Original article:

Hypertriglyceridemia, hyperuricemia, and anemia among Sudanese patients with type 2 diabetes mellitus

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Abstract:

Introduction: There is an increasing awareness about the serious consequences of hypertiglyceridemia andhyperuricemia regarding cardiovascular risks and end organ damages especially among patients with diabetes mellitus.

Objectives: We aimed to assess hyperuricemia, anemia, and hypertriglyceridemia among patients with type 2 diabetes mellitus.

Subjects and Methods: A cross-sectional study was conducted among 170 patients with type 2 diabetes mellitus attending a diabetes center in Omdurman, Sudan during the period January 2016 to September 2017. A structured questionnaire was used to collect demographic data, and a fasting blood sample was taken for lipid profile, the Total white cell count, hemoglobin, erythrocyte sedimentation rate (ESR), blood urea, serum electrolytes, and serum creatinine were also measured. All the participants signed a written informed consent, and the ethical committee of Omdurman Teaching Hospital Approved the research.The Statistical Package for Social Sciences (SPSS) was used for data analysis

Results: Participants (51.8% males), 69.4% had anemia, 80% had high ESR, 34.1% had triglycerides above 150mg/dl, high total cholesterol was found in 5.9%, low density lipoprotein >100mg/dl in 31.8% and <55mg in 16.5% of patients, while hyperuricemia was evident in 15.1% of patients. No significant statistical differences were found between men and women regarding lipid profile and serum uric acid.

Conclusion: Anemia, hypertriglyceridemia, and hyperuricemia were common among patients with type 2 diabetes mellitus in Sudan which put them at a high risk of stroke and cardiovascular disease. A great effort is needed to raise the awareness about these serious disorders and their lethal consequences on the patient's health.

Keywords: Hyperuricemia, hypertriglyceridemia, anemia, type 2 diabetes, Sudan

1. Introduction:

Diabetes mellitus is the 9th primary cause of death, in the past three decades the number of people suffering from this lifelong chronic disease has quadrupled. Currently, 9.1% (about 1 in 11) of the population were affected worldwide, and the projection for the year 2030 is 438 million. In Sudan by the year 2000, half million were affected, and the number is projected to jump to one million in 2030. The prevalence is 7.1% according to the International Diabetes Federation [1-4].

Type 2 diabetes mellitus often occurs as a component of metabolic syndrome together with other cardiovascular and metabolic disorders having insulin resistance as the underlying mechanism, and hyperuricemia has been described as a component of this syndrome [5,6]. Recent evidence suggests that chronic hyperuricemia is an independent risk factor for, premature death, diabetes, hypertension, cardiovascular disease, and metabolic syndrome. Furthermore, it could be an independent risk factor for chronic kidney disease [7,8]. A recent study large study published in the United States of America(including nearly quarter million people with gout and diabetes) concluded that, gout is associated with a similar risk for incident stroke as diabetes [9].

With the increasing incidence of diabetes, obesity, and metabolic syndrome, more patients with high triglycerides will be encountered putting them at a high risk of nonalcoholic fatty liver disease, cardiovascular disease, and pancreatitis. Lifestyle modifications are recommended to reduce triglycerides below 150mg/dl to avoid these complications [10]. The American Diabetes Association urged low-density lipoprotein target of <100mg/dl in patients with type 2 diabetes mellitus, but unfortunately, these levels are not met in most patients [11] with deleterious consequences. A recent study found that treating patients with statin/TG specific combination therapy targeting both LDL and triglycerides is economically beneficial (substantial reduction in 1-year medical costs) compared with monotherapy [12].

Previous literature reported that anemia is common among patients with type 2 diabetes mellitus and could be associated with increased mortality and morbidity, and renal impairment, furthermore various types of anemia could affect the level of glycated hemoglobin and give rise to both high and low false results [13-15]. The effects of anemia on the glycated hemoglobin as a an important tool for follow-up to optimize glycemic control, the serious effects of, anemia, hyperuricemia, diabetes, and hypertriglyceridemia indicated that these disorders when coexist could lead to deleterious consequences.

Aims and objectives: To our best of knowledge, no researchers have studied hyperuricemia, hypertriglyceridemia, and anemia among patients with type 2 diabetes mellitus in Sudan. Thus we conducted this research to assess hyperuricemia, hypertriglyceridemia, and anemia among patients with type 2 diabetes.

2. Subjects &Methods

This cross-sectional study conducted at a diabetes clinic in Omdurman Teaching Hospital, Omdurman, Sudan during the period from March 2017 to September 2017. One-hundred-seventy subjects with the diagnosis of type 2 diabetes were approached. The patients were diagnosed according to the American Diabetes Association Guidelines, they were taking their medications including antihyperglycemic medications and lipid-lowering drugs, and came for routine follow-up. A structured questionnaire was used to collect the data. The sample size was calculated using the formula: $n=Z^2$ P-Q/d^2 where Z = 95% confidence (1.96), P = Prevalence of diabetes mellitus in Sudan [3]. Participants were invited to sign a written informed consent, and a blood sample was taken after a twelve-hour overnight fast. The blood sample was taken in a red top venipuncture tube without additions or gel barrier, allowed to clot, and centrifuged to separate the serum. The following investigations were done: Serum uric acid in mg/dl using URCA Siemens Healthcare Diagnostics Newark, DE 19714, USA, the colorimetric enzyme assay

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was used to measure total cholesterol and triglycerides (mg/dl). Low-density lipoproteins were calculated according to Edward formula: LDL= total cholesterol – TG /5 – HDL. Erythrocyte sedimentation rate, blood urea (mg/dl), sodium, and potassium were also measured. Serum creatinine (mg/dl) was estimated using CREA Healthcare Diagnostics Newark, DE 19714 USA based on the idea that in the presence of NaOH, pictate reacts with creatinine to form a red chromophore measurable by bichromatic (510e600). A blood count was done for hemoglobin, and total white blood cells.

For the purpose of this research, the following cut-off were used:

- Lipid profile:

Serum cholesterol: <200mg/dl

Triglycerides: <150mg/dl

LDL targets: 55mg/dl-100mg/dl

HDL: >40mg/dl for men and >50mg/dl for women [16].

- Serum uric acid:

<5.5mg/dl for females and <6mg/dl for males [17,18].

- Anemia <11.5g/dl in females and <13.5g/l in males

The ethical committee of Omdurman Teaching Hospital approved the research, and the Statistical Package for Social Sciences (SPSS, version 20, New York) was used for data analysis. The chi-square test and one-way sample t-test were used to compare categorical and non-categorical data. The data were presented as percentages and mean± SD, a P-value <0.05 was considered significant.

3. Observations &Results:

Out of the 170 patients with type 2 diabetes mellitus, 58.1 were men, age mean± SD (59.62±9.91), the majority had anemia (69.4%), 15.3 had hyperuricemia, hypokalemia was found in 2.3%, hyponatremia in1.2%, while 80% of patients had high erythrocyte sedimentation rate (80%). It is interesting to note that nearly one-third of patients (31.8%) had their low-density lipoproteins above the target recommended by the American Diabetes Association, and 16.5% were above the safe lower level of LDL. The current data showed hypertriglyceridemia in 15.3%, borderline triglycerides in 18.8%, and high cholesterol level in 5.9% of patients with type 2 diabetes. Table 1.

In the present study, the mean serum uric acid was (4.76±1.56mg/dl), ESR was (42.07±29.51), the blood urea (34.15±10.39mg/dl), serum creatinine was (0.86±0.26mg/dl), the mean serum sodium was (138.54±2.34mmol/l), potassium was (3.74±0.15mmol/l), and hemoglobin was (11.76±2.21gm/l). The current study showed that the total cholesterol was (164.12±47.89mg/dl, LDL was (94.60±41.70mg/dl), HDL was (39.75±12.06), and triglycerides were (140.77±73.90mg/dl). Table 2.

Table 3, depicted a comparison between men and women patients with type 2 diabetes in which: No significant statistical differences were evident regarding total cholesterol (163.49±47.89 vs. 164.82±48.52, P-value=0.901), triglycerides (150.19±83.06 vs. 130.38±61.69, P-value=0.228), and LDL (93.72±42.22 vs. 95.58±41.65, P-value=0.841).

Tabled 5, showed that anemia was commoner among females with a highly significant statistical difference (88.6% vs. 45.5%, P-value=0.000). No significant statistical differences were found between

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women and men regarding hyperuricemia (13.6% vs. 12.5%, P-value=0.887) and hypertriglyceridemia (41.9% vs. 35.9%, P-value=0. 580).

Table 1. The laboratory results of patients with type 2 diabetes (percentage)

Character	%
Sex	
Males (n=88)	51.8%
Females (n=82)	48.2%
Anemia	69.4%
High uric acid	15.3%
Hypokalemia	2.3%
Hyponatremia	1.2%
High ESR	80%
High total cholesterol (>200mg)	5.9%
High triglycerides (>200mg/dl)	15.3%
Borderline≥150mg/dl	18.8%
LDL	
>100mg/dl	31.8%
<55mg/dl	16.5%

Table 2. The laboratory results of patients with type 2 diabetes (Mean± SD)

Character	Minimum	Maximum	Mean± SD
Serum uric acid	1.8	9.0	4.76±1.56
ESR	1.0	120	42.07±29.51
Urea	14	60	34.15±10.39
Creatinine	0.4	1.5	0.86±0.26
Sodium	126	149	138.54±2.34
Potassium	3.4	4.1	3.74±0.15
Cholesterol	76	356	164.12±47.89
Triglycerides	50	538	140.77±73.90
LDL	29	218	94.60±41.70
HDL	27	62	39.75±10.06
Hemoglobin	8.1	18.30	11.76±2.21

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*Table 3. A comparison between women and men regarding lipid (Mean± SD)

Character	Males	Females	P-value
Cholesterol	163.49±47.89	164.82±48.52	0.901
Triglycerides	150.19±83.06	130.38±61.69	0.228
LDL	93.72±42.22	95.58±41.65	0.841

*T-test

*Table 4. A comparison between males and females regarding anemia

Character%	Males	Females	P-value	95% CI
Anemia	45.5%	88.6%	<0.001	
Serum uric acid	13.6%	12.5%	0.877	1.105
Hypertriglyceridemia	41.9%	35.9%	0.580	1.286

*Chi-square test

4. Discussion:

Previous literature showed that long-term control of asymptomatic hyperuricemia in patients with type 2 diabetes mellitus is effective in reducing creatinine, albumin excretion rate, increased the glomerular excretion rate and could improve renal function [19]. The current data showed hyperuricemia in 15.3% of the study sample; our result is lower than a study conducted in sub-Saharan Africa (38.1%) [20]. The earlier detection and treatment of hyperuricemia is highly needed to improve kidney function and avoid deterioration. Further randomized trial indicated that control of asymptomatic hyperuricemia among patients with type 2 diabetes mellitus might decrease the serum levels of hs-CRP, improve insulin resistance, reduce the carotid intimal thickness, and may delay the development of atherosclerosis [21]. In the present study, 80% had high ESR (a marker of inflammation). Physicians and those in care of type 2 diabetes may need to treat asymptomatic hyperuricemia to reduce macrovascular complications. Furthermore, recent studies showed hyperuricemia is an independent risk factor for type 2 diabetes and hypertension [22], associated with the metabolic syndrome [23], and cardiac conduction defects [24]. In the current study, more than one-third of the study sample had triglycerides > 150mg/dl, the present findings are similar to a survey conducted in China [25] and found hypertriglyceridemia in 31.9% of patients with type 2 diabetes. Inadequate control of high triglycerides is associated with cardiovascular risk, pancreatitis, and macular edema [26]. There is an increasing effort to stop focusing on specific goal targets and looking to the broader aspects of dyslipidemia rather than targeting LDL. There is a growing awareness of the Non-high density lipoprotein targets as a critical ignored aspect in the management of dyslipidemia and now included in some guidelines. Most patients are aware of cholesterol as bad and increasing the cardiovascular risk, but unfortunately, they are unaware of the deleterious consequences of high triglycerides, the matter is further complicated by the unfeasibility of obtaining a fasting sample for the estimation of TG level according to the current standard of care [27]. It is interesting to note that, recent studies indicated that nonfasting triglyceride level may be a more accurate indicator of cardiovascular risk and may be adequate for diagnosis [28]. In the present study, 31.8% had LDL higher than 100mg/dl recommended for most patients with diabetes [4] and further16.5% had levels <55mg/dl recommended by the American Heart Association/American

College of Cardiology, the current findings are in similarity to a study conducted in Saudi Arabia [29] and found a suboptimal adherence to LDL-C targets (58.5%). In spite of the beneficial effects of statins remain to levels as lower as 10mg/dl for LDL-C, it is not recommended due to lack of safety data.

The current data reported anemia in 69.4% (even after reducing the cut-off to <11gm/l for women and 13gm/l for men [30], the figure stands at 65.8%) of the study sample, in addition to the well-known serious consequences of low hemoglobin, the high rate of anemia could compromise the efficacy of the glycated hemoglobin as a measure of glycemic control [4]. The present finding indicated that the glycated hemoglobin as a diagnostic and follow-up tool may be compromised by the low hemoglobin shown in our sample, a recent study concluded in Mexico concluded the discrepancy between the glycated hemoglobin and oral glucose test [31]. The current findings call for more researches to assess the effects of anemia on HbA1c in Sudan. In the current study, anemia was commoner among females, while no significant differences was observed between men and women regarding hyperuricemia and hypertriglyceridemia, in contrast to Yu et al. [32] who found higher rates of hyperuricemia among males. In contradiction to the present findings, Karpov et al. [33] found a higher rate of hypertriglyceridemia among males, a plausible explanation could be the age among females in the present finding because both high serum uric acid and triglycerided are higher among females 60-69 years old. The study limitations were the small size of the sample, and the study was conducted at a single diabetes outpatient clinic, so generalization cannot be insured.

5.Conclusion: The majority of patients with type 2 diabetes had anemia, more than one third had inadequate control of triglycerides and a considerable number of undiagnosed hyperuricemia. Physicians may need to screen for the mentioned serious diseases for the proper management to prevent the serious complications. Raising the awareness of both the treating doctors and the whole community about the deleterious consequences of hypertriglyceridemia, hyperuricemia, and anemia is highly needed. A more deep insight for dyslipidemia including the non-HDL, and triglycerides as targets is of paramount importance.

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