Original Research Article

A study of serum magnesium levels to insulin in type2 diabetes mellitus

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Abstract

Back ground: Glucose homeostasis reflects a balance between hepatic glucose production and peripheral glucose uptake and utilization Insulin is the most important regulator of this metabolic equilibrium but neural input, metabolic signals, other hormones (e.g. Glucagon) results in integrated control of glucose supply and utilization. The ingested sugars are broken down which enters the digestive system and forms glucose. It enters the blood stream and leads to increase in blood glucose levels. When glucose molecules are high in the blood, these molecules will reach the pancreatic beta cells and enter in to the beta cells resulting in release of insulin which enters the blood stream and transported all over the body leads for glucose utilization. Serum magnesium levels are known to be lowered in diabetes and its supplementation in known to improve the out comes in terms of metabolic stability. Now we are in need to ensure the relation between serum magnesium levels and serum insulin levels. Very few studies have been done to establish a definite relationship between these two. This study puts in a since efforts to understand the relation between serum magnesium level to serum insulin level in diabetes mellitus type 2.

Material and methods: The present study was carried out in south Indian population at PRS hospital Trivandrum on 150 recently diagnosed type 2 DM patients. 150 healthy individuals were taken as control group. Permission was obtained from institutional ethics committee. The patients included were who attended the Department of General Medicine outpatient department. History of the patient was obtained before including in to present study. Fasting samples for glucose were checked for confirmation of diabetic status. Insulin and magnesium levels were estimated. The Hb A1c was also measured and compared between diabetics and control group. Blood glucose levels analysis was performed by semi auto analyzer. Serum fasting insulin levels were measured by ELISA Method (Genx bio).

Results: Low serum magnesium levels was observed and found to be statistically significant ($P < 0.001$) in cases of diabetics, when compared to the control group. Increased serum insulin levels in

diabetic patients was recorded in statistically significant manner ($P < 0.004$) when compared to control group. The levels fasting glucose and magnesium in diabetic patients were observed to be inversely proportional.

Conclusion: Type 2 diabetes which involves loss of insulin and leptin sensitivity is easily preventable disease. However preventing the disease requires a multi-faceted approach. Getting adequate magnesium is just one part of the formula. Others critical life style factors include diet, exercise and optimizing gut flora.

Key words

Diabetes, Magnesium, Insulin, Glucose and diabetic drugs.

Introduction

The ingested sugars are broken down which enters the digestive system and forms glucose. It enters the blood stream leads to increase in blood glucose levels [1]. Various mechanisms that brings down the blood glucose level to normal set point is an example of homeostasis. The body tendency is to maintain glucose levels at relatively constant to range during fasting and fed state. Insulin and Glucagon are the key hormones produced by pancreas in regulating the blood glucose levels.

The blood glucose levels when are high, these molecules will enter into the pancreatic beta cells which leads insulin secretion and release. Insulin then enters the blood stream and transported all over the body. Insulin acts on the liver by increasing uptake by liver cells to form glycogen. The blood glucose levels are decreased as it is taken up by liver cells and other body cells, as a result further insulin release from beta cells will decrease and maintains the glucose at normal levels.

In the fasting condition blood glucose levels are low the alpha cells of pancreas will release glucagon hormone which enters the blood stream and acts on the target cells in liver. Glucagon binds to receptors on liver cells which in turn break down glycogen to glucose and increases the blood glucose levels. Thus these two hormones allow the body to maintain homeostasis of glucose levels. In diabetes body is unable to maintain homeostasis of blood of glucose levels.

These are mainly two types of diabetes, type 1 and type 2. Type 1 ADM results from auto immune beta cell destruction which leads to insulin deficiency. Type 1 BDM is also characterized by insulin deficiency, as well as tendency to develop ketosis. The mechanism for beta cell destruction in these patients is unknown. Type 2 DM is heterogenous group of disorder usually characterized by variable degree of insulin resistance, impaired insulin secretion and increased glucose production. Various genetic and metabolic defects in action or secretion give rise to hyperglycemia in type 2 DM.

According to American diabetes association, there are 415 million cases of diabetes in the year 2015 and it expected to rise to 645 million cases around the globe by 2040 [2]. In the current scenario one 11 adults have diabetes and it may increase to 1 in 10 adults by 2040. Diabetes increases the risk of many serious health problems. By treating at the right time we can prevent/stabilize the disease process.

Non-pharmacological approach includes recommending life style changes to reduce weight and increase physical activity as well as by screening for cardiovascular disease.

The complications include diabetic foot, diabetic neuropathy, stroke, Hypertension, coronary artery disease and diabetic nephropathy.

Recent studies have showed that magnesium has a role in glucose homeostasis. Magnesium

increases the insulin secretion there by lowers blood glucose levels [3]. There are also beneficial effects like increasing HDL cholesterol levels and decreasing inflammation. Previous studies showed that supplementation of magnesium resulted in modest reduction in fasting sugar levels and increased HDL cholesterol levels. Beneficial effects were shown in around 15% of previously diagnosed with diabetes [4].

Magnesium is a mineral required for many enzymes in the body which helps hydrolyse proteins into carbohydrate in the body, which is important to maintain blood sugars balance, acts as a natural statin in the body and is necessary for nerve cell to nerve cell conduction. Magnesium has its actions antagonistic to calcium in the body. Whereas magnesium helps in relaxation of muscles, calcium ions help in contraction of the muscles. Deficiency of magnesium has also been proven to have its role in coronary artery disease. Thus our present study is done to investigate the role of magnesium in glucose homeostasis. This study puts in a sincere effort to understand the relation between serum magnesium levels to insulin levels in type2DM patients.

Materials and methods

The present study was carried out in PRS hospital Trivandrum among 150 recently diagnosed type 2 DM patients aged 20 – 60 years. American diabetes association criteria were followed throughout study period. 150 individuals were selected randomly who were aged between 20 – 60 years as control group. This study was conducted after obtaining approval from institutional ethics committee at PRS hospital Trivandrum, The patients included are, who attended to the Department of General Medicine history of the patients were obtained before including in to the study.

Inclusion criteria: Diabetics who were maintaining normal blood glucose levels with either diet alone or any combination of oral anti-diabetic agents.

Exclusion criteria: Patients with hypothyroidism, patient suffering from chronic inflammatory diseases and infections, liver disease, nephritis, CVS problems, abdominal hernias, tumours and pregnant ladies. The patients who took insulin also not considered for the study. Informed consent was obtained from all the patients before including in to study.

Blood samples for fasting glucose were estimated. This was done to confirm the hyperglycemic state. The glucose levels were estimated. Blood glucose and HDL analysis was performed by semi auto analyzer. Serum fasting insulin levels was arranged by ELISA method (Genxbio). The HbA1c was also measured to compare diabetics and control group.

The date represented in mean±SD. Analysis of variance (ANOVA) was used to perform the results. Statistical analysis was done using Statistical Package for Social Sciences (SPSS).

Results

There was increased blood glucose which was observed in the diabetic patients when compared with the controls who consisted of healthy individuals. There was a statistical significance between the diabetics and the control group ($p<0.001$). This was a known fact and has been just done to show the difference and significance between the two groups.

Similarly in the case of serum magnesium, it was found to be less in the diabetic patients. When compared to the non - diabetic control group there was a statistically significant difference between the two groups ($p<0.003$) as per **Table - 1**.

There was increase in serum insulin levels which was observed in the diabetic patients when compared to the control group which was showed statistically significant ($p<0.004$).

Similarly in the case of HbA1c which showed more in the diabetic patients when compared to the normal patients and this showed statistically significant difference (p<0.005) as per **Table – 2**.

When the serum insulin levels which was noted as against the serum magnesium levels some interesting facts came to light. **Graph - 1** clearly shows the relation between the insulin and the magnesium levels.

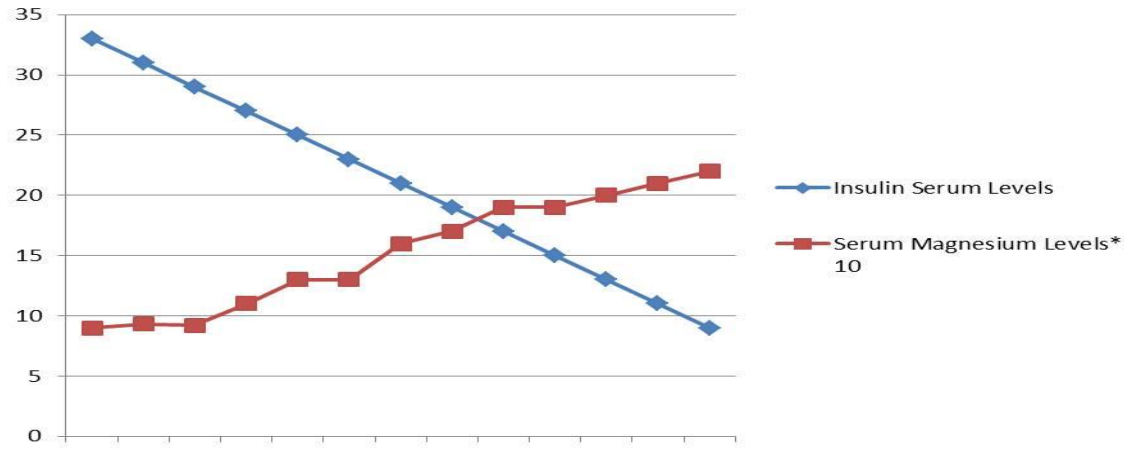
Table - 1: Fasting blood glucose and serum magnesium in type 2 diabetic patients.

Parameters	Diabetics	Controls	P value
Blood glucose (mg/dl)	165±4	86±3	0.001
Serum Magnesium Levels	1.09±0.31	1.68±0.14	0.003

Table - 2: Insulin and blood glucose levels in type 2 diabetic patients and the control group.

Parameters	Diabetics (Type 2)	Control Group	P value
Blood insulin (mIU/l)	33±2	22±2	0.004
Haemoglobin A1c (millimoles/M)	50±3	40±1	0.005

Graph - 1: Linear decrease in the serum magnesium levels.



Discussion

Magnesium is the fourth most abundant mineral in the body. Insufficient magnesium level of leads to cellular damage and deterioration of proper metabolic function that typically snowballs into more significant health problems. Previous study reported to have now detected 3,751 magnesium-binding sites on human proteins, reflecting how important this mineral is to a great many biological processes [5]. Magnesium plays a role in detoxification processes and therefore is important for minimizing damage from environmental chemicals, heavy metals, and other toxins.

It also plays roles in preventing migraine headaches, cardiovascular disease includes heart attack, blood pressure, stroke and sudden cardiac arrest reduces all these causes.

One of the study in the year 2013 involving pre-diabetics found that most had inadequate magnesium intake. Those with the highest magnesium intake reduced their risk for blood sugar and metabolic problems by 71 percent [6]. In the present also showed similar type of results in consistent with previous report. Earlier work by Grel, et al. found that higher magnesium intake reduces risk of impaired glucose and insulin metabolism and slows progression from pre-diabetes to diabetes in middle-aged Americans [7]. Researchers stated, "Magnesium intake may be particularly beneficial in offsetting risk of developing diabetes.

In a large Japanese study published in Diabetic Medicine December 2013, researchers found magnesium intake was a significant protective factor against type 2 diabetes in the general Japanese population, especially among those "with insulin resistance, low-grade inflammation and a drinking habit [8]. This could be the mechanism by which magnesium controls glucose and insulin homeostasis appears to involve two genes responsible for magnesium homeostasis. It is well known that people with insulin resistance also experience increased excretion of magnesium in their urine, which further contributes to diminished magnesium levels. This magnesium loss appears to be secondary to increased urinary glucose, which increases urinary output. Therefore, inadequate magnesium intake seems to prompt a vicious cycle of low magnesium levels, elevated insulin and glucose levels, and excess magnesium excretion.

Conclusion

Type 2 diabetes, which involves loss of insulin and leptin sensitivity, is easily preventable, and nearly 100 percent reversible without drugs. However, preventing this disease requires a multi-faceted approach. Getting adequate magnesium is just one part of the formula. Other critical lifestyle factors include exercise and optimizing gut flora.

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