Original Research Article

A study on clinical serum uric acid levels in type 2 diabetes mellitus patients in tertiary care hospital in Chengalpattu District

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Abstract

Background: The prevalence of hyperuricemia has been increasing around the world accompanied by a rapid increase in obesity and diabetes. There has been a growing interest in the association between elevated uric acid and other metabolic abnormalities of hyperglycemia, abdominal obesity, dyslipidemia, and hypertension. Hyperuricemia has been positively associated with hyperglycemia. Diabetic patients tend to have higher levels of serum uric acid levels as compared to the normal population.

Aim of the study: To identify whether any association exists between age, sex, anthropometric measurements (BM1, WHR), hypertension, dyslipidemia & coronary artery disease with serum uric acid level.

Materials and methods: The Study group consisted of 100 individuals studied over a period of 2 years of which 70 typed 2 diabetics and 30 were healthy controls were included. After obtaining informed consent, the required patient details were obtained. Patient height, weight, waist circumference, and hip circumference were measured. By aseptic precautions5 ml of blood is collected from the antecubital vein after 8-12 hours of fasting. Following parameters such as height, weight, waist circumference, and hip circumference; Body Mass Index and Waist hip ratio, serum uric acid level, blood pressure were measured.

Results: Among 70 cases and 30 controls screened for BMI, none were obese. The mean and standard deviation for BMI of cases and controls was 24.93 ± 3.13 and 21.8 ± 2.3 respectively. Serum uric acid in the study population and control varied from2.8 to 8.3 and 2.9 to 5.3 mg/dl respectively. The mean

and standard deviation of uric acid among cases was 5.25 ± 1.59 while in control it was 3.91 ± 0.98 respectively. The serum uric acid level of diabetics was very much elevated compared with controls and it was highly significant.

Conclusion: Diabetes mellitus is strongly associated with hyperuricemia. The role of uric acid as an independent risk factor for cardiovascular disease is a matter of controversy. The present study was proposed to assess the uric acid status in patients with diabetes mellitus and to find out its association with age, gender, BMI, WHR, smoking, and CAD. Since uric acid is a confounding factor and multiple factors are involved for elevated uric acid. Meticulous control of blood sugar, hypertension, dyslipidemia among diabetics will bring down an elevated uric acid level in diabetics.

Key words

Serum uric acid, Diabetes mellitus, Coronary artery disease, Body Mass Index.

Introduction

Diabetes is a term that describes several diseases of abnormal carbohydrate metabolism that is characterized by hyperglycemia. It is associated with a relative or absolute impairment of insulin secretion, together with differing degrees of peripheral resistance to the actions of insulin. Uric acid is a product of the metabolic breakdown of purine nucleotides, and it is a normal component of urine. Hyperuricemia is defined as a serum urate level of 6.8 mg/dL (404 μmol per liter) or more [1]. The rising incidence and prevalence of hyperuricemia are probably related to the increased life expectancy of the population, increasing levels of obesity, sedentary lifestyles and change in dietary habits [2]. Type 2 diabetes mellitus consists of an array of dysfunctions characterized by hyperglycemia and resulting from the combination of insulin resistance, inadequate insulin secretion, and excessive or inappropriate glucagon secretion. Type 2 diabetes mellitus is less common in Non-Western countries where the diet contains fewer calories and daily caloric expenditure is higher [3]. However, as people in these countries adopt western lifestyles, weight gain and Type 2 diabetes mellitus are becoming almost epidemic. It has been shown that serum uric acid is positively associated with serum glucose levels in healthy subjects [4]. Recent studies have demonstrated that uric acid levels are higher in subjects with Type 2 diabetes than in healthy controls [5]. Furthermore, an elevated serum uric acid level was found to increase the chances and predispose to developing Type 2 diabetes in individuals with impaired glucose tolerance [6]. Hyperuricemia has been also added to the set of metabolic abnormalities associated with insulin resistance and/or increased insulin secretion in metabolic syndrome [7]. An elevated uric acid level, as reported, often precedes the development of obesity, hyperinsulinemia, and diabetes [8].

Studies related to uric acid levels in diabetes are few and deserve further analysis on the prevalence of hyperuricemia in our country as it confers a poor prognosis on the patients. This study in turn help to add knowledge on the prevalence of hyperuricemia in our set up, and the relationship of hyperuricemia to the duration of diabetes, glycemic control and some risk factors such as age, sex BMI and hypertension [8].

Materials and methods

The study was conducted in the Karpaga Vinayaka Institute of Medical Sciences in the year 2018-2019. The Study group consisted of 100 individuals studied over a period of 2 years of which 70 typed 2 diabetics and 30 were healthy controls were included. After obtaining informed consent, the required patient details were obtained. Patient height, weight, waist circumference, and hip circumference were measured. By aseptic precautions 5 ml of blood is collected from the antecubital vein after 8-12 hours of fasting. Following parameters such as

height, weight, waist circumference, and hip circumference; Body Mass Index and Waist hip ratio, serum uric acid level, blood pressure were measured.

Inclusion criteria: Patients with type 2 diabetes mellitus (patients were taken irrespective of their glycemic control and their duration of diabetes). Patients who were above 40 years were included. Both sexes were included.

Exclusion criteria: Patients with renal failure, Pregnancy and lactating mothers, Patients who were on long term diuretics and steroids, Patients who were regularly consuming alcohol, Patients who were on antimetabolite and chemotherapy drugs, Patients who had hepatic and metabolic disorders, Patients who had PVD/CVA/ Pulmonary Tuberculosis, Renal transplant patients.

Statistical analysis: Data was entered in Microsoft Excel spreadsheets and analyzed statistically using standard statistical software. Student 't' values were applied for significance. The significance of the 'P' value was below 0.05.

Results

The age of the subjects in the study group was ranged from 43 to 72 years. The mean and standard deviation for the age of the cases and controls were 59.13±9.11 and 56.97±8.41 respectively, there was no significant difference among the cases and controls with reference to the age. P = 0.0551 (Not Significant) as per **Table – 1**.

Among 70 cases and 30 controls screened for BMI, none were obese. The mean and standard deviation for BMI of cases and controls was 24.93 ± 3.13 and 21.8 ± 2.3 respectively. The BMI of the study group was significantly higher than that of control group. P = 0.0002 (Significant) as per **Table – 2**.

Table - 1: Cases and controls in relation to age.

Age group (Years)	Cases		Controls	
	No	%	No	%
40-50	14	20	6	20
51-60	21	30	10	33.33
61-70	26	37.14	11	36.66
71-80	9	12.85	3	10
Mean	59.13		56.97	
S.D.	9.11		8.41	

Table - 2: Cases and controls in relation to BMI.

BMI	Cases		Controls	
	No	%	No	%
< 25	34	48.57	24	80
≥25	36	51.42	6	20
Total	70	100	30	100
Mean	24.93		21.8	
S.D.	3.13		2.3	

There was no significant difference between cases and controls in relation to selected cardiovascular risk factors (**Table – 3**).

Serum uric acid in the study population and control varied from 2.8 to 8.3 and 2.9 to 5.3 mg/dl respectively. The mean and standard deviation of uric acid among cases was 5.25 ±

1.59 while in control it was 3.91 ± 0.98 respectively.* P-value: 0.0001 (significant). The serum uric acid level of diabetics was very much elevated compared with controls and it was highly significant (**Table – 4**).

Hyperuricemia is defined as SUA level 8 mg/dl in males and 6 mg/dl in females. 15 cases had hyperuricemia while none in controls. *P = 0.0001 (Significant). **Table - 5** showed that the prevalence of hyperuricemia is more in diabetic patients when compared to controls.

Table – 3: Distribution of cases and controls in relation to selected cardiovascular risk factors.

Risk Factor	**Cases**		**Controls**	
	No	**%**	**No**	**%**
Family History				
Yes*	20	28.57	7	23.34
No	50	71.43	23	76.66
* P-value 0.5622 (Not Significant)				
Smoking among Males				
Yes**	19	27.14	8	26.66
No	51	72.85	22	73.33
** P value 0.5746 (Not Significant)				
Hypertension				
Yes***	18	25.71	7	23.33
No	52	74.27	23	76.67
*** P value 0.5044 (Not Significant)				

Table – 4: Distribution of cases and controls in relation to serum uric acid level (SUA).

Serum Uric Acid *	**Cases**		**Controls**	
	Mean	**S.D.**	**Mean**	**S.D.**
	5.25	1.59	3.91	0.98

Table – 5: Analysis of hyperuricemia in cases and controls.

Hyperuricemia	**Cases**				**Controls**			
	No	**%**	**Mean**	**S.D**	**No**	**%**	**Mean**	**S.D**
+	15	21.4	7.16	0.5	0	-	-	-
-	55	78.67	4.73	1.21	30	100%	3.91	0.98

Table – 6: Serum uric acid values in hypertensive patients.

HT	**No.**	**Mean**	**S.D.**
Yes*	18	6.45	1.15
No	52	4.83	1.43

Table – 7: Serum uric acid value in relation to duration of diabetes.

DOD	**No.**	**Mean**	**S.D.**
2-4 years	12	4.31	1.08
5-8 years	37	5.01	1.891
9-12 years*	21	6.87	1.03

The mean serum uric acid level in the hypertensive group (6.45±1.15) was significantly more than the non-hypertensive group (4.83±1.43) in the cases. The mean serum uric acid level in the hypertensive group (6.45±1.15) was significantly more than non-hypertensive group (4.83±1.43) in the cases * P-Value = 0.0001 (Significant) as per **Table – 6**.

The mean value of serum uric acid level was higher in longer duration (9-12 years) of diabetes 6.87±1.03 when compared to shorter duration (2-4 years) of diabetes 4.31±1.08. P-Value = 0.001 (Significant). Uric acid level increases with the increasing duration of diabetes and it was statistically significant (**Table – 7**).

Discussion

Diabetes is the most common risk factor for cardiovascular disease, and it is present in nearly 25% of adults and increases in prevalence with age. Hyperuricemia is one of the components of metabolic syndrome. "In the absence of gout, the presence of hyperuricemia in patients with type 2 diabetes mellitus is an important marker as well as an added risk factor for atherosclerosis [9]." In this study, the relationship between serum uric acid level and diabetes was examined. Uric acid is a marker for CAD in combination with other risk factors among diabetics. Though uric acid level and age were independent it is possible that the duration of the illness may have an impact on uric acid levels. Obesity has been found to contribute to hyperuricemia. BMI is highly dependent on the individual's genetic composition, dietary habits, and level of physical activity. The majority of our population was obese and overweight at 75.3%. In the hyperuricemia group, 89.7% were in the overweight and obese group. The mean (SD) BMI among the patients with hyperuricemia was 29.2 kg/m². This is similar to the majority of the studies [10]. Hak AE, et al. found a low prevalence, his study had a lower number of obese participants. In our study, we did not reach a statistical significance between serum uric acid levels and BMI, p = 0.100. Though we did not entirely screen for metabolic syndrome in our study, it seems like most of our patients would fall in this category; considering that the prevalence of obesity and metabolic syndrome is rapidly increasing in developing countries due to urbanization, unhealthy food options, and physical inactivity [11]. The metabolic syndrome causes insulin resistance which enhances renal urate reabsorption via stimulation of urate-anion exchanger and/or the sodium-dependent anion co-transporter in brush border membranes of the renal proximal tubule. Our population needs to be screened for fructose consumption habits. The epidemic trend of obesity in recent years has also coincided with the increasing use of fructose, especially in beverages. Fructose intake contributes to insulin resistance, impaired glucose tolerance, and hyperinsulinemia predisposing to hyperuricemia by increasing ATP degradation to AMP, a uric acid precursor and also de novo purine synthesis is accelerated In the present study females have higher uric acid level when compared to males. The mean uric acid value in males was 5.06±1.64while in females it was 5.93±1.13, and the difference was statistically significant in this study [12]. The possible reasons for such difference may be attributable to increased BMI and increased WHR among women. In the present study serum uric acid correlated well with body mass index (BMI). The mean uric acid in those subjects with BMI >25 was higher than those with BMI < 25 (6.13±1.45 Vs 4.13±1.23) and the difference was statistically significant [13]. Yu S Chen, et al. assessed the various components of insulin resistance syndrome in young black and white adults. They concluded that body mass index showed the strongest positive correlation with the uric acid among insulin-resistant components. Waist hip ratio is an important measure of obesity, especially central obesity. Intrabdominal fat has significant implications for morbidity than subcutaneous fat present in buttocks and extremities. Abdominal obesity is a component of metabolic syndrome. Waist circumference > 102 cm in men and >88cm in women is abnormal [14]. In this study patients with a higher waist-hip ratio had higher uric acid levels when compared

with a low waist-hip ratio. The mean uric acid value in patients with waist-hip ratio abnormality and patients without waist-hip ratio was 5.93±1.38 and 4.63±1.3 respectively and the difference was statistically significant. Strong epidemiologic data have linked serum uric acid to hypertension in humans and experimental animal data suggests hyperuricemia causes hypertension [15]. When the level of serum uric acid in hypertensive patients was compared with non-hypertensive patients in cases, the difference was significantly higher in the present study. (6.45±1.15 vs 4.83±1.43)Uric acid stabilizes the platelet aggregation and enhances thrombotic tendency," thus suggesting hyperuricemia as a strong predictor of myocardial infarction and stroke. Patients with poor metabolic control and longer duration of diabetes were more susceptible to develop various complications including hyperuricemia [16]. Our study also shows that a higher level of serum uric acid was seen in patients with longer duration of diabetes when compared with shorter duration of diabetes, 6.87±1.03 (9-12 years) vs 4.31±1.08 (2-4 years). This difference was statistically significant. The association of serum uric acid with cardiovascular disease has been appreciated for nearly half a century. However, its role as a cardiovascular risk factor remains controversial. Of the 70 cases of type 2 diabetes mellitus, hyperuricemia was observed in 15 patients which accounts for 21.43% of cases [17]. Fouad M showed a prevalence of hyperuricemia in 25% of longstanding uncontrolled diabetes. But in this study, many of the cases were on treatment which might have affected the results [18]. A large body of evidence links uric acid with the metabolic syndrome of insulin resistance, obesity, hypertension, and dyslipidemia. In this study relationship between obesity, hypertension, dyslipidemia, and hyperuricemia was statistically significant [19, 20].

Conclusion

Uric acid was significantly elevated in the diabetic population. The serum uric acid level was independent of age and smoking status in males. A significant correlation was noticed between serum uric acid and BMI. A significant elevation of the uric acid level was observed more among females. Elevated uric acid levels were significantly noticed among those with hypertension, dyslipidemia, coronary artery disease and chronicity of diabetes. A uric acid level above 4 mg/dl in the diabetic population (considered as a "Red flag" sign) was a marker or risk factor for CAD, which was present in 78% of the study population.

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