

Original Research

Serum Magnesium Level and HbA1c in children with Type1 Diabetes Mellitus

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ABSTRACT:

Background: In children and adolescents, type 1 diabetes mellitus (T1DM) is the most common endocrine-metabolic disorder, with significant physical and psychosocial repercussions. Those children will require exogenous insulin on a regular basis, as well as the ability to check their own glucose levels and pay close attention to the imnutritiona lconsumption. Magnesium levels may be decreased in patients with type 1 diabetes mellitus (T1DM), influencing disease control. Present study aimed to evaluate association between serum magnesium levels and glycemic management in children withT1DM. **Materials and method:** A 94 diabetic child with T1DM, and a 30 healthy control of similar ages were involved in this study. Both groups had blood samples drawn to determine serum magnesium and HbA1c levels. Data were statistically analyzed using SPSS 22. A Pvalue of <0.05 was considered significant. **Results:** The serum magnesium is significantly low among males than females in the diabetic group. Serum magnesium is significantly low in children with T1DMspecially in those with poorly controlled diabetes (high level of HbA1c) in comparison with control group(non-diabetic children). The high prevalence of magnesium deficiency in diabetes mellitus may be due to insufficient dietary intake, or impaired intestinal absorption of magnesium or increased urinary loss of magnesium compared to healthy individuals. **Conclusion:** Serum magnesium level is frequently low in children with type 1 diabetes mellitus. There is a significant correlation between serum magnesium leveland the glycemic control. Therefore we recommenddoing regular monitoring of serum magnesium in typ 1diabetic childrenand appropriate supplement of low levels.

Keywords: Magnesium, type1diabetesmellitus(T1DM),children,hypomagnesemia.

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INTRODUCTION

Diabetes mellitus is accompanied by alteration in the metabolism of micronutrients and magnesium (Mg) is the most common one studied in this regard. Mg has an important role in the metabolism of carbohydrate so that it may affect the release and activation of insulin which is the hormone that controls levels of blood glucose.¹Mg is the fourth most abundant cation in the body and its biggest portion is stored in the cells. The magnesium homeostasis is mostly under the control of major organs; gut, kidney and bonebut it is not yet fully understood what regulators affect these organs at the cellular level.¹⁻⁴It is obtained from the diet andis present in high amounts in a variety of

unprocessedfoods, including nuts, legumes, and vegetables; in contrast, meat, fish, and dairy products have a relativelylow magnesium content.¹ Although clinically evidentmagnesium deficiency is uncommon in otherwisehealthy subjects, it may result from renal dysfunction, endocrine causes, gastrointestinal losses, or inadequateintake. Magnesium deficit may also coexist with deficiencies of other dietary elements, such as vitamins,calcium, and potassium, particularly in cases of malnutrition. It may manifest as anorexia, nausea, muscleweakness, ataxia, tetany, convulsions, mental confusion, and irritability, typically within 1–3 months afterbeginning a magnesium-free diet.^{3,4} Hypomagnesemia is common in patients with bothT1DM and T2DM, especially in poorly controlled

andchronically treated patients. However, to our knowledge, little research has addressed the relationshipbetween serum magnesium levels and diabetes in youth.Different studies all over the worldhave found a lower serum Mg in type 1 diabetic children with poor glycemic control reflected mainly by HbA1C level as compared to their healthy age-and sex-matched controls. Several studies were focused on evaluating Mg status in patients with type 2 diabetes and the role of supplementation of Mgto prevent diabetic complications and to optimize the diabetic control. A few studies have been concerned with serum Mg level in children with type 1diabetes with opposing results.⁵⁻⁸ In the present study we aimed to evaluate association between serum magnesium levels and glycemic management in children with T1DM.

MATERIALSANDMETHODS

This study was undertaken on childrenwith T1DM who attended the Department of Pediatrics. A written informed consent was obtained from each diabetic subject and the study protocol was approved by the Institutional Ethical Committee.

EXCLUSION CRITERIA

1. Consistent diarrhea and vomiting.

2. Renal impairment detected by renal function tests (blood urea and serum creatinine).

BLOOD SAMPLES

For all diabetic subjects and control group, a blood sample was taking under aseptic technique and transferred to a Jul tube devoidofanti coagulant, then centrifuged at 3000rpm for10 minutes to separate the serum, which was then used to determine serum magnesium and the HbA1c levels. All of the assays were carried out according to standard operating protocols with a kit provided by Bio labo(France). The results were expressed as mean ± SD. Data were statistically analyzed using SPSS 22. Differences between groups were assessed by paired Student's t test. Correlation between variables was assessed using Spearman rank correlation coefficient. A p value of <0.05 was considered significant.

RESULTS

In this study, a 94 diabetic child with T1DM(60 males and 34 females) of mean age (12.6± 4.2) years, and a 30healthy control (14 males and 16 females)with mean age (10.4±4.2)years, were participated. The general features of all children in both categories, as shown in table 1, are identical in the term of age and gender distribution.

Table1: Characteristics of the test subjects

Characteristics	Diabetics children		Controls children	
No. of subjects	94		30	
Sex	Males	females	males	females
No.	60	34	14	16
Age(y)±SD	12.6±4.2		10.4±4.2	

Table2: Magnesium level in diabetic and non-diabetic controls

Magnesium levels	Diabetic children	Non-diabetic control	P value
Hypomagnesemia <1.7mg/dl	84	2	<0.001
Normo-magnesemia 1.7-2.2mg/dl	8	26	<0.04
Hypermagnesemia >2.2mg/dl	2	2	0.52 Not significant

Table3: Magnesium levels in diabetic subjects amongst males and females

Magnesium Levels	Males	Female	P value
Hypomagnesemia <1.7mg/dL	58	26	<0.005
Normomagnesemia(1.7-2.2mg/dL)	2	6	Not significant
Hypermagnesemia >2.2mg/dL	0	2	Not significant

The mean HbA1c and magnesium levels showed inverse variation. When the values were arranged in an order of non diabetic (control)

Table4: Gender wise mean HbA1c and serum magnesium levels in diabetic children

Parameters	Good controlHbA1c<7%		Poor controlHbA1c≥7.5	
Magnesiumlevels	Male	Female	Male	Female

Hypomagnesemia <1.7mg/dl	8	4	50	22
Normomagnesemia 1.7- 2.2mg/dl	2	2	0	4
Hypermagnesemia >2.2mg/dl	0	2	0	0

DISCUSSION

Of the most common diseases studied for their relation to serum Mg level is diabetes mellitus type 1. This is because of the significant role Magnesium plays a significant role in the metabolism of glucose and insulin, mainly through its direct effect on Glucose Transporter protein activity 4 and the regulation of glucose translocation into the cell.

Present study showed that the serum magnesium levels are much lower in children with T1DM as compared to non-diabetic controls. This is in accordance with Asmaa et al⁶ and Shahah et al⁷ that found total serum magnesium was frequently low in Egyptian children with type 1 diabetes and it was correlated with HbA1c and also Ahmed et al, that found serum magnesium along with zinc and copper were lower in diabetics than controls. Likewise, Xu et al⁸ found that both serum and urine levels of magnesium were lower in Chinese diabetic patients and Lin et al found similar results in Chinese children

Exactly, why there is a such higher prevalence of magnesium in sufficiency in children with diabetes mellitus as compared to healthy persons? It is unclear. However, this could be attributed to a lack of food consumption, poor intestinal absorption of magnesium, or a higher urinary loss of magnesium. In diabetic individuals, magnesium deficiency has deleterious impact on glucose homeostasis and insulin sensitivity, so limiting hypomagnesemia in diabetic youngsters may be beneficial for the controlling the diabetes mellitus. The level of glycosylated hemoglobin(HbA1c) is used to determine the status of diabetic control. Although HbA1c readings vary depending on the method used for assessment, it is usually less than 6% in people who do not have diabetes (range is 4.5-5.7 percent). For all children with diabetes, the HbA1c objective is 7.5 percent, and for those over 18, it is 7.0 percent. (1) When we compared the poorly controlled diabetics (HbA1c 7.5%) to well-controlled diabetics (HbA1c 7%), we found that serum magnesium was significantly lower in poorly controlled group. Several writers have found an association between HbA1c and serum magnesium. This can be described through the fact that urine magnesium elimination may be higher in diabetics with poor metabolic regulation, because glycosuria in such children causes osmotic diuresis and hypermagnesuria resulting a decline in blood magnesium (hypomagnesemia). Because insulin increases magnesium uptake in insulin-sensitive tissues including muscle, a lack of insulin or insulin resistance could produce or worsen intracellular

magnesium shortage.^{9,10,11}

The cross-sectional design and the relatively small sample size of the present study may be considered limitations. In addition, because magnesium is an intracellular cation, its serum concentration may not accurately reflect total body magnesium status. However, in a recently published systematic review, it was concluded that serum and/or plasma magnesium concentrations appear to be useful biomarkers of magnesium status.¹²

Future study should focus on the impairment of cellular magnesium uptake in T1DM, as well as strategies to increase cellular magnesium uptake. Furthermore, we discovered that serum magnesium levels are much lower in males than females in diabetic group of this study, and this finding necessitate further research to elucidate the underlying reasons.

CONCLUSION

Serum magnesium level is frequently low in children with type 1 diabetes mellitus. There is a significant correlation between serum magnesium level and the glycemic control. Therefore we recommend doing regular monitoring of serum magnesium in type 1 diabetic children and appropriate supplement of low levels.

We need to conduct additional research on the effects of administering magnesium supplements to diabetic children with hypomagnesemia on glycemic management.

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