

Plasma Uric Acid and Lipid Profile among Sudanese with Type 2 Diabetes in Khartoum State, Sudan

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ABSTRACT

Background: Hyperuricaemia and hyperlipidaemia have been reported to be a potential risk factor for cardiovascular disease in type 2 diabetes mellitus. The objective of this study was to assess the plasma levels of uric acid and lipid profile in Sudanese patients with type 2 diabetes in comparison with apparently healthy (non-diabetic volunteers as controls).

Materials and Methods: This is an analytical, cross-sectional and hospital-based study conducted during the period from March to May 2013 in two Diabetes centers in Khartoum state, Sudan. The study group included 52 patients with Type 2 diabetes (as a test group) and 30 healthy subjects (as a control group, both groups were matched for age and gender). A Fasting venous blood sample was collected from each participant. Serum levels of uric acid, and lipid profile were assayed using commercial reagent kits from Bio-system Company. SPSS was used for analysis of data.

Results: The means of the plasma levels of uric acid, total cholesterol, triglycerides and low density lipoprotein cholesterol were significantly raised, whereas the mean of the plasma levels of high density lipoprotein was significantly reduced in the diabetic group when compared to the controls. The plasma levels of uric acid had moderate positive correlations with both, the duration of diabetes and the body mass indexes of the diabetic patients.

Conclusion: Hyperuricaemia and hyperlipidaemia are significantly associated with type 2 diabetes mellitus and can increase the morbidity and mortality of diabetes if not managed in time. Elevated plasma levels of uric acid, total cholesterol, LDL and triglycerides are associated with increased risk of cardiovascular mortality in type 2 diabetes.

Key words: Type 2 diabetes mellitus, Plasma urate, cardiovascular disease.

Introduction

hyperglycemia due to absolute or relative deficiency of insulin.^{1,2} It may be associated with a number of complications including nephropathy, neuropathy, retinopathy, diabetic foot and macro and micro vascular diseases³.

Type 2 diabetes is characterized by a group of abnormalities: hyperinsulinaemia, dyslipidemia, obesity and vascular abnormalities³. These groups of abnormalities are associated with increased risk for cardiovascular disorder. The cardiovascular risk is increased three to four fold in patients with type 2 diabetes as compared to non-diabetic population⁴.

Uric acid is the final oxidation product of purine catabolism, Excess serum uric acid accumulation can lead to various diseases, and most notably uric acid is involved in the pathogenesis of gouty arthritis^{5,6}. Also, for more than 50 years, increased serum concentrations of uric acid have been implicated in cardiovascular disease^{5,6}. Hyperuricaemia has been found to be associated with obesity and insulin resistance, and consequently with type 2 diabetes^{7,8}.

The actual mechanism of hyperuricemia found in patients with type 2 diabetes mellitus is not known but it has been observed that compensatory Diabetes mellitus is a clinical syndrome characterized by hyper-insulinaemia in insulin resistant individuals impose an antiuricosuric effect on the kidney^{1,9,10}.

Recently, elevation of serum uric acid has been found to be associated with subsequent morbidity and mortality in the general population among patients with congestive heart failure, diabetes and hypertensive patients^{1,11}. It has been proposed that the serum uric acid levels are linked to the other risk factors, such as dyslipidaemia and diabetes^{1,12}.

Materials and Methods

This study included 52 patients with type2 diabetes (26 males and 26 females)in the age group of 40-75 years, who visited Jabir Abu Elezand Nurein diabetic centers, both centers in Khartoum state, Sudan.

Fifty-two apparently healthy subjects (non-diabetic) matched for age and sex in were recruited as controls this study. Patients with type 1 diabetes mellitus, gout, hypertension, renal impairment, familial hyperlipidaemia, and coronary heart disease had been excluded from this study. After consent was given, anovernight-fasting venous blood sample was collectedfrom each participant in aethium heparin container. The samples were then centrifuged at 3000rpm for 5minutes andplasma was separated.

Plasma uric acid, total cholesterol, triglycerides, and high density lipoprotein (HDL), were assayed using spectrophotometric technique and enzymatic endpoint kits from Bio-system Company. LDL concentration was calculated using Friedwald formula. Thebody mass index for each participant was calculated using the formula:

BMI= weight in kilograms/ square of height in meters. SPSS was used for analysis of data. t-test was used for comparison of variables of the test group and the control group. Person's correlation was used for assessment of correlation between variables. P. value ≤ 0.05 was considered significant.

Results

Table 1: shows no significant difference in age between the test group and the control group. The mean of the BMI was significantly elevated in the test group when compared to the control group. Table 2: show significantly raisedmeansof plasma uric acid, T. cholesterol, triglycerides, and LDL, whereas the mean of HDL was significantly reduced inthe diabetics as compared to the controls.

Table 1: Age and body mass index of the control group and the test group

Parameters	Control	test	P-value
Age in years	49.63± 8.31	51.35± 11.3	0.57
BMI (kg/m ²)	23.42±4.01	27.68±6.3	0.020

The table shows the mean \pm st. deviation, and the level of significance (P- value)

Table 2: Plasma biochemical parameters of the test group and the control group.

Parameter	Controls n=52	Test group n=52	P-value
Ur. acid (mg/dl)	4.607±1.1	6.294±1.8	0.000
T.chol. (mg/dl)	171.90±35.62	189.90±40.33	0.039
TG (mg/dl)	100.19±42.23	146.40±52.32	0.000
HDL (mg/dl)	66.33±20.94	26.79±12.47	0.000
LDL (mg/dl)	92.78±34.05	122.38±35.20	0.000

The table shows the mean \pm st.deviation , and the level of significance (P-value).

Table 3: Correlation of the plasma levels of uric acid, total cholesterol, LDL, HDL and triglycerides with the body mass index of the diabetics.

Parameter	Correlation coefficient (r)	P. value
Uric acid	0.61	0.023
T.cholesterol	0.11	0.121
LDL-C	0.35	0.85
HDL-C	-0.18	0.210
Triglycerides	0.47	0.044

Table 4: Correlation of the plasma levels of uric acid, total cholesterol, LDL, HDL and triglycerides with the duration of diabetes.

Parameter	Correlation coefficient (r)	P. value
Uric acid	0.57	0.021
T. cholesterol	0.21	0.139
LDL-C	0.08	0.732
HDL-C	0.11	0.557
Triglycerides	0.19	0.331

Discussion

In the present study there was a significant elevated mean of plasma uric acid in type 2 diabetics as compared to the controls. Hyperuricaemia is found to be associated with impaired glucose tolerance, insulin resistance syndrome and hyperinsulinemia in type 2 diabetes^{4,13}. In the current study there was a significant increase in BMI of the diabetics as compared to the controls. Zang et al. have reported a positive correlation between the BMI and cardiovascular disease among diabetic patients^{14,15}. High BMI itself is a potential risk factor for type 2 diabetes. In the current study the mean of plasma urate levels was found to be significantly increased in patients with type 2 diabetes when compared with the control group. These results agree with that obtained in a study done by Safi et al¹, who found the average level of serum uric acid in the diabetic patients was 6.07 mg/dl as compared to 5.01 mg/dl in the control group. It was seen that serum uric acid is positively associated with type 2 diabetes mellitus and the association was relatively more significant in females, obese patients and patients with hyperlipidemia. Also these results were comparable in most aspects to similar studies performed by different research workers^{16,17,18,19}.

Pathologically and epidemiologically, it has been indicated that elevated plasma uric acid concentration is correlated with lifestyle factors and various metabolic profiles specially high values of BMI, blood pressure, fasting plasma glucose, triglycerides, and low HDL values, which are typically considered to be diagnostic criteria for metabolic syndrome²⁰.

In the present study all lipid fractions with exception to HDL are significantly elevated in patients with type 2 diabetes, supporting the fact that high morbidity and mortality in diabetes may be due to derangement in lipid profile. Uric acid can promote LDL oxidation, a key step in progression of atherosclerosis by stimulating granulocyte adherence to the endothelium. High range of glycaemia can promote non enzymatic glycosylation of LDL which in turn can be phagocytosed into the arterial wall independent of receptor

mechanism^{21,22} Phagocytosed uric acid can transverse through dysfunctional endothelium, this in turn leads to plaque formation.^{23,24} Diabetics with elevated uric acid levels are at increased risk for developing nephropathy and cardiovascular disease²⁵. The link between elevated serum uric acid and cardiovascular disease may arise through its non-causal relationship with insulin resistance syndrome.

The current study shows moderate positive correlations between the plasma levels of uric acid and both; the duration of diabetes and body mass index. In a study done by Talat, et al,²⁶ they found a moderate correlation between the duration of diabetes and both; the plasma uric acid levels and hyperlipidaemia .

Conclusion

Hyperuricemia is a common finding in type 2 diabetes mellitus adding to the morbidity and mortality of these patients. In this study it was found that, plasma uric acid is significantly associated with type 2 diabetes mellitus and has moderate positive correlation with both, the duration of diabetes and the body mass index of the diabetics.

References

1. Safi AJ, Mahmood R, Khan MA, Alhaj A. Association of serum uric acid with type II diabetes mellitus. *JPMI* 2004 ; 18(1):59-63
2. Marks V, Teale JD. Hypoglycemia in adults. *Baillie's Clinical Endocrinology and Metabolism* 1993 ;(3): 705-729.
3. Kumar P, Clark ML. Diabetes mellitus and other disorders of metabolism. *Clinical Medicine*. 3rd ed. London: WB Saunders; 2002.
4. Preis SR, Haong SJ, Coady S, Pencina MJ, Agostino RB, Savage PJ, et al. Trends in all-cause and cardiovascular disease mortality among women and men with and without diabetes mellitus in the Framingham Heart study. *Circulation* 2009; 19(17) :28-35.
5. Becker BF. Towards the physiological function of uric acid. *Free Radic Biol Med* 1993;14:615-631.
6. Strazzullo P, Puig JG. Uric acid and oxidative stress: relative impact on cardiovascular risk. *Nutr Metab Cardiovasc Dis*. 2007;17:409-414.
7. Gersch MS, Johnson RJ. Uric acid and the immune response. *Nephrol Dial Transplant*. 2006;21:3046-3047.
8. Sanchez-Lozada LG, Nakagawa T, Kang DH, Feig DI, Franco M, Johnson RJ. Hormonal and cytokine effects of uric acid. *Curr Opin Nephrol Hypertens* 2006; 15:30-33.
9. Clausen JO, Borch JK, Ibsen H, Pedersen O. Analysis of the relationship between fasting uric acid and the insulin sensitivity index. *Eur J Endocrinol*. 1998; 138 (1) : 63-69.
10. Moriwaki Y, Yamamoto T, Takahashi S, Suda M, and Higashino K. Effect of Glucose infusion on the renal transport of purine bases and oxypurinol. *Nephron*. 1995; 69 (4): 424-427.
11. Alderman M. uric acid in Hypertension and Cardiovascular Disease. *Can J Cardiology* 1999; 15:20-25.
12. Milionis HJ, Elisaf MS. Management of Hypertension and Dyslipidaemia in Patients Presenting with Hyperuricemia. *Curr Med Res Opin* 2000; 16 (3):164-170.
13. Hayden MR, Tyagi SC. Uric acid - A new look at an old risk marker for cardiovascular disease, metabolic syndrome and Type 2 D.M: The urate redox shuttle. *Nutr. Metab* 2004 ; 1: 10.
14. Aronson D, Rayfield EJ: How hyperglycemia promotes atherosclerosis: molecular mechanisms. *Cardiovasc Diabetol.*, 2002, 1(1): 1.
15. Zhang X, Shu XO, Gao YT, Yang G, Mathew CE, Li Q, et al: Anthropo-metric predictors of coronary heart disease in Chinese women. *Int J Obes Relat Metab Disord* 2004; 28: 734-40.

16. Quinone GA, Natali A, Baldi S, Sanna G. Effect of Insulin on Uric Acid excretion in human *Am J Physiol*, 1995; 268(1): 1-5.
17. Iwaski N, Ogata M, Tomonaga O, and Kasahara T. Liver and Kidney function in Japanese patients with Maturity- onset Diabetes of the young. *Diabetes Care*, 199;21(12):2144-2148.
18. Muscelli E, Natali A, Bianchi S, Ferrannini E. Effect of insulin on Renal Sodium and Uric Acid handling in Essential Hypertention. *AM J Hypertens* 1996;9(8): 746-752.
19. Ishihara M, Shinoda T, Yamada T. Hypercalciuria and Hyperuricemia in Type 2 Diabetic patients. *Diabet Med* 1989; 5(5): 406-411.
20. Kodama S, Saito K, Yachi Y, Totsuka K. Association between Serum Uric Acid and Development of Type 2 Diabetes. *Diabetes Care* 2009; 32.
21. Gonen B, Baenziger J, Schonfeld G, JacobronD, Farrar P: Non enzymatic glycosylation of low density lipoprotein in vitro. Effect on cell -interactive properties. *Diabetes* 1981; 30(10): 526–530.
22. Bowie A, Owens D, Collins P, Johnson A, Tomkins GH: Glycosylated low density lipoprotein is more sensitive to oxidation: implications for the diabetic patient. *Atherosclerosis* 1993, 102: 63-67.
23. Waring WS, Webb DJ, Maxwell SRJ: Uric acid as a risk factor for cardiovascular disease. *Q J Med* 2000 ; 93: 707-711.
24. Leyva F, Anker SD, Godsland IF, Teixeira M, Hellewell PG, Kox WJ, etal: Uric acid in chronic heart failure : a marker of chronic inflammation . *Eur Heart J* 1998; 19: 1814-22.
25. Fukui M, Tanaka E, Shiraishi I, Harusato H, Haroda H, Arso M, Kanado G, Hasegoda T, et al: Serum uric acid is associated with microalbuminuria and subclinical atherosclerosis in men with type 2 diabetes mellitus. *Metabolism* 2008; 57: 625-629
26. Talat N, Amir Khan, Gulsena M, Belal B. Dyslipidemias in type 2 diabetes mellitus Patients in a Teaching Hospital of Lahore, Pakistan .*Pak J M*; 283