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RESEARCH ARTICLE

TO STUDY EFFECT OF HBA1C LEVELS IN NEWLY DIAGNOSED TYPE II DIABETES MELLITUS PATIENTS ON SERUM MAGNESIUM LEVELS

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ABSTRACT

Background: The epidemiologic transition from communicable to non-communicable disease has become a major public health concern. Diabetes is one of the causes for the increased burden of NCD's. Among the many complications of diabetes, hypomagnesemia is a manifestation which is overlooked. ***Objectives:*** This study was designed to assess the effect of glycaemic index on serum magnesium levels. ***Methods:*** The Observational Cross-Sectional study was conducted in the Internal Medicine, of tertiary care center of Northern India, through October 2017-September 2018, among thenewly diagnosed type II diabetes mellitus patients. ***Results:*** The mean magnesium in patients with HbA1C levels <7 % was 2.07 ± 0.125, in those with HbA1C 7-9 % was 1.94 ± 0.318 and those with HbA1C >9 % was 1.92 ± 0.286. It indicates inverse relationship between serum magnesium and HbA1C levels. ***Conclusion:*** Comparison of serum magnesium levels with glycaemic index of newly diagnosed type II diabetes mellitus patients was done with the concluded that, serum Magnesium levels decline as the HbA1Clevels increases. Based on this finding we could recommend diet rich in magnesium to avoid complications.

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INTRODUCTION

Diabetes mellitus is a heterogeneous group of metabolic disorders characterized by chronic hyperglycaemia with disturbance of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both. The effect of diabetes mellitus includes long-term damage, dysfunction and failure of various organs, eyes, kidneys, nerves and heart, and blood vessels (ADA, 2004). The recent estimates by the International Diabetes Federation (IDF) showed that the number of adults affected by the disease in 2011 was 366 million which was projected to increase to 552 million by 2030 (Unwin, 2011). In 2003–2005, a national survey was conducted in persons of age greater than or equal to 15 years, in which self-reported prevalence of diabetes was 7.3% in the urban areas and 3.2% in periurban slum areas. The prevalence in rural areas was significantly lower (3.1%) (Mohan, 2008). Magnesium is second most abundant intracellular cation and fourth most abundant cation in the human body that serves as a co-factor for all enzymatic reactions that require ATP. It is an essential enzyme activator for neuromuscular excitability and cell permeability, a regulator of ion channels and mitochondrial functionand an important factor in both cellular and humoral immune reactions (Phuong-Chi, 2007).

Its involvement in cardiac excitability, gating of calcium ion channels, transmembrane ion flux and neurotransmitter release is evident (Mirrahimi, 2012). Magnesium deficiency appears to have a negative impact on glucose homeostasis and insulin sensitivity inpatients with Type 2 diabetes (Nadler, 1993). Magnesium depletion has also beenassociated with arrhythmogenesis, vasospasm, plateletactivity, and hypertension (Sasaki, 2000). 25-39% of outpatient diabeticshas low concentrations of serum magnesium (Nadler, 1995). Magnesium depletion has a negative impact on glucose homeostasis and insulin sensitivity in type 2 diabetic patients (Wälti, 2003). It has been suggested that hypomagnesemia may induce altered cellular glucose transport by altering Na-K-ATP gradients, reduce pancreatic insulin secretion, and altered insulin–insulin receptor interactions (Phuong-Chi, 2007). Insulin has been suggested to enhance intracellular Mg uptake via tyrosine kinase. Active intestinal Mg absorption is presumed to involve transient receptor potential channel mela statin 6 (TRPM6), which is expressed along the brush border membrane of the small intestine. Mutations of TRPM6 have been reported to be associated with hypomagnesemia (Phuong-Chi, 2007).

Aims and Objectives: To determine theeffect of HbA1C levels in Newly diagnosed Type II Diabetes Mellitus withserum magnesium levels.

MATERIALS AND METHODS

Study design: A descriptive analytical cross-sectional study.

Study area and population: The study was conducted among the newly diagnosed type 2 diabetes mellitus patients at Indira Gandhi Medical College (IGMC), a tertiary care centre in Shimla, Himachal Pradesh.

Study duration: One year through October 2017-September 2018.

Sample size: All the patients attending the medicine OPD or those admitted in medicine ward, diagnosed as Type II Diabetes mellitus were taken consecutively for period of six months.

Inclusion Criteria

- Newly diagnosed type 2 diabetes mellitus Patients
- Who consent for the study

Exclusion Criteria

- Patients on drugs that affect magnesium levels (diuretics, aminoglycosides, amphotericin B, etc)
- Malabsorption or diarrhoea
- Alcohol consumption
- Vitamin or mineral supplements in recent past
- Pregnancy & Lactation
- Sepsis

Data collection Methodology: The demographic details, history, clinical examination of the patients diagnosed with Type II Diabetes Mellitus was taken and relevant biochemical investigations were done, after taking informed consent from the patients. Blood sample of the patients for fasting blood sugar, post-prandial blood sugar and HbA1C was sent for biochemical investigation to the SRL laboratory of the hospital. Fasting serum magnesium of the patients were ascertained in the laboratory of the institute by spectrophotometric method. The reference value of serum Mg^{2+} was between 1.9 – 2.5 mg/dl. Relevant investigations were also done in all patients in lab of the hospital. These patients were divided into three groups based on HbA1C levels: <7mg/dl, 7-9mg/dl, >9mg/dl

Statistical Analysis

Data was collected and entered in Microsoft excel spread sheet, cleaned for errors and analysed using Epi info version 7.2.1.0 software. Descriptive statistics were used to summarize the demographic data. Proportions and percentages were used to describe categorical variables. For continuous variables if data was normally distributed, mean and standard distribution were calculated and for non-normal distribution, median and inter quartile range were calculated. The data was analysed using appropriate statistical test techniques.

RESULTS

Total 53 patients of newly diagnosed type 2 diabetes mellitus, who presented to Department of Medicine at Indira Gandhi Medical College, Shimla from October 2017 to September 2018, were enrolled in the study.

The maximum number of patients were in the age group of 41-50 years(Table 1). The proportion of males and females were approximately equal (Table 2). The mean value of fasting blood sugar was 218.9±84.3 mg/dl, post-prandial was 313.2±85.4mg/dl and HbA1C 10.0±2.7 %, which was on higher side. (Table 3). Table 4 and 5 explains how serum magnesium levels are affected by the change in HbA1C levels.

Table 1. Age distribution of the patients (N=53)

Age(years)	Frequency (n)	Percentage (%)
31-40	9	17.0
41-50	19	35.8
51-60	15	28.3
61-70	8	15.1
>70	2	3.8

Table 2. Sex distribution of the patients (N=53)

Sex	Frequency(n)	Percentage (%)
Female	27	50.9
Male	26	49.1

Table 3. Mean values of blood sugar & HbA1C (N=53)

Sr. No.	Characteristics(N=53)	Mean±SD
3	FBS(mg/dl)	218.9±84.3
4	PPBS(mg/dl)	313.2±85.4
5	HbA1C(%)	10.0±2.7

Table 4. Comparison of S. Magnesium level with glycaemic index (N=53)

	HbA1c (%)		
S. Magnesium (mg/dl)	<7	7-9	>9
<1.9	0	4 (22.2)	10 (33.3)
1.9-2.5	4 (100)	13 (72.2)	20 (64.5)
>2.5	0	1 (5.6)	1 (3.2)

Table 5. Trend of mean value of serum magnesium in relation to HbA1C

HbA1C (%)	S. Magnesium (Mean ± SD)
<7	2.07 ± 0.125
7-9	1.94 ± 0.318
>9	1.92 ± 0.286

DISCUSSION

In our study of 53 patients, 27 (50.9%) were females and rest males. Most of them were in the age group of 41-50 years (31.6%). In a study conducted by Abdul Razaq et al. (2017), 189 patients with type 2 diabetic mellitus were observed, in which 123 (65.1%) were male and 66(34.4%) were female patients. Hypertension was present in 17% patients in our study., in contrast to the study conducted by Venugopal et al (Venugopal, 2014), where hypertension was noted in 25.6% of the patients. Serum magnesium value of the patients ranged from 1.20-3.0 mg/dl with mean value of 1.9±0.3. In a study conducted by Arpaci D et al (2015), the mean magnesium level was 1.97 ± 0.25 (1.13 - 3.0) mg/dl which was almost similar to our study. In our study, 14(26.4%) patients presented with hypomagnesaemia. In a study of conducted in Germany by Schimatschek HF *et al*. (Schimatschek, 2001), prevalence of magnesium deficiency was found to be 14.5%. The results of our study could be attributed to frequent routine serum magnesium level tests. Our present study also correlated with Schlienger et al (Schlienger, 1998), S.Ramadas et al (Ramadas,

2015), Senthil Manikandan TJ et al. (Senthil Manikandan, 2016), Sharma A et al (Sharma, 2007), and de Lordes et al (de Lordes Lima, 1998), who found a decline of serum magnesium levels with rise in HbA1c levels (with poor metabolic control of diabetes). The mean magnesium in patients with HbA1C levels <7 % was2.07 ± 0.125, in those with HbA1C 7-9 % was 1.94 ± 0.318 and those with HbA1C >9 % was 1.92 ± 0.286. It indicates inverse relationship between serum magnesium and HbA1C levels. And this was in concordance with the study done by Reddy *et al* (2018), where negative correlation between serum Mg and HbA1c levels (r =-0.110, p =0.004) was seen, which means decreased serum Mg levels with increased HbA1c levels.

Conclusion

Type 2 diabetes mellitus treatment requires an approach in which a close monitoring alongwith proper treatment is required to avoid potentialcomplicating factor. Our study compared serum magnesium levels with glycaemic index of newly diagnosed type II diabetes mellitus patients, and it concluded that, serum Magnesium levels decline as the HbA1C levels increases. But it is frequently overlooked and undertreated in patients of diabetes, which can further complicate the course of disease. So, in such patientswith magnesium deficiency, diet and oral supplements could be effective in prevention of control of Diabetes Mellitus and further educating the patients regarding the diet rich in magnesium could be helpful.

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