

Correlation Between Serum Magnesium Level and Hba1c in Glycemic Control of Type 2 Diabetes Mellitus

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ABSTRACT

Background: Type II Diabetes Mellitus is characterized by impaired insulin secretion and resistance to insulin action resulting in hyperglycemia. Magnesium plays an important role in insulin secretion, insulin binding, and homeostasis. Magnesium acts directly on glucose metabolism through its role as a cofactor in the phosphorylation of glucose. Hypomagnesaemia is often left undiagnosed in diabetic subjects. Recent studies reveal that chronic deficiency of magnesium may contribute to systemic inflammation and insulin resistance.

Aim: The study is to find the correlation between serum Magnesium level and HbA1c in glycemic control of Type 2 Diabetes mellitus patients.

Materials and Method: This is a prospective observational study conducted by analyzing the HbA1C and Serum Magnesium in a tertiary care hospital, Chennai. We categorized into three different study population, to find out whether there is any correlation between magnesium levels and glycemic control in diabetic patients. The obtained values were subjected to statistical analysis by Analysis of variance with post hoc analysis and determination of correlation coefficient.

Results: The results proved that the HbA1c and the serum magnesium levels showed inverse variation each other.

Conclusion: The results proved that if serum magnesium values are made to rise, glycemic control is better and HbA1c values will fall thus proving that serum magnesium plays a major role in glycemic control. Hence, its association with HbA1c value, which indicates the level of glycemic control, would be, if found out, a very valuable addition to the fund of knowledge in healthcare.

Keywords: Type II diabetes mellitus; Magnesium; Glycemic control; Hypomagnesemia

INTRODUCTION

Type II Diabetes Mellitus is characterized by impaired insulin secretion and resistance to insulin action resulting in hyperglycemia. Symptoms of this condition include frequent urination, increased thirst, and increased hunger [1]. If left untreated, diabetes can cause many micro and macrovascular complications [2]. Maturity-Onset Diabetes of the Young (MODY) is one of the rare types in which it is due to a heterogeneous inherited genetic disorder that results in beta cells dysfunction characterized by non-insulin dependent form of diabetes which shows some similarities to type 2 Diabetes

mellitus [3]. Glycemic regulation is the process by which the levels of blood sugar, primarily glucose, are maintained by the body within a narrow range. This tight regulation is referred to as glucose homeostasis [4]. **Acute** complications are **diabetic ketoacidosis, hyper osmolar hyperglycemic state**, or death. Chronic complications include diabetic nephropathy, diabetic nephrology, and diabetic retinopathy [5]. Genetic predisposition and environmental factors such as obesity and a sedentary lifestyle attribute to be the main etiologies for the development of insulin resistance. Pieces of evidence suggest that decreased peripheral glucose uptake and utilization in muscle is the primary site of insulin resistance and results in prolonged

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postprandial hyperglycemia [6]. Resistance may be secondary to decreased numbers of insulin receptors on the cell surface, decreased affinity of receptors for insulin, or defects in insulin signaling and action that follows receptor binding. Defects in insulin signaling and action are referred to as post-receptor or post binding defects and are likely to be the primary sites of insulin resistance [7].

Magnesium is the 2nd most abundant intracellular cation in which plays an important role in insulin secretion, insulin binding, and homeostasis [8]. Magnesium acts directly on glucose metabolism through its role as co-factor in the phosphorylation of glucose and by that magnesium is involved in glycemic regulation [6]. Decreased magnesium levels have revealed to damage tyrosine kinase activity and receptors involved in signaling [7,9]. The deficiency of cellular magnesium may change the activity of the membrane-bound Na⁺ K⁺ ATPase. This moiety is responsible for the maintenance of sodium and potassium gradients in glucose transport [10]. Hypomagnesaemia is often left undiagnosed in diabetic subjects [11]. Recent studies reveal that chronic deficiency of magnesium may contribute to systemic inflammation and insulin resistance [8].

Several cohort prospective studies reported the association between low magnesium levels and poor glucose level control [12] and also suggested that magnesium supplementation has beneficial effects on glucose metabolism [13]. Some cross-sectional studies reported an inverse association between magnesium intake and fasting insulin levels [6].

AIM

The study is to find the correlation between serum Magnesium level and HbA1C in glycemic control of Type 2 Diabetes mellitus patients.

MATERIALS AND METHODS

This is a prospective observational study conducted to find out whether there is any correlation between magnesium levels and glycemic control in diabetic patients. The research project was carried out as per the protocol laid out. 130 subjects were employed for the out of which 30 are non-diabetics, 50 newly diagnosed as diabetics, and 50 established diabetic history for the past 5 years attending the endocrinology outpatient department in a tertiary care hospital, Chennai. With the patient’s consent, blood samples, and data regarding age, height, weight, history regarding treatment and presence or absence of hypertension was collected. The blood samples were analyzed for HbA1c, and serum magnesium levels. The mean and SD values of age, HbA1c, and serum magnesium of the three groups were subjected to one-way ANOVA with post hoc analysis. The correlation coefficient was determined and also mean and Standard deviation for magnesium as well as HbA1c would be determined.

The Inclusion criteria of our study were patients in the age range of 18-70 years, non-diabetic, newly diagnosed as diabetic, and patients with type 2 diabetes with a duration of over 5 years would be taken for the study, patients have documented

evidence of the disease and must be capable of proper compliance

The exclusion criteria were pregnant or lactating women, patients having some other health problems in addition to diabetes.

RESULT

The mean HbA1c and magnesium levels showed inverse variation. When the values were arranged in an order of non-diabetic, newly diagnosed diabetic, and established diabetic subjects the HbA1c values increased proportionally, while the magnesium levels showed inverse variation to the HbA1c values (Table 1).

Table 1: Gender wise mean HbA1c and Serum magnesium levels in 3 different study group.

Parameters	Group 1		Group 2		Group 3	
	Non DM		Newly DM		Established DM	
	Males	Females	Males	Females	Males	Females
HbA1c	5.57	5.5	8.66	7.08	7.98	8.93
Serum Magnesium	2.39	2.21	1.81	1.78	1.49	1.44

The correlation coefficient calculated for the two variables, HbA1c and serum magnesium, is showing a negative correlation coefficient value of -0.381.

DISCUSSION

The previous studies [1,13] stated that hypomagnesemia is associated with poor glycemic control and microvascular complications in diabetic patients than those without microvascular complications. Other studies [13] also say that magnesium concentrations result in a defective tyrosine-kinase activity, post-receptor impairment in insulin action, and worsening of insulin resistance in diabetic patients. Low magnesium intake and an increased magnesium urinary loss appear the most important mechanisms leading to hypomagnesemia in patients with type 2 diabetes. On the other hand, insulin deficiency and resistance can affect tubular reabsorption of magnesium. The objective of the current study was to bring out any relationship between serum magnesium levels and HbA1c values. Our study showed an inverse variation between mean HbA1c and magnesium levels. Upon evaluation, our study population (arranged in an order of non-diabetic, newly diagnosed diabetic, and established diabetic subjects) showed a directly proportional increase of the HbA1C values, while the magnesium levels showed inverse variation to the HbA1c values. The negative correlation coefficient strengthens the interpretation of the HbA1c and serum magnesium values being inversely proportional. So if serum magnesium values are made to rise, glycemic control is better and HbA1c values will fall. Thus, from the observations from the current study, it is evident that serum magnesium plays a role in glycemic control.

CONCLUSION

The results proved that if serum magnesium values are made to rise, glycemic control is better and HbA1c values will fall thus proving that serum magnesium plays a major role in glycemic control. Hence, its association with HbA1c value, which indicates the level of glycemic control. Proper counseling should be given to diabetic patients about the need of taking magnesium through diet and the health care professionals should be made aware of the risks associated with hypomagnesemia left undiagnosed in diabetic patients and its ill effects.

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