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Original Research Article

A Hospital-Based Study Assessing the Association of Serum Magnesium, Serum Uric Acid Levels and Microalbuminuria in Patients with Type 2 Diabetes Mellitus

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Conflict of interest: Nil

Abstract

Aim: The aim of the study was to assess the incidence and association of serum magnesium levels, serum uric acid levels and microalbuminuria in patients with type 2 DM.

Methods: The present study was a hospital based, cross-sectional study, conducted for a period of two years carried out on 200 patients diagnosed with type 2 diabetes mellitus and admitted to AIIMS Patna, Bihar, India. The study was done in the department of general medicine AIIMS Patna, Bihar, India who satisfied the inclusion criteria, after taking an informed written consent from all the subjects.

Results: In our study, 40% of the population belonged to 51-60 years of age group followed by 20% in 31-40 age group. There were 160 males and 40 females in the study. Serum magnesium levels were on the lower side in 92% of the population and only 8% had levels within the normal range in our study. Serum uric acid levels were elevated in 65% of the study population whereas 35% were within the normal range or low. Out of 200, 160 were having Microalbuminuria and 30 were having macroalbuminuria. In our study, there was a strong positive correlation between, hypomagnesemia and microalbuminuria, with highly significant p value of 0.000. Out 160 study population with microalbuminuria, 146 patients had elevated serum Mg levels, i.e., 91.25%. In our study, there was a positive correlation between, high uric acid levels and microalbuminuria with a highly significant value of 0.000. Out of 160 study population with microalbuminuria, 102 had elevated serum uric acid levels.

Conclusion: There was a significant microalbuminuria in patients with type 2 DM, with reduced serum Mg levels and elevated serum uric acid levels as compared with patients who had serum Mg and uric acid levels within the normal range.

Keywords: Magnesium, Uric acid, Microalbuminuria, Type 2 diabetes.

Introduction

Diabetes mellitus is a heterogeneous group of metabolic disorders causing macrovascular (like coronary artery disease) and microvascular (kidney damage) complications. Type 2 diabetes mellitus is characterized by deficiency of insulin, variable degree of insulin resistance, impaired insulin secretion, and impaired glucose utilization. Among individuals with type 2 diabetes mellitus, death from macrovascular disease is more common. [1] Higher levels of serum insulin may decrease uric acid (UA) clearance by kidneys and predispose to UA injury. [2] Several large epidemiologic studies have reported that elevated serum UA concentration is associated with cardiovascular disease. [3]

Microalbuminuria means significant increase in albumin excretion rate (AER) [4] and may reflect a generalized defect in vascular permeability and a concomitant atherogenic diathesis. [5]

Magnesium is considered being one of the most important minerals for human body as it plays important role in the phosphorylation reactions of glucose and its metabolism. [6] Its lower intake and low serum level are linked to with insulin resistance, and type-2 diabetes mellitus (T2DM). [7] It's also observed that low Mg level was associated with complications of diabetes like diabetic retinopathy in caucasians but not in black African diabetics. [8] Urate (soluble form of uric acid) is known to scavenge superoxide radicals, hydroxyl radicals and other free radicals and may have therapeutic influences. [9] In spite of this, definitive role of uric acid in diabetes is not yet understood but hyperuricemia in glucose intolerance and uncontrolled diabetes is thought to be closely associated. [10,11]

The aim of the study was to assess the incidence and association of serum magnesium levels, serum uric acid levels and microalbuminuria in patients with type 2 DM.

Materials and Methods

The present study was a hospital based, cross-sectional study, conducted for a period of two years carried out on 200 patients diagnosed with type 2 diabetes mellitus and admitted to AIIMS Patna, Bihar, India. The study was done in the department of general medicine AIIMS Patna, Bihar, India who satisfied the inclusion criteria, after taking an informed written consent from all the subjects.

Inclusion and exclusion criteria

All the type 2 diabetic patients department of general medicine AIIMS Patna, Bihar, India of any age and gender are included in the study. Those Patients with type 1 diabetes mellitus, patient with history of alcohol intake, gout fever, UTI (urinary tract infections), arthritis, acute myocardial infarction, recent major surgery/major trauma, hypertensive, recent (6 months) intervention with ACE inhibitors/ARB and those on chemotherapeutic agents (anti-neoplastic drugs) were excluded from the study.

A pre-structured proforma was used to collect the data. Detailed history was taken from the patients about the fever, chest pain, breathlessness, lifestyle, history of chronic disease, current medications including anti diabetic drugs (oral agents or Insulin), anti-hypertensive agents, uricosuric drugs and chemotherapeutic agents. Personal history (alcohol etc.) was taken. Fasting and post prandial sugar levels, HBA1C levels for diagnosis of type 2 DM, serum magnesium and serum uric acid levels were also estimated. Urinary albumin excretion was assessed by urinary albumin: creatinine ratio in spot sample. Those who die during the hospital stay, date & cause of death were recorded. The patients were divided into the following groups according to the degree of albuminuria as follows: normal: <30 mg/day, microalbuminuria: 30-300 mg/day and macroalbuminuria: >300 mg/day. [12] The serum uric acid normal range is 3-7 mg/dl in male whereas it's 2.5-6 mg/dl in female. [13] For serum magnesium, a serum level of 1.4.-2 mg/dl is considered to be in normal range. [14]

Statistical analysis

Collected data from the study population were entered into Microsoft Excel 2007 and Epi Info 7. Their demographic data analysis was performed. Descriptive data were expressed as frequency, percentage, Chi-square test, Fisher Exact and 't' test were applied whenever applicable. The entire data were analysed using the software graph pad, $p<0.05$ was considered to be statistically significant and $p<0.001$ was considered to be statistically highly significant.

Results

Table 1: Age and gender distribution in the study group

Age groups (years)	N	%
31-40	40	20
41-50	30	15
51-60	80	40
61-70	38	19
Above 70	12	6
Gender		
Male	160	80
Female	40	20

In our study, 40% of the population belonged to 51-60 years of age group followed by 20% in 31-40 age group. There were 160 males and 40 females in the study.

Table 2: Serum magnesium levels, serum uric acid levels and Microalbuminuria in the study group

Serum magnesium	N	%
Elevated	184	92
Normal/low	16	8
Serum uric acid		
Elevated	130	65
Normal/low	70	35
Albuminuria		
Microalbuminuria	160	80
Macroalbuminuria	30	15
Normal	10	5

Serum magnesium levels were on the lower side in 92% of the population and only 8% had levels within the normal range in our study. Serum uric acid levels were elevated in 65% of the study population whereas 35% were within the normal range or low. Out of 200, 160 were having Microalbuminuria and 30 were having macroalbuminuria.

Table 3: Serum magnesium and microalbuminuria

Serum magnesium	Microalbuminuria; N (%)			Total N (%)
	Microalbuminuria	Macroalbuminuria	Normal	
Elevated	150	30	4	184
Normal/low	10	0	6	16
Total	160 (80)	30 (15)	10 (5)	200 (100)

In our study, there was a strong positive correlation between, hypomagnesemia and microalbuminuria, with highly significant p value of 0.000. Out 160 study population with microalbuminuria, 146 patients had elevated serum Mg levels, i.e., 93.75%.

Table 4: Serum uric acid and microalbuminuria

Serum uric acid	Albuminuria; N (%)			Total N (%)
	Microalbuminuria	Macroalbuminuria	Normal	
Elevated	102	28	0 (0)	130
Normal/low	58	2	10	70
Total	160 (80)	30 (15)	10 (5)	200 (100)

In our study, there was a positive correlation between, high uric acid levels and microalbuminuria with a highly significant value of 0.000. Out of 160 study population with microalbuminuria, 102 had elevated serum uric acid levels.

Discussion

Chronic vascular complications in type 2 diabetes (T2DM) are the deteriorating conditions underlined by inflammation. [15] The chronic vascular complications in diabetes mellitus (DM) are classified by vascular size into macro- and microvascular diseases. The chronic vascular complications are a serious problem, since they generally yield devastating outcomes for the T2DM patients, which include coronary arterial disease (CAD), cerebrovascular disease (CVD), peripheral arterial disease (PAD), diabetic nephropathy (DN), diabetic retinopathy (DR). [16]

In our study, 40% of the population belonged to 51-60 years of age group followed by 20% in 31-40 age groups as in study by Tseng et al where the mean age of T2DM was 62.8±10.8 years, and in a study by Xu et al the mean age was 61.11±10.01 years. [17,18] In our study, there was a strong positive correlation between, hypomagnesemia and microalbuminuria, with highly significant p value of 0.000. Out 160 study population with microalbuminuria, 146 patients had elevated serum Mg levels, i.e., 93.75%. There was a statistically significant increased incidence of microalbuminuria in patients with hypomagnesemia as compared with normal levels. Our findings were similar to study done by Xu et al who showed that serum magnesium was inversely associated with the prevalence of microalbuminuria. [19] Gupta et al also showed increased incidence of microalbuminuria in T2DM patients with hypomagnesemia. [20] The exact relationship between hypomagnesemia and microalbuminuria in DM is not known. Oxidative stress is becoming increasingly recognized as an important factor for microalbuminuria. [21] Magnesium has been reported to possess antioxidant property.

Hence, oxidative stress may be one of the mechanisms that underlie the association between serum Mg and microalbuminuria. Magnesium depletion is said to reduce the insulin sensitivity, thereby increasing the risk of secondary complications. [22] In our study, 65% of the population with positive microalbuminuria showed hyperuricemia. There was statistically significant increased incidence of microalbuminuria in patients with hyperuricemia as compared with normal/low serum uric acid levels. The present study shows a strong relationship between hyperuricemia and microalbuminuria, which was similar to findings of study done by Chin-Hsiao. Our findings were similar to study done by Bonakdaran et al which also concluded that higher serum uric acid concentrations were associated with a greater probability of albuminuria in patients with type 2 diabetes mellitus. [23] Uric acid is the final breakdown product of adenosine, which plays an important role in the pathophysiology of insulin resistance. [24] Hyperinsulinemia resulting from insulin resistance can decrease the renal excretion, increase the renal absorption, and increase the production of uric acid. Microalbuminuria is an integral part of metabolic syndrome characterized by insulin resistance. [25,26]

Conclusion

Based on the results of present study, serum magnesium level was inversely related with the incidence of microalbuminuria whereas there was linear association with high serum uric acid level. Good glycemic control and correction of hypomagnesemia and hyperuricemia could be effective to reduce the incidence of microalbuminuria and

progression of renal impairment in type 2 diabetic mellitus.

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