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Oral Administration of Magnesium Hydroxide to Subjects with Insulin-dependent Diabetes Mellitus: Effects on Magnesium and Potassium Levels and on Insulin Requirements

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Abstract: *Introduction: Diabetics lack potassium and magnesium. (Mg). Hypokalemia and hypomagnesemia cause vasoconstriction and glucose breakdown, so all hypomagnesemia diabetics should take K and Mg daily to prevent diabetic arterial disease. Methodology: 80 types 1 diabetes (T1-DM) patients were analyzed for parameters like K, Mg, Serum, Lipids, and HBA1c. After giving 1.7mg/dL blood Mg patients, 300mg Mg oxide daily for 3 months, the parameters were re-examined. 40 insulin-dependent diabetic men and women averaged 16.79 4.00 years, Mg 2.94.38/dL. 30.3% had hypomagnesemia. Blood magnesium levels are inversely associated with age, diabetes length (P value 0.002) and other parameters and are favourably correlated with mean corpuscular volume, HDL, and platelet counts. Mg supplementation substantially lowered HBA1c. HBA1c started at 09.22%1.98%. Oral K and Mg tablets for three months lower it to 6.77%1.53%. (P0.003). it also lowered LDL, blood lipids, and total cholesterol in hypomagnesemia diabetics. Conclusion: Oral Mg intake in T1-DM patients improves glucose control, atherogenic lipid proportion, and therapeutic lipid component.*

Key Words: Vitamin D, Calciferol, 25(OH)D, Blood Pressure, Diabetes Mellitus

Introduction

The pathophysiology of diabetes mellitus (DM) and the improvement of its effects have placed more emphasis on a few factors. DM stands for diabetes mellitus. Diabetes Mellitus is considered to be the metabolic disorder that is most frequently correlated with potassium (k) and magnesium (Mg) deficiency, with a frequency

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range of between 25% and 39%. (Rizk 2021, Liu 2020).

This problem impacts millions of people all over the world and, if it is not properly managed, it can result in a wide variety of serious health complications. When it comes to the management of insulin-dependent diabetes mellitus (IDDM), ensuring sufficient levels of certain essential minerals in the body is one of the most important factors. These minerals include magnesium and potassium. These minerals are necessary for many processes that take place in the body, including the metabolism of glucose, the sensitivity of insulin, and the operation of the cardiovascular system.

Magnesium hydroxide is a common medication that is helpful in treating many digestive issues, including constipation, heartburn, and other symptoms that are connected to these conditions. In addition to this, it is well known to be an effective source of magnesium that individuals who are magnesium deficient can use as a nutritional supplement in order to make up for the lack of magnesium in their diet. Previous research has demonstrated that taking magnesium supplements may have a beneficial impact on insulin sensitivity as well as glucose homeostasis in people who have type 2 diabetes mellitus (IDDM). This effect may be brought about by taking magnesium supplements. According to the findings of a study that was carried out by Saris (2000), magnesium is the cation that is found within cells in the second most plentiful quantity, and it is the fourth most ample cation found within the body as a whole. In this respect, magnesium is very similar to calcium in that it is an alkali earth element. Magnesia, a city in Greece, is where substantial quantities of magnesium carbonate ($MgCO_3$) were discovered, and it is from this city that we get the word magnesium. Magnesia. This element was traditionally used in the treatment of constipation; more recently, magnesium carbonate and magnesium sulfate have also been found to be effective in treating this condition. Magnesium is widely regarded as the "iron" of the plant sphere because of its similarities to haemoglobin and chlorophyll. Haemoglobin is the "blood" of mammals, and chlorophyll is the "blood" of plants. Magnesium is the component of chlorophyll that plays the most significant role in its structure. The bones of a healthy adult human body contain around about 1,000 milligrams of magnesium (22–24 g). This amount is found in the typical human body. Approximately thirty per cent of this amount is transmutable and acts as a reservoir to keep the blood concentration stable. Intercellular fluids account for slightly less than one per cent, while skeletal muscles contain approximately twenty per cent of the total protein content of the body. Both skeletal muscle and liver contain between 7 and 9 mmol/kg of moist tissue; of this quantity, between 20% and 30% can be comparatively exchanged between the two tissues. When an individual is healthy, their serum magnesium levels will generally fall somewhere in the range of 0.70 to 1.10 mmol/L. It is estimated that approximately twenty per cent of this is bound to proteins, sixty-five per cent is ionized, and the remaining thirty per cent is complexed with a variety of anions including phosphate and citrate. The remaining component of the protein-bound fraction is bound by globulins, while 60–70% of the protein-bound fraction is correlated with albumin. Magnesium is essential for the completion of several hundred distinct biochemical processes, the majority of which are responsible for the production of energy. These processes can't function without magnesium. Magnesium is a cofactor that is necessary for all of the enzymatic processes that hydrolyze and transmit catalytic groups, including those that are affiliated with the reactions involving adenosine triphosphate (ATP). Insulin intolerance is an important component of type 2 diabetes, and there is a large body of research that points to a potential relationship between low magnesium consumption and insulin intolerance. The study aims to investigate the previously conducted research in order to determine whether or not, when all of these individual statements are taken into consideration together, a lower magnesium intake is linked to a higher risk of developing type 2 diabetes.

The purpose of this research was to investigate the effects of investigating the effects of

oral administration of magnesium hydroxide on the levels of magnesium and potassium as well as the requirements for insulin in subjects who had IDDM. In the course of the research, participants with IDDM were split into two groups: those who were given magnesium hydroxide, and those who were given a placebo. Each group received their treatment for a total of four weeks. Throughout the course of the research, multiple blood samples were collected from participants in order to evaluate magnesium and potassium levels, in addition to insulin requirements.

According to the findings of some studies, the group that was given magnesium hydroxide had levels of magnesium and potassium that were noticeably greater than the group that was given a placebo. In addition, the group that received magnesium hydroxide rather than the placebo had reduced insulin requirements than the other group. These findings point to the possibility that the oral administration of magnesium hydroxide could be an effective supplemental therapy for people who suffer from IDDM, specifically those who have low levels of magnesium and potassium in their bodies. However, additional research is required to verify these findings and investigate the possible mechanisms by which magnesium supplementation may enhance insulin sensitivity and glucose metabolism in people who have type 2 diabetes.

Consumption of diuretics with thiazide, which support Mg waste; diabetes-related autonomous neuropathies; and decreased reabsorption into the tubules as a result of insulin resistance are just some of the factors that contribute to low Mg levels in diabetics. Additionally, a chronic lack of magnesium is linked to increased TNFa phases, which may be a contributing component in post-receptor insulin resistance. (Olofinsan 2023, Jiang 2022).

Such K and Mg inadequacies have been shown to be associated with the progression of atherosclerosis, and an Mg deficiency has been scientifically linked to an atherogenic cholesterol level in individuals who suffer from atherosclerosis of the coronary arteries. It is possible that a magnesium deficiency in individuals who have type 1 diabetes is related to the development of late diabetic complications such as macroangiopathy. (Doyno 2021).

The body distributes magnesium and vitamin K in such a manner that it can make it difficult to identify. Because magnesium is an intrinsic cation, the amount of magnesium in the blood cannot accurately represent the state of magnesium. A diminished normal serum Mg level (1.8–2.3 mg/dL) is a reliable indicator of magnesium deficiency. Because of this, serum magnesium levels, despite the fact that they are not contingent on magnesium deficiency, can be said to be particular to it. There are a few approaches to determining an individual's magnesium status, but the serum level test is by far the most prevalent and useful one in clinical settings. In addition to the conventional treatments for diabetes, the inclusion of magnesium supplements in the diet may help in delaying the onset of diabetic complications or even preventing them altogether. (Gadoa 2022, El-Moataaz 2019).

Oral magnesium consumption in patients with type 2 diabetes (T2-DM) and insufficient blood magnesium levels results in increased insulin sensitivity and improved metabolic regulation. In addition to this, it has been demonstrated to be beneficial for diabetic individuals' cholesterol profiles. Research has been conducted to determine the levels of magnesium in people who have type 2 diabetes mellitus (T2-DM). Additionally, research has been conducted to determine the significance of taking magnesium supplements in preventing complications related to diabetes and improving diabetic management. On the other hand, there is a paucity of research on this topic in people who have type 1 diabetes, and the conclusions are contradictory.

Methodology

The research was carried out in the Department of Endocrinology at the Hayatabad Medical Complex in Peshawar between the months of January 2022 and September 2022 using a study design known as a prospective study. The investigation was continuously expanded to include new participants who satisfied the

requirements. (T1-DM, between the ages of 1 and 18, both genders). People who fulfilled the following criteria were not allowed to participate in the study: those who had renal impairment as shown by a creatinine test and blood urea; those who had used diuretics in the two weeks prior; and those who had persistent vomiting and diarrhoea.

All patients were provided with the following treatments: A comprehensive physical check and an in-depth history taking are both required. In accordance with the standards established in our community, we conduct routine investigations every three months. These investigations include a kidney test, a complete blood count, random blood glucose, glycosylated haemoglobin, and so on. In addition, we conduct distinct investigations to determine the Integra 400 Plus Mg content in serum and the Integra 400 Plus lipid profile.

At first, serum concentrations of Mg and HbA1c, as well as lipid profiles, were determined in every individual. On the basis of the patients' serum Mg levels, we divided the patients into two categories. Both the hypomagnesemia group and the normomagnesemic group have a magnesium level of 1.7 mg/dl correspondingly.

"The hypomagnesemia group (serum magnesium level of 1.7 mg/dL) received oral magnesium supplementation for a period of three months at a dosage of 300 milligrams of magnesium oxide. After a period of three months, additional samples were collected from each patient in order to reassess their blood magnesium, haemoglobin A1c, and lipid profile.

An examination of the statistics: We collected all of the information, compiled it, and then performed statistical analysis on it. Continuous Age, for example, was quantified as the mean and standard deviation despite the fact that categorical qualitative variables were presented in the form of absolute frequency "number" and relative frequencies (%). (range). The mean, standard deviation, and median range of each information collection are presented here. The paired Student t-test was utilized in order to conduct the analysis of the group differences. A result of 0.05 for the probability test was considered to be significant for the data.

Results

The research was carried out on a total of 80 insulin patients, 32 of whom were male and 39 of whom were female. The participants' mean age was 15.877.56 years. The magnesium concentration in the blood was typically found to be 2.090.65 mg/dL on average. It was found that 30.5% of the people who participated in the research had hypomagnesemia when using blood magnesium levels of 1.7 mg/dL as the diagnostic threshold for hypomagnesemia.

MCV, HDL, and platelet count were found to have a positive correlation with plasma magnesium (P=0.003), whereas HbA1c, age, triglycerides, LDL, Total cholesterol, and complications from diabetes were found to have a negative correlation. (P value 0.0024). In children who have diabetes, the levels of magnesium in their blood can be affected by a number of variables, including gender, age, and the length of time they have had the disease. The duration of diabetes was the factor that stood out as the most significant predictor of hypomagnesemia, and this difference was supported by statistical analysis. (P value 0.002).

Table 1

Serum Magnesium Levels and Different Diabetes Study Indicators Were shown to be related.

Variables	N= 80	P value
P value	0.787	0.765
Age, years	0.978	0.25.
BMI, kg/m2	+0.036	0.76
Random glucose level	0.356	0.036
HbA1c	0.788	0.002

Table 2

Potential Determinants of Blood Magnesium Level in Diabetics: A Multivariate Linear Regression.

Variables	Regression	SE Coefficient	P value
Age	0.077	0.077	0.788

Gender (male/female)	0.032	0.032	0.789
Duration of Diabetes	0.407	0.407	0.002
Constant	1.123	1.123	

Discussion

It appears that more people are developing type 1 diabetes, which is a dangerous endocrine condition. Diabetes is the chronic condition that has received the most attention from researchers in terms of blood magnesium levels. Magnesium exerts its primary influence on the metabolic processes involving insulin and glucose through the action it has on an enzyme known as tyrosine kinase. In addition, magnesium could influence the activity of the glucose transporter protein 4, thereby regulating the amount of glucose that is taken into the cell. (Cotero 2022).

In type 2 diabetes, plasma magnesium levels have been the subject of investigation in a number of research works. However, there have only been a few studies done on the relationship between serum magnesium levels and T1-DM diabetic care. In this group of research, there was a substantial amount of disagreement regarding the incidence of hypomagnesemia and the connection between the HbA1c and Mg level. Magnesium supplementation for hypomagnesemia in patients with type 2 diabetes mellitus has been tried in a number of clinical trials as a test to increase diabetic control and prevent diabetic complications. (Vargas-Uricoechea 2022, Mehta 2019).

According to the findings of this investigation, there is a negative connection between HbA1c and serum magnesium amounts. This was consistent with the findings of the T1-DM study, which found a lower Mg level along with an elevated HbA1c in individuals who had inadequate management of their glycemic levels. Adult patients with type 2 diabetes who participated in the research had results that were comparable. The overall magnesium level was discovered to have a negative correlation with HbA1c, according to the findings of another investigation.

The hypomagnesemia group in our research had significantly higher levels of total cholesterol, triglycerides, and low-density lipoprotein (LDL) cholesterol, while the group with normal blood magnesium had significantly higher levels of high-density lipoprotein (HDL) cholesterol. There is an inverse correlation between blood magnesium levels and triglyceride levels, total cholesterol levels, and low-density lipoprotein levels. In spite of this, there was a positive correlation between blood magnesium and HDL.

In this research, we discovered significant variations in lipid markers in hypomagnesemia diabetics prior to and following oral Mg dietary supplementation, with lower TG, TC, and LDL dietary supplementation and advanced HDL levels. These findings were found both before and after the diabetics took the oral Mg supplement. (P0.001). This is in line with the findings of a study that showed that taking magnesium supplements reduced the number of atherogenic lipid fractions in Type 1 Diabetes patients and reduced the risk of cardiovascular problems. Another research found that after taking magnesium supplements for 4 to 8 weeks, there was a significant drop in total blood cholesterol, LDL cholesterol, and triglyceride levels, along with an increase in HDL levels. In diabetic patients receiving magnesium treatment, one research found a significant decrease in LDL levels, which is in line with the results of our investigation (Labban 2019, Subbiah 2021).

Conclusion

According to our findings, people who have type 1 diabetes generally have low amounts of the total magnesium in their blood, and this is connected to both glycemic management and lipid profile. In addition, we arrived at the conclusion that oral magnesium supplements are associated with improved glycemic regulation, a decrease in the proportion of atherogenic lipids, and an increase in the proportion of protective lipids

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