47)	Non-diabetic Control group (n=32)	P value
LDL	3.5±0.3	3.3±0.1	2.9±0.2	0.120
HDL	0.93±0.08	0.89±0.6	1.2±0.1	0.006
Cholesterol	5.2±0.2	5.3±0.1	4.6±4.1	0.280
Triglycerides	1.5±0.3	2.2±0.2	1.4±0.3	0.006
Magnesium	0.82±0.03	0.86±0.01	1.04±0.14	<0.001

Magnesium levels (mmol/L)	T1DM			T2DM			P-value
	<0.7 N=5	0.7-0.9 N=18	>0.9 N=8	<0.7 N=4	0.7-0.9 N=26	>0.9 N=17	
Age in years	22.96	30.93	32.5	50.93	52.54	49.65	<0.001
Systolic BP	108.43	117.96	122.97	123.64	133.67	134.67	0.006
Diastolic BP	72.67	80.67	80.96	72.72	81.64	85.15	0.029
BMI	20.64	20.45	19.36	24.12	24.24	23.12	<0.001
HDL	1.01	1.03	0.83	1.12	0.82	0.92	0.108
LDL	3.63	3.33	3.31	3.11	3.52	3.12	0.120
Cholesterol	5.32	5.66	5.33	5.21	5.29	5.41	0.220
Triglycerides	1.02	1.52	2.37	1.72	1.91	2.23	0.136

Discussion

The most common metabolic and endocrine disease associated with the deficiency of magnesium is diabetes mellitus. Many studies have proven that the mean level of magnesium in the plasma of patients with T1DM and T2DM is lower.

A significantly negative association of fasting blood glucose level and HbA1c with magnesium was noted in the study of Sales et al [11]. A diet low in magnesium is one of the most important causes of the deficiency of magnesium in diabetic patients. Other causes are insulin insensitivity, osmotic diuresis leading to the excretion of magnesium, thiazide diuretics, loop diuretics, diabetic neuropathy, and resistance to insulin [12].

Shaikh et al conducted a similar study in 2010 in which they included 100 diabetic patients. They identified a 14.5% prevalence of hypomagnesemia in patients with T1DM and 85.5% in patients with T2DM. The results were consistent with the results of the present study. They also noted that the HbA1c was elevated in patients with hypomagnesemia [13]. The study of Kurstjens et al suggests that the major determinants of the low level of magnesium in blood are plasma triglycerides. They also concluded that hypomagnesemia is prevalent in diabetes patients [14]. The study of Corica et al supports the theory that the level of magnesium in the blood is directly associated with and can be determined by the level of triglycerides [15]. The present study has also determined triglycerides to be associated with the level of magnesium.

The study of Ramadass et al included 50 patients with T2DM. The study aimed to the determination of association of hypomagnesemia with HbA1c and serum glucose levels. They observed a decline in serum magnesium with an increase in HbA1c. They concluded that poor control of diabetes leads to hypomagnesemia [16]. The results of the study are consistent with the results of the present study. Nasri et al deduced that dietary magnesium can potentially prevent dyslipidemia and improve metabolism in patients with T2DM[17]. Baig et al conducted a study in which they included 60 patients. The ages of the patients were between 40-70 years. All of the participants were diagnosed with T2DM. They observed that the serum magnesium level was lower in those patients with or without apparent complications. They also showed that the level of magnesium was comparatively lower in patients with diabetic complications than the patients without diabetic complications [18].

Kocot et al carried out a similar study to the present study. They included 54 diabetic patients. All the patients had T2DM. They also found lower magnesium levels in diabetic patients compared to healthy individuals. Their study found a weak negative correlation between cholesterol and triglycerides and the magnesium level in serum [19]. Mishra et al examined 45 patients with type 2 diabetes. They, on the other hand, found a significantly negative relation between magnesium levels in serum with triglycerides [20]. These results are consistent with the present study.

Conclusion

Patients with diabetes have a significant deficiency of magnesium. Hence, they are at potential risk of the development of metabolic and other diabetic complications. A periodic determination is necessary for such patients. Dietary magnesium can help in the reduction of insulin resistance and the prevention of complications.

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Conflict in the interests

Not any kind of conflict was seen in the interests in the present study

Permission

Due permission was acquired from the ethical committee before the conduction of the research.

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