Turkish Journal of Physiotherapy and Rehabilitation; 32(3)
ISSN 2651-4451 | e-ISSN 2651-446X

SERUM MAGNESUM LEVEL AND HBAIC IN PEDIATRIC TYPE1 DIABETES MELLITUS IN MISAN PROVENCE

Mohammed A. Darweesh[1], Mohammed Abdul-Mounther Othman[2], Eman Khammas ALSaadi[3], Salah H Al-Zuhairy[4]

[1,3,4]*Department of Pediatrics, College of Medicine, Misan University, Iraq*

[2] *Department of clinical Biochemistry, College of Medicine, Misan University, Iraq*

ABSTRACT

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 their nutritional consumption.

Magnesium is found in the body of an adult in the amount of 24 g.

We want to see if there is a link between serum magnesium levels and glycemic management in kids with T1DM.

A 47 diabetic child with T1DM , and a 30 healthy control of similar ages in Misan province, south of Iraq were involved in this study. Both groups had blood samples drawn to determine serum magnesium and HbA1c levels.

The results of our study reveals that the serum magnesium is significantly low in children with T1DM specially in those with poorly controlled diabetes (high level of HbA1c) in comparison with control group (non-diabetic children). Furthermore the serum magnesium is significantly low among males than females in the diabetic group.

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.

Keywords: type 1 diabetes mellitus (T1DM), children, S. mg++, hypomagnesemia.

I. INTRODUCTION

Diabetes mellitus (DM) is a prevalent chronic metabolic condition in which hyperglycemia is a key biochemical characteristic. Type 1 diabetes mellitus (T1DM) is the most common endocrine-metabolic illness in children and adolescents, with important consequences for physical and emotional development. T1DM patients must make significant lifestyle changes including an absolute daily need for exogenous insulin, the need to monitor their own glucose levels, and the need to keep track of their nutritional consumption.(1)

T1DM is caused by the autoimmune destruction of the pancreas' insulin-producing cells (islets). The presence of diabetes susceptibility genes isn't the only thing to consider. An unknown environmental insult, such as cow's milk feeding at a young age, viral infectious agents (coxsackie virus, cytomegalovirus, mumps virus, and rubella virus) , vitamin D insufficiency, and perinatal factors, are thought to begin the autoimmune process. (2) Type 1 diabetes manifests itself in two peaks: preschool and adolescence. It's also more common in the spring and autumn months.(3) T1DM has a global incidence of 15 per 100,000 people and a prevalence of 9.5 percent (95 percent CI: 0.07 to 0.12).(4) Annual incidences range from 0.1 per 100,000 in China and Venezuela to 36.5 per 100,000 in Finland and 36.8 per 100,000 in Sardinia. The lowest incidence (1/100,000 per year) was observed in Chinese and South American groups, while the greatest incidence (1/100,000 per year) was found in populations

from Europe Sardinia, Finland, Sweden, Norway, Portugal, the United Kingdom, Canada, and New Zealand have all documented cases of (>20/100,000 per year).[5] Iraq's average yearly incidence rate of T1DM was 7.4 per 100,000, with a prevalence of around 87 per 100,000, putting the country in the intermediate group.[6] The average adult's body has about 24 g of magnesium, with (50 to 60%) of it found in the bones and the remainder in the soft tissues. The blood serum contains less than 1% of total magnesium, and these levels are closely monitored.[7] Around 55% of the entire magnesium in the serum is extant as free ionized $Mg^{2+,}$ 15%of mg++ is bonded to anions such as HCO_3^- ; $C_6H_5O_7^-$ and $SO_4^=$ and 30% bonded to proteins such as Albumin.[8]

Magnesium levels in the blood should be between 1.7 and 2.2 mg/dL (1.2-1.9 mEq/L; 0.85-1.10 mmol/L), with significant variance between clinical laboratories. A serum magnesium level of less than 0.75 mmol/L is considered hypomagnesemia.[9]

Magnesium levels are difficult to determine since the bulk of magnesium is stored in cells or bones.[10] Regardless of the fact that serum magnesium levels have no correlation with total body magnesium, measuring S. magnesium focus is the most common and accessible method for evaluating magnesium grade or concentrations in particular tissues.[11]

Magnesium is a mediator in approximately 300 enzyme systems throughout the body that regulate a variety of biological activities, including protein synthesis and blood glucose management. [9,12]

Free ionized magnesium is the physiologically active form of magnesium . Hexokinase, pyruvate, dehydrogenase, enolase, and creatinine phosphokinase are all rate-limiting enzymes that are controlled by the amount of free Mg^{2+} in the cell.[12] Magnesium interacts with enzymatic operations in a variety of ways, including attaching to the substrate or directly to the enzyme according to the enzyme By delivering high-energy phosphate, adenosine triphosphate (ATP) serves as a crucial "energy provider" for practically all cellular functions. MgATP is the primary form in which it can be found in all cells[13]. MgATP and the enzyme adenylate cyclase are used to make cyclic AMP, which is then activated by Mg via its two binding sites[14]. Magnesium is also necessary for DNA replication, transcription into mRNA and protein translation.[15] Magnesium is also required for ion transport, membrane integrity, and Ca++ channels function.[16]

Magnesium is involved in the regulation of neuronal activity, cardiac excitability, neuromuscular transmission, muscular contraction, vasomotor tone, blood pressure, and other biochemical cellular activities as a result of its various biochemical cellular activities Circulation of blood in the extremities.[12] Mg++ is the 2^{sd} most prevalent intracellular cation in the human body (after k^+), as well as the 4^{th} most rich whole cation.[17] Kidneys, which excretes roughly 120 mg of magnesium into the urine each day, is principally responsible for magnesium homeostasis [18]. When magnesium levels are low, urinary excretion is reduced. [11]

II. MATERIALS AND METHODS:

Study area:

This study was undertaken on children with T1DM who attended the outpatient clinics in Misan Hospital for Child and Maternity, and AL-Sadder Teaching General Hospital in Misan Government in collaboration with clinical biochemistry lab. in College of Medicine / Misan University during the period from the 15th of May 2018 to 15th of November 2019.

Children with the following conditions were excluded from the study:

1. Consistent diarrhea and vomiting .

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

A written informed consent was obtained from each diabetic subject and the study protocol was approved by the Ethical Committee in the University of Misan / College of Medicine .

Blood samples:

For all diabetic subjects and control group, a blood sample was taking under aseptic technique and transferred to a Jul tube devoid of anticoagulant, then centrifuged at 3000 rpm for 10 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).

Data management and statistical analysis:

Before being imported into the Statistical Package for Social Sciences (SPSS), data were two times entered into a Microsoft Excel database, compared, and item errors were corrected. The data was visually examined for extreme values in single parameters and removing 10 values that seemed biologically impossible. Outliers in the remaining data were found using box plots and P-values for differences among study groups were calculated using the Mann-Whitney test, with ($p \leq 0.05$) and ($p \leq 0.001$) being regarded significantly different. The means comparison using One-Way-ANOVA was used to compare reference ranges for distinct within-groups.

III. R ESULTS:

In this study, a 47 diabetic child with T1DM (30 males and 17 females) of mean age (12.3± 3.9) years, and a 30 healthy control (14 males and 16 females) with mean age (10.8±4.6) 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	47		30	
Sex	Males	females	males	females
No.	30	17	14	16
Age (y) ±SD	12.3±3.9		10.8±4.6	

Table 2: Magnesium level in diabetic and non-diabetic controls

Magnesium levels	Diabetic children	Non-diabetic control	P value
Hypomagnesemia < 1.7 mg/dl	42	2	<0.001
Normomagnesemia 1.7-2.2 mg/dl	4	26	<0.05
Hypermagnesemia >2.2 mg/dl	1	2	0.33 Not significant

Table 3: Magnesium levels in diabetic subjects amongst males and females

Magnesium Levels	Males	Female	P value
Hypomagnesemia <1.7 mg/dL	29	13	<0.005
Normomagnesemia (1.7-2.2 mg/dL)	1	3	Not significant
Hypermagnesemia >2.2 mg/dL	0	1	Not significant

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

Table 4: Gender wise mean HbA1c and serum magnesium levels in diabetic children

Parameters	Good control HbA1c < 7%		Poor control HbA1c ≥7.5	
Magnesium levels	Male	Female	Male	Female
Hypomagnesemia < 1.7 mg/dl	4	2	25	11
Normomagnesemia 1.7-2.2 mg/dl	1	1	0	2
Hypermagnesemia >2.2 mg/dl	0	1	0	0

IV. DISCUSSION

Diabetes mellitus is a common chronic metabolic condition among children.(19) About 25% of inorganic compounds that abundant with mg++ play important roles in physiological processes of the human body.(20)

Obviously, we noticed that the serum magnesium levels are much lower in children with T1DM as compared to non-diabetic controls. Similar findings have been recorded in other studies.(21,22) Exactly, why there is a such higher prevalence of magnesium insufficiency 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 a deleterious impact on glucose homeostasis and insulin sensitivity, so limiting hypomagnesemia in diabetic youngsters may be beneficial for the controlling the diabetes mellitus. (18) 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 a link between HbA1c and serum magnesium.(20,23) 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 in a decline in blood magnesium (hypomagnesemia). Because insulin increases magnesium uptake in insulin-sensitive tissues including muscle (24), a lack of insulin or insulin resistance could produce or worsen intracellular magnesium shortage (25).

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.

V. CONCLUSION:

The serum magnesium level in children with T1DM in Misan province, south of Iraq, is usually low, and it is linked to glycemic control (HbA1c level) in those children.

Hypomagnesemia was particularly noticeable in kids with poor diabetes control, so we recommend that serum magnesium be monitored on a frequent basis in these children. If your serum magnesium level is low, increasing your magnesium intake through foods like pumpkin seeds, almonds, spinach, and peanuts may be useful.

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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