The Correlation between Magnesium and HbA1C in type Two Diabetes

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ABSTRACT

One of the most prevalent metabolic disorders and a major global cause of death and disability is diabetes mellitus. Deficits for both extracellular and intracellular magnesium are typically found in type 2 diabetes. The goal of the study was to compare the serum magnesium and HbA1c levels of patients with type 2 diabetes. A 95 people with diabetes overall risk indicators for magnesium insufficiency were included in this investigation. Blood was drawn to estimate the levels of serum magnesium, FBG, and HbA1C, (95) people in all were enrolled in our study; the mean age of the patients were (55.2 ±3.24 years) the most of those taking oral hypoglycaemic agents. The mean of serum magnesium, glycated haemoglobin (HbA1c) level and fasting blood glucose (FBG) was (1.75 ± 0.26 mg/ dL), (7.83 ± 1.4 % ) and (190.56  ±70.9 mg/dL) respectively. The study found a positive association between HbA1C and FBG and a negative link between serum magnesium levels and HbA1C. As for the study's conclusion, type two diabetes mellitus has hypomagnesemia and a high HbA1c level. We suggested increasing the amount of magnesium in the diet, and greater clinical studies will be required in the future.

Keywords: Type 2 diabetes, Magnesium, HbA1C

I. INTRODUCTION:

Diabetic, which affects 366 million people worldwide, is a common condition known as type two diabetes mellitus (T2DM). Electrolyte imbalance is one of the problems that can result from type 2 diabetes mellitus [1].

An essential element, magnesium (Mg), is involved in over 300 enzyme activities in the human body. Among its various roles are boosting the immune system, controlling blood pressure, and assisting with the muscle and nerve function. Magnesium is necessary for the oxidative phosphorylation, glycolysis and generation of energy. It is necessary for the production of DNA, RNA, and the antioxidant enzymes and aids in the structural growth of bone. Magnesium also participates in the facilitated diffusion of calcium and potassium ions through cell membranes, a mechanism necessary for the transmission of nerve impulses, the contraction of muscles, and a regular heartbeat [2].

Magnesium has gained a lot of interest because of its ability to enhance insulin sensitivity and shield against diabetes and its heart-related consequences. Endocrine and metabolic problems are frequently linked to magnesium shortage [3].

A biomarker of glucose levels within the erythrocyte's half-life, or three months, is glycosylated haemoglobin (Hb1Ac). In addition to haemoglobin A1 and A2, adults also have HbA1c, a derivative of HbA1 created by haemoglobin glycosylation. HbA1c is slowly produced within RBCs by a reaction between haemoglobin and glucose-6-phosphate, which results in a ketoamine (amino-1-desoxifructose) on the N-terminal end of the haemoglobin subunits. HbA1c can make up to 3.5 percent of the total haemoglobin in blood [4].

High levels of HbA1c are observed in diabetic patients with poorly managed diabetes. This glycosylated derivative can account for up to 15% of total haemoglobin levels and is directly correlated with blood glucose levels over the preceding two or three months (the red blood cells remain in circulation no more than four month). HbA1c is a marker that can be used to detect if glycemia was elevated in the time leading up to the
In the current study, 95 patients with type 2 diabetes mellitus had their plasma levels of magnesium and HbA1C evaluated.

II. PATIENTS AND METHOD

95 individuals of recognized type 2 diabetes with risk factors for magnesium shortage were excluded from examined in the current investigation. They were mostly identified through clinical examination, and biochemical tests were used to further assess them. To determine the impact of body magnesium concentration on the level of glycosylated haemoglobin (HBA1C) in diabetic patients, all cases were chosen from the patients visiting the specialized laboratory in the Baghdad Governorate. Blood was drawn and placed in EDTA and gel tubes for testing in the lab.

Measurement of blood parameters
1. Glycated Haemoglobin (%): The test done by using (Cobas c111) apparatus according to manufactures kit.
2. Fasting blood glucose concentration (mg/dl): The test done by using (Cobas c111) apparatus according to manufactures kit.
3. Serum magnesium concentration (mg/dl): The test done by using FUJIFILM apparatus according to manufactures kit.

Statistical analysis:
In data analysis, Using the SPSS program, the mean was calculated and parameters were compared using the Pearson correlation test.

III. RESULTS:

From total 95 patients recruited in our study; the mean age of the patients was (55.2 ± 3.24 years). The majority of them are taking oral hypoglycaemic drugs. The mean of serum Mg, HbA1C level and FBG was (1.75 ± 0.26 mg/dL), (7.83 ± 1.4 %) and (190.56 ±70.9 mg/dL) respectively. The correlation between glycated haemoglobin and serum magnesium was done by Pearson correlation test and it showed negative correlation of HbA1C (-0.622**) with serum magnesium. This correlation was illustrated in table (1)

Table 1
Showed correlation value of HbA1C (%) and serum magnesium (mg/ml)

<table>
<thead>
<tr>
<th></th>
<th>HBA1C</th>
<th>Mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBA1C</td>
<td>Pearson Correlation</td>
<td>.622**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.003</td>
<td>.003</td>
</tr>
<tr>
<td>N</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>Mg</td>
<td>Pearson Correlation</td>
<td>-0.622**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.003</td>
<td>.003</td>
</tr>
<tr>
<td>N</td>
<td>95</td>
<td>95</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

On the other hand, the result was showed positive correlation (0.795) between fasting blood glucose and HbA1c as illustrated in table (2).
Table (2)

Showed correlation value of HbA1C (%) and fasting blood glucose

<table>
<thead>
<tr>
<th>Correlations</th>
<th>HBA1C</th>
<th>FBG</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBA1C</td>
<td>Pearson Correlation</td>
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</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>95</td>
</tr>
<tr>
<td>95FBG</td>
<td>Pearson Correlation</td>
<td>.795**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
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<tr>
<td></td>
<td>N</td>
<td>95</td>
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</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

IV. DISCUSSION

Studies with diabetes mellitus mostly focus on hypomagnesemia. The diabetic condition interferes with the preservation of the normal concentrations of magnesium in the body and can easily cause hypomagnesemia due to poor metabolic regulation, which causes chronic problems from diabetes to develop more spontaneously. Furthermore, the presence of additional associated risk factors makes it more likely that hypomagnesemia may result in diabetes and its consequences [5].

In type two diabetes patients, magnesium deficiency has a deleterious effect on insulin sensitivities and glucose metabolism[6]. Hypomagnesemia has been linked to changed insulin-insulin receptor relationships, decreased pancreatic insulin production, altered post-receptor insulin transduction, and altered cellular glucose uptake [7].

The results of this investigation corroborated with Kareem et al (2004) [8], Diwan AG et al (2006)[9], and Manonmani & Manimekalai (2018) [10] who also discovered that type two diabetic patients have decreased magnesium levels when compared with healthy peoples.

Our current research also showed correlations with Sharma A et al (2007) [11], Ramadas. S et al (2015)[12], Jayaraman. et al (2017) [13] They discovered a decrease in serum magnesium levels as HbA1C levels rose, (with bad metabolic control of the diabetes). Tyrosine kinase has been proposed as the mechanism through which insulin increases intracellular Mg absorption. Additionally, it increases the synthesis of cAMP and uses other cAMP-dependent hormones to augment Mg absorption. Transient receptor potential channel melastatin 6 (TRPM6), which is expressed throughout the brush border membrane of the small bowel, is thought to be involved in active intestinal Mg uptake. Hypomagnesemia has reportedly been linked to TRPM6 mutations. This shows that diabetes can cause hypomagnesemia and also that hypomagnesemia can begin the onset of diabetes mellitus [7].

By enhancing the favourable trans-epithelial potential difference for magnesium re-absorption, insulin has been suggested to be involved at the loop of Henle. Claudin 6 (paracellin 1), a junctional protein linked to extreme hypomagnesemia, facilitates paracellular Mg reabsorption at the loop of Henle. Both hyperglycaemia and hypo-insulinemia can reduce Mg tubular reabsorption and increase urine Mg excretion. [7].

diabetes mellitus are present. Low magnesium has been linked to arterial calcifications, oxidative stress, enhanced platelet aggregation, thrombogenesis, and vascular dysfunction.

**CONCLUSIONS**

The study concludes magnesium and HbA1C levels are negative correlation. If serum magnesium is low, increased dietary intake of magnesium should be recommended. Monitoring of HbA1C levels also helps in dealing with the complications.

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**REFERENCES**


