DOI: 10.21276/sjams.2016.4.8.72

Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(8E):3107-3112 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Original Research Article

Assessment of Plasma Malondialdehyde and Uric Acid among Sudanese Patients with Type- 2 Diabetes Mellitus in Khartoum State

Hazim Ahmed[1], Noon Mohammed[1], Mohammed abdelrouf[2], Mohammed El-mak[3], Mamoun Elmanna[4]
[1]College of Medical Laboratory Sciences, University of Sciences and Technology, Omdurman, Sudan.
[2]College of applied medical sciences, King Khalid University, Abha, KSA
[3]Faculty of Medical Laboratory Sciences, Al-Neelain University, Sudan.
[4]College of Medicine, University of Sciences and Technology, Omdurman, Sudan.

***Corresponding author**
Hazim Abdelrahim Ahmed
Email: hazim_1381@yahoo.com

Abstract: Diabetes mellitus (DM) describes a metabolic disorder of multiple etiology, which is characterized by chronic hyperglycemia, with disturbances of carbohydrate, fat and protein metabolism, which result from defects in insulin secretion, insulin action. The objective of this study was to assess some of the biochemical parameters related to types 2 diabetic patients. It was a descriptive, case control hospital based study. 250 Sudanese patients with Type 2 diabetes mellitus were involved as test group and 150 apparently healthy subjects (non-diabetics) as control group. Age and sex of both groups were matched. The Plasma Malondialdehyde(MDA), Uric Acid and other blood parameters were measured using spectrophotometric methods. The (mean ±SD) of MDA, uric acid and glucose of patients were(63.8±40.7, 4.3±1.7, 196.6±75) respectively, compared to healthy subjects(49.8±30.0, 3.7±1.0, 93.5±10.5)respectively. There was significant increase of malondialdehyde and uric acid in patients compared to control groups (P value ≤ 0.05).From this study concluded that, increased of malondialdehyde and uric acid in patients compared to control groups.
Keywords: malondialdehyde, uric Acid, Diabetes mellitus, Sudanese.

INTRODUCTION

Diabetes mellitus (DM) describes a metabolic disorder of multiple etiology, which is characterized by chronic hyperglycemia, with disturbances of carbohydrate, fat and protein metabolism, which result from defects in insulin secretion, insulin action, or both [1]. Non-insulin-dependent diabetes mellitus is one of the most widely spread and severe disorder currently, globally. The number of patients suffering from diabetes mellitus was reported to be over 381.8 million people worldwide [2]. In recent decades, oxidative stress has become a focus of interest in most biomedical disciplines and many types of clinical research. Increasing evidence shows that oxidative stress is associated with the pathogenesis of diabetes and recent studies suggest a possible relationship between lipid peroxidation and complications of diabetes mellitus [3,4]. It has been shown that an increase in free radicals production in type2 diabetes mellitus occurs due to lipid peroxidation or non enzymatic glycosylation of proteins or antioxidation of glucose. Poor glycaemic control in type2 DM also has been associated.

Oxygen free radicals and lipid peroxides have been implicated in the pathogenesis of a large number of diseases such as Diabetes mellitus, cancer, rheumatoid arthritis, infectious diseases, and atherosclerosis. Malondialdehyde (MDA) is a highly toxic by-product formed in part by oxidation derived from free lipid radicals, and studies have shown considerably raised concentrations in diabetes mellitus. MDA reacts both irreversibly and reversibly with proteins and phospholipids with profound effects [5]. Hyperuricemia has been also added to the set of metabolic abnormalities associated with insulin resistance and/or hyperinsulinemia in metabolic syndrome [3,4,6]. Hyperuricemia is a condition that is significantly associated with markers of metabolic syndrome such as dyslipidemia, Glucose intolerance, high blood pressure, and central obesity, which are accepted as risk factors for developing cardiovascular disease. Hyperuricemia is probably associated with glucose intolerance due to various mechanisms; however, the most important is the association between insulin and renal resistance to absorption of urates [7-9]. Recent studies have demonstrated that UA levels are

higher in subjects with prediabetes and early Type 2 diabetes than in healthy controls [10,11]. Furthermore, an elevated serum uric acid (UA) level was found to increase chances for developing Type2 diabetes in individuals with impaired glucose tolerance[12].The objective of the current study was to assess some of the biochemical parameters related to diabetic patients.

MATERIAL AND METHODS

The study was a descriptive, case control hospital based study. 250 Sudanese patients with Type 2 diabetes mellitus were involved as test group and 150 apparently healthy subjects (non-diabetics) as control group. Age and sex of both groups were matched. This study was conducted in Khartoum state (Al-Amal national hospital) during the period between September 2013 to June 2016. Patients with type 1 DM, renal failure, liver disease, anemia, and thyroid disease were excluded from this study. All ethical consideration and concern forms were obtained prior the research.

The Plasma MDA, UA, fasting blood glucose (FBG) and HbA1c were measured for patients and healthy subjects. The body mass index (BMI) was calculated based on the following formula[13].

Bodyweight in kilograms divided by height in meters squared

or

BMI = x KG / (y M * y M)

Where:

x = bodyweight in KG

y = height in m

Statistical Package for Social Science (SPSS version 13) computer software was used for data analysis. The means and standard deviations of the plasma levels of MA, uric acid and fasting plasma glucose were calculated and T-test (independent T samples) was used for comparison (significant level was set at $P \leq 0.05$).

Linear regression analysis was used to assess the correlation between the HbA1c, duration of diabetes, and BMI) and the plasma levels of MA, UA, and FBG. The results presented in form of tables and figures.

RESULTS

In this study, Height BMI distribution was significantly different between control and patients($P< 0.05$). While there was no significant differences regarding the weight ($P = 0.17$) (Table 1). Figure 1 illustrated the strong positive correlation between the changes in BMI and plasma level of malondialdehyde among the test group ($P < 0.05$).

Table-1: Baseline characteristics of the respondents

Variables	Control (none-diabetics) (n=150)	Test Group (diabetics) (n=250)	*P* value
Age (years) (Min-Max)	49.1±13 (36.0-62.0)	51.2±13 (38.0-64.0)	0.1
Weight (kg) (Min-Max)	64.8±10.4 (50.0-109.0)	66.3±8.8 (49.0-89.0)	0.17*
Height (m) (Min-Max)	167.5±6.4 (148-190)	163±8.7 (142-192)	0.001*
BMI (w/h^2) (Min-Max)	23.1±3.3 (17.7-36.2)	24.9±3.1 (24.0-36.0)	0.001*

- The table shows the means and probability value (*P*)
- T-test was used for comparison.
- *P* value ≤ 0.05 is considered significant

Table-2: Comparison of the means of Blood Parameters between diabetics and none diabetics

Variables	None-diabetics (n=100)	Diabetics (n=300)	*P* value
MDA (nmol/ml) (Max-Min)	49.8±30.0 (188.0-13.0)	63.8±40.7 (313.0-22.5)	0.001*
Uric acid (mg/dl) (Max-Min)	3.7±1.0 (7.3-1.9)	4.3±1.7 (12.4-1.0)	0.001*
Glucose (mg/dl) (Max-Min)	93.5±10.5 (120-69.0)	196.6±75.7 (432.0-65.0)	0.006*

* Significant differences in all blood parameters (except copper not significant *P*> 0.05) between control and test group (*P* value < 0.05).

The results also showed highly significant difference between the means of plasma MDA of the test group and the control group Means: (63±40.1) versus (49.8±30.0) nmol/l, respectively (*P* = 0.001). Furthermore, there was a highly significant difference between the means of plasma UA, HbA1c% and FBG between the studied groups (P = 0.001) as shown in Table 2. There was a significant moderate negative correlation between the changes in plasma HbA1c% and plasma uric acid among the test group (*P*< 0.05) as shown in Figure 2.

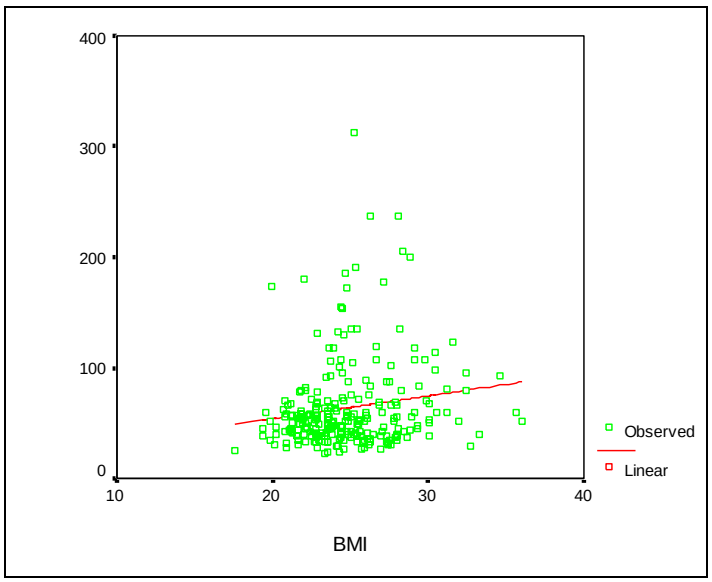

Fig-1: Scatter plot shows the relationship between BMI and plasma level of MA of the test group

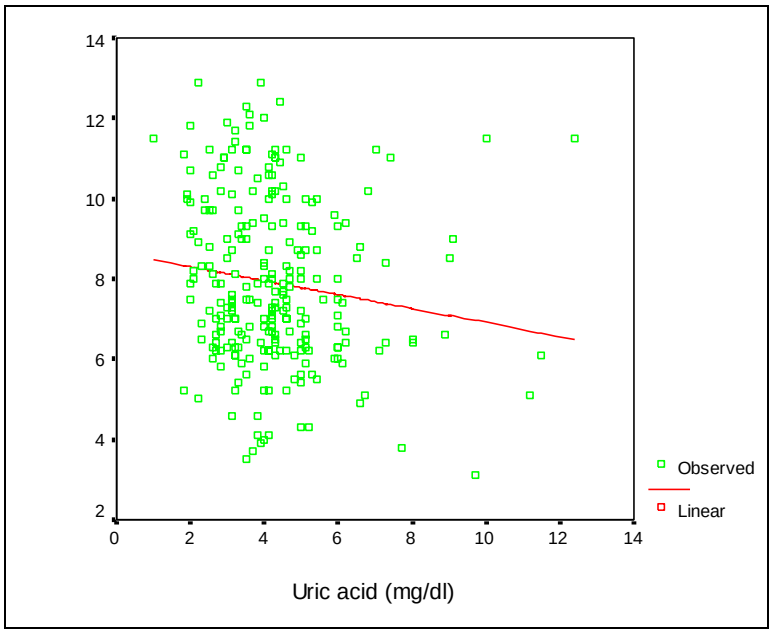

Fig-2: Scatter plot shows the relationship between plasma HbA_{1c}% and plasma UA in the test group

DISCUSSION

Diabetes is one of the fastest-growing health problems in the world (especially type 2), which is reaching epidemic proportion in some regions, as consequence of life-style, lack of exercise, unhealthy diet, obesity and overweight. In 2013, 382 million people had diabetes; this number is expected to rise to 592 million by 2035 [14]. During the past 20 years, major socio demographic changes have occurred in Sudan, and changes in physical activity and dietary patterns have promoted the development of non-communicable disease, such as diabetes mellitus. The microvascular and naturopathic complications of DM

are a major clinical and public health problem in Sudan [15].

Body mass index of diabetic subjects was found to be higher than that of non-diabetics this results agree with the study done by Helen *et al*. [16]. Similar studies had been reported that there was strong interrelation between BMI and type 2 DM which states that increase in BMI predisposes to type 2 DM [17]. The results also was in accordance to with a study done in USA which found that obesity and overweight strongly correlated with diabetes mellitus among American subjects [18].

In this study a significant difference between the means of plasma MDA of the patients and control, this was agreed with study done by Kalaivanam *et al* reported that there is significant increase in MDA levels among control diabetic patients in comparison to the uncontrol diabetic patients who have poor glycemic control [19]. Rama Srivatsan *et al* have reported an increased MDA levels in uncontrol diabetics among a Southern Karnataka population [20]. In 2009, Manjulata *et al* followed by Kumar *et al* in 2011, reported that increased oxidative damage in diabetes as shown by elevated MDA level in diabetic with poor glycemic control [21, 22].

Other finding of this study was slightly significant positive correlation was reported between plasma MDA of test group and BMI and duration of disease. This agreed with results obtained by Yazum *et al* and Karatas whom observed significant increase in the MDA in diabetic patients with increased BMI and duration of the diseases [23, 24] on the other hand, the result was disagree with study done by Benitiz *et al.* and Freitas *et a l* they reported no correlation between the duration of diabetes mellitus and level of MDA in patients with type 2 [25,26].

In this study there was no significant relationship between MDA and HbA_{1c} %of the test group, this finding disagree with study done by Desai Vidya *et al* who their study showed a positive correlation between plasma MDA and HbA1c .Their results suggested that increased lipid peroxidation and a decline in the antioxidant defense mechanisms plays a very important role in the initiation and progression of micro-vascular complications [27].

In the current study highly significant difference between the means of plasma UA of the test group and the control group was noticed. The result was agreed with results obtained by Satoru *et al* which report plasma UA levels in patients with type 2 diabetes are significantly increased [28]. A possible explanation for this is the biologically role of UA in worsening of insulin resistance by inhibiting the bioavailability of nitric oxide in vascular smooth muscle and endothelial cells and direct scavenging of nitric oxide by uric acid [29]. Decrease in endothelial nitric oxide production by uric acid, has been also associated with endothelial dysfunction and insulin resistance [30]. Hyperinsulinemia as a consequence of insulin resistance causes an increase in serum uric acid concentration by both reducing renal uric acid secretion and accumulating substrates for uric acid production [29].

The results showed no significant relationship between plasma level of plasma UA and BMI of the test group, this disagree with Tsushima *et al;* According to his report, UA secretion from adipose tissue in obese was increased. Among obese subjects, excessive fat accumulation in obesity could produce and secrete uric acid and is relatively associated with overproduction-type hyperuricemia. This may provide a possible mechanism for the relationship between BMI and plasma uric acid [31].

CONCLUSION

The means of plasma malondialehyde, plasma uric acid, fasting plasma glucose, and HbA_{1c} of the test group (diabetics) are significantly raised when compared with healthy control group, while the means of plasma copper slightly raised but there is no significant difference in Sudanese patients with type 2 diabetes mellitus when compared with healthy control subjects.

There is significant reduction of the means of the plasma levels of malondialehyde and copper of the control diabetic patients when compared with uncontrol diabetic patient, where there is insignificant differences between the means of plasma levels uric acid, FPG and HbA_{1c} between two groups.

The means of plasma levels of malondialehyde of the diabetic patients on hypoglycemic drugs are significantly raised when compared with those were not, where there is insignificant differences between the means of plasma levels uric acid, HbA_{1c} and FPG between two groups.

Significant strong positive correlation between BMI, duration of diabetes, plasma malondialehyde, and HbA_{1c}, on one hand, moderate negative correlation with plasma uric acid, and there is significant strong negative correlation between the BMI and plasma levels of FPG.

There is significant moderate positive correlation between HbA_{1c} and plasma uric acid, where there is no significant relationship between HbA_{1c} and plasma malondialehyde of the test group was reported.

There is significant strong positive correlation between the duration of disease (in years) and HbA_{1c} and, slightly significant strong positive correlation

between the duration of disease and plasma malondialehyde, on one hand, there is moderate positive correlation between duration of disease and FPG of the test group was reported.

Acknowledgement:
The authors are grateful to all patients and all who support this study.

Conflict of interest:
There was no conflict of interest

REFERENCES

1. RK Murray, D Granner, P Mayes, V Rodwell; Harper's Biochemistry (25 th International Edition) (2000) Appleton and Lange, USA.
2. Guariguata L, Whiting D, Hambleton I, Beagley J, Linnenkamp U, Shaw J; Global estimates of diabetes prevalence for 2013 and projections for 2035. *D*iabetes research and clinical practice, 2014; 103: 137-149.
3. Conen D, Wietlisbach V, Bovet P, Shamlaye C, Riesen W, Paccaud F, et al.; Prevalence of hyperuricemia and relation of serum uric acid with cardiovascular risk factors in a developing country.BMC Public Health, 2004; 4: 9.
4. Nakagawa T, Hu H, Zharikov S, Tuttle KR, Short RA, Glushakova O, et al.; A causal role for uric acid in fructose-induced metabolic syndrome. Am. J. Physiol. Renal. Physiol, 2006; 290(3): f625-631.
5. Chen LY, Zhu WH, Chen ZW, Dai HL, Ren JJ, Chen JH, et al.; Relationship between hyperuricemia and metabolic syndrome. J. Zhejiang. Univ. Sci., 2007; (8): 593-598.
6. Taysi S, Polat F, Gul M, Sari RA, Bakan E; Lipid peroxidation, some extracellular antioxidants and antioxidant enzymes in serum of patients with rheumatoid arthritis. RheumatolInt, 2002; 21: 200–204
7. American diabetes association. Diagnosis and classification of diabetes mellitus. Diabetic care, 2012; 35(1): 64-71.
8. National clinical guideline for management in primary and secondary care. Type 2 diabetes. Royal college of physicians.2002; 1: 259.
9. WHO Consultation; Definition, Diagnosis and Classification of diabetes mellitus and its complications. World health organization. Dept. of Noncommuniable disease surveillance. WHO/NCD/NCS/99.(2).1999; 1: 49
10. Wun YT, Chan CS., Lui CS; Hyperuricaemia in Type W diabetes mellitus. Diabetes Nutr. Metab. 1999; 12(4): 286-291.
11. Kodama S, Saito K, Yachi Y, Asumi M, Sugawara A, Totsuka K, et al.; Re association between serum uric acid and development of type W diabetes mellitus. A Meta-Analysis. Diabetes Care, 2009;23(9): 1737-1724.
12. Niskanen L, Laaksonen DE, Lindstrom J, Eriksson JG, Keinanen- Kiukaanniemi S, Ilanne-Parikka P, et al.; Serum uric acid as a harbinger of metabolic outcome in subjects with impaired glucosetolerance: the Finnish Diabetes Prevention Study. Diabetes Care, 2006; 29(3): 709-711.
13. MacKay N J; Scaling of human body mass with height: The body mass index revisited". Journal of Biomechanics, 2010; 43 (4): 764–6.
14. Guariguata L, Whiting DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE; Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes research and clinical practice. 2014; 103**,** 137-149.
15. Elbagir MN, Eltom MA, Elmahadi EM, Kadam IM, Berne C; A population-based study of the prevalence of diabetes and impaired glucose tolerance in adults in northern Sudan. Diabetes Care, 1996; 19(10): 1126-1128.
16. Looker HC, Knowler WC, Hanson RL; Changes in BMI and Weight Before and After the Development of Type 2Diabetes. Diabetes Care, 2001; 24: 1917-1922.
17. Shah S, Bharat, Madhav K; Effects of Aging and Ethnicity on Serum Free Prostate Specific Antigen. Asian Pacific J Cancer Prev, 2011; 12: 2509-2512.
18. Fujimoto WY, Jablonski KA, Bray GA, Kriska A, Barrett-Connor E, Haffner S, et al.; Diabetes Prevention Program Research Group. Body size and shape changes and the risk of diabetes in the diabetes prevention program. Diabetes, 2007; 56(6):1680–1685.
19. Kalaivanam KN, Dharmalingam M, Marcus SR; Lipid peroxidation in Type 2 diabetes mellitus Int J.Diab Dev Cltries, 2006; 26:30-2.
20. Srivatsan R, Sujata D, Gadde R, Krishna KM, Taduri S; Diabetic patients with and without complication. Arch of Iranian Med, 2009; 12(2):121-7.
21. Manjulata K, Pahwa M, Bala G, Veena S, Singh N; Status of Antioxidant Enzymes and Lipid Peroxidation in Type 2 Diabetes Mellitus with Micro Vascular Complications. The Open Endocrinology Journal, 2009; 3:12–5.
22. Kumara R, Ahmedb S; Antioxidant and lipid peroxidation level in type2 diabetes mellitus Int J Cur Bio Med Sci, 2011; 1(4):147-8.
23. Yazum B, Amrita G, Mingma L, Sherpa RP, Pradip KM; Serum malondialdehyde level: Surrogate stress marker in the Sikkimese diabetics. J Nat SciBiol Med., 2011; 2(1): 107–112.
24. Karatas F, KaratepeM, Baysar A; Determination of free malondialdehyde in human serum by high performance liquid chromatography. Analytical Biochemistry, 2002; 311: 76-79.

25. Benitez S, Perez A, Sanchez-Quesada JL; Electronegative low-density lipoprotein subfraction from type 2 diabetes subjects is proatherogenic and unrelated to glycemic control. Diabetes Metab Res, 2007; 23:26-34.
26. Freitas JP, Filipe PM, Rodrigo FG; Lipid perixidaion in type 2 normolipidemic diabetic patient. Diabetes Res Clin, 1997; 71-15.
27. Desai V, Shekhar R; Oxidative Stress in Diabetic Retinopathy Journal of Clinical and Diagnostic Research, 2011; 5(5): 994-997.
28. Gersch C, Palii SP, Kim KM, Angerhofer A, Johnson RJ, Henderson GN; Inactivation of nitric oxide by uric acid. Nucleosides Nucleotides Nucleic Acids, 2008; 27(8): 967-978.
29. Chien KL, Chen MF, Hsu HC, Chang WT, Su TC, Lee YT, et al.; Plasma uric acid and the risk of type W diabetes in a Chinese community. Clin. Chem, 2008; 54(2): 310-316.
30. Tsushima Y, Nishizawa H, Tochino Y, Nakatsuji H, Sekimoto R, Nagao H, Shirakura T, Kato K, Imaizumi K, Takahashi H, Tamura M, Maeda N, Funahashi T, Shimomura I. Uric acid secretion from adipose tissue and its increase in obesity. J BiolChem, 2013; 288(38): 27138–28149.
31. Corry DB, Eslami P, Yamamoto K, Nyby MD, Makino H, Tuck ML; Uric acid stimulates vascular smooth muscle cell proliferation and oxidative stress via the vascular renin-angiotensin system. J. Hypertens, 2008; 26(2): 269-275.