Correlation of Glycated Hemoglobin (Hba1c) and Serum Uric Acid in Type-2 Diabetic Patients

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Abstract

Type -2 diabetes mellitus (DM) is a metabolic disorder identified as chronic hyperglycemia with disturbance of carbohydrate, protein and fat caused by defects in insulin action and/or secretion. This study was designed to determine the relationship between glycated hemoglobin (HbA1c) and serum uric acid (SUA) for type-2 diabetic patients. the study was performed on forty-eight patients (58 ± 14 years old) and thirty-nine healthy individuals matched the sex, and age with patients (control group). Fasting blood samples were collected from both groups. Fasting blood sugar (FBS), SUA concentration, HbA1c level, total protein (TP), cholesterol, and triglyceride (TG) were measured and investigated. The obtained results showed that there is a significant positive correlation (r= +0.103, p= 0.04) between HbA1c and SUA for patients group. As well as significant positive correlations with FBS (r= + 0.410), TG (r= +0.305), TP (r=+0.322), and cholesterol (r=+0.23). Comparison study was also performed between patients and healthy subjects and the results showed a significant elevation for SUA, TG, cholesterol, TP, FSB, and HbA1c for the patients in type-2 diabetes compared with healthy subjects. The current study confirms serum uric acid level acts as a biomarker of blood glucose and has an adverse effect on glycemic control in type-2 diabetic patients.

Keywords: *Type-2 diabetes, Serum Uric acid, HbA1c.*

Introduction

Diabetes mellitus (DM) considered as a widespread global disease. conferring to recent reports, about 171 million persons in the world with DM in the year 2000 and this number expected to increase to 366 million through 2030 [1,2]. This disease is correlated with reducing life expectancy and significant other illnesses due to its relationship with microvascular complications (ischaemic heart disease, stroke and peripheral vascular disease), as a result led to lessen life quality [1].

Glycated hemoglobin (HbA1c) represents the blood glucose average level within the past 3 months. Therefore, HbA1c is a very important biochemical parameter that provide long term status of blood glucose levels and monitoring tool for measuring glycemic control in Type – 2 diabetic patients [3]. HbA1c in general, developed when the hemoglobin joined with glucose in the blood and become glycated [4]. According to many studies, HbA1c levels could be used as an independent risk factor for stroke and Cardiovascular disease (CVD) in both healthy and diabetics persons. It has been found that a (0.2%) decrease of HbA1c level can lower the risk of CVD development by 10% [5]. Furthermore, many studies have revealed, newborns moms with high HbA1c levels are more likely suffering from development of CVD in the future [6]. Serum uric acid may be considered also as indicator for glycometabolic disorder due to its relationship with metabolism of glucose [7]. It is well known that uric acid is the final breakdown products of purin metabolism [8]. Elevated uric acid concentration can cause a cardiovascular disease [9]. Facchini et al showed when urinary uric acid execration decrease (which is proportional to increase in insulin resistance) lead to rise in serum uric acid concentration [10]. Different reports have suggested that uric acid might be involved in the atherosclerotic development and its clinical problems. When uric acid concentrations elevated can act as a prooxidant and thus could be an oxidative stress marker, however it might have also worked as an antioxidant

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[7,8]. Based on above information, this study is focused on finding the possibility of any correlation between glycated hemoglobin and serum uric acid, as well as to compare other important biochemical parameters between health and patient groups.

Materials and Method

This study was conducted on 48 patients (22 females and 26 males) diagnosed with type-2 diabetes their age ranged from (38-74) years old (mean of 58 ± 14 years), and 39 healthy individuals (20 females and 19 males) randomly were selected with the same age as type-2 diabetic patients (Control Group). Blood samples were collected from the private clinic in northern Hilla (Babylon province) during the time from June to November 2018. Subjects who had any history of renal, cardiovascular, stroke or any history that may be effect their serum uric acid concentration were excluded. A complete history for each individual was recorded before any clinical test was performed including name, sex, age, duration of diabetes, diet and drugs, weight, and height. About 6 ml fasting venous blood specimens were gathered from both patients and healthy groups. 2 ml were transferred into anticoagulant EDTA container for estimating HbA1c, and the rest were subjected for centrifugation. After that, serum was separated which then used for assess other biochemical parameters. Fasting blood sugar (FBS), HbA1c, Serum uric acid, Triglyceride (Tg), cholesterol (CHO), and total protein (TP) were all measured for both control and patient groups by the enzymatic colorimetric methods using oxidase for FBS [11], Uricase for serum uric acid [12], Biuret method for TP [13], glycerol phosphate oxidase for Tg, and cholesterol oxidase-phenol 4-aminoantipyrine peroxidase for Cholesterol. HbA1c was measured using the instruction guidance of (PARAMEDICAL Kit, Italy).

Statistical Analysis

SPSS version 23.0 was used for data analysis. Pearson's correlation test was achieved to observe the correlations between the interest of the study. For comparing the means among different biochemical parameters, independent sample t-test (2-tailed) was used. All the results are stated as mean ± standard deviation of mean. It was considered statistically significant when $P \leq 0.05$.

Results and Discussions

Glycated HbA1c is commonly used as a clinical indicator for glycemic control. It is an easy assessment of mean level of glucose for the past 2-3 months and it is used as a tool to recognize people with undiagnosed type-2 DM or who are at risk of it. SUA is identified as a possible risk factor for many cardiovascular diseases, hypertension, and stroke [14]. Researcher reported that a 59.5umol, increase in SUA cause in a 60% increase in developing of type-2 DM [15].

This study was focused on evaluation of HbA1c, serum uric acid levels and other important biochemical aspects for type-2 diabetic patients and comparing their results with healthy individuals (control). Moreover, finding the correlation between HbA1c and serum uric acid, as well as age with all measured parameters. The study was setup up in patients group had mean age 58 ± 14 and healthy individuals (control) age 55 ± 11. Gender and age distribution for both groups were shown in table 1. Other descriptive physical characteristics were presented in table 2. In this study, the distribution of type -2 patients by the gender and HbA1c data demonstrated that most of them undergoing poor glycemic control irrespective to their gender as shown in Table 3.

Based on obtained records there is no significant differences in the weight and IBM for patients and healthy individuals.

Table 1: Gender-wise and Age distribution of patients and control groups

Parameters	Patients	Healthy (Controls)
Number of Subjects	48	39
Age (years) Mean ± SD	58 ± 14	55 ± 11
Gender		
Male	22 (45.8%)	19 (48.7%)
Female	26 (54.1%)	20 (51.2%)

Table 2: Physical characteristics for patients and control groups

Physical characteristics	Patients	Control
Height (cm)	160.3 ± 22	158 ± 18
Weight (kg)	82 ± 17	79 ± 8
B.M.I (Kg/m^2)	32 ± 1.8	31 ± 4.2

According to the observed outcomes, FBS of patients was 175.5 ± 30.08 (mg/dL) which is significantly higher than control group their mean 74.17 ± 13.76 (mg/dL) (P< 0.01). Concerning to glycated hemoglobin HbA1c, patients with type-2 diabetes had significantly higher mean value 8.852 ± 0.5803 compared to 5.16 ± 0.5049 of control group (P< 0.01). This outcome consists with several studies [16,3,4]. In diabetic patients group, total protein results were shown significantly elevating (6.15 ± 0.98) in comparison to control group (4.31 ± 0.73). This results is an agreement with [17,18]. Elevating in concentration of total protein may be because the elevation of acute phase proteins (like globulins, fibtingen, and compounded) by decrease in the rate of fractional synthetic of albumin due to insulin deficiency or resistance [17]. Similarly, the serum uric acid for diabetic type-2 patients is significantly higher in comparison with healthy group 7.95 ± 0.87 and 5.98 ± 0.715 respectively. This finding is similar to earlier reported studies [19] in which hyperuricemia has been correlated with the greater risk for the development of impaired glucose tolerance and type-2 DM [20]. Cholesterol and TG both showed significantly higher value for diabetic patients (202.75 ± 22.2, 190.63 ± 22.7) comparing to control group (142.67± 27.1, 124.67 ± 18.2) respectively which is consists with several studies [2, 21, 22]. Data comparison is showing in Table 3.

Table 3: Different measuring of biochemical parameters in patients and healthy groups.

Parameter	(Health) control n=39	(patient) n=48
Uric acid mg/dl	5.98 ± 0.715	7.95 ± 0.87
TG mg/dl	124.67 ± 18.2	190.63 ± 22.7
Cholesterol mg/dl	142.67± 27.1	202.75 ± 18.2
Total protein mg/dl	4.31 ± 0.73	6.15 ± 0.98
FSB mg/dl	74.17 ± 13.76	175.5 ± 30.08
HbA1c%	5.16 ± 0.5049	8.852 ± 0.5803

P ≤ 0.05

The correlation of HbA1c with serum uric acid was positive (r = +0.103, p = 0.042) (Table 4) and statically significant. This agree with several reported studies [14,19]. Based on that, the obtained results propose the adverse effect of elevated SUA for glycemic control. Other reporters suggest that there is a possible mechanism for the relationship between elevated SUA and HbA1c in DM patients could be linked to the defect of reabsorption of uric acid in the proximal tubal in diabetic individuals with high glucose levels [19]. Positive correlation statically significant was observed between HbA1c and FBS (r = +0.410, p=0.025). This finding is an agreement with many reported studies [19, 23]. HbA1c also showed strong and direct positive correlation with total protein (r = +0.322, p= 0.01). This hypothesis is consistent with earlier findings [24-26]. Furthermore, HbA1c demonstrated significantly positive correlation with TG, and cholesterol (r = +0.305, p= 0.051), (r = +0.23, p = 0.031) respectively. Several studies have demonstrated a significant positive correlation between HbA1c and lipid profile parameters (triglyceride, and cholesterol) and they proposed the vital rule of glycemic control in normalizing dyslipidemia [23]. correlation data is showing in Table 4. Additional correlation study was made between age of patients and all above biochemical parameters and the results demonstrated no significant correlation between them.

Table 4: Correlation of HbA1c with different biochemical blood parameters

Parameters	Correlation coefficient (r)	P-value
Uric acid	+0.103	0.042
FBS	+0.410	0.025
TG	+0.305	0.051
Total protein	+ 0.322	0.01
Cholesterol	+ 0.23	0.031

NS, Non-significant

Further comparison investigation was done between male and female diabetic patients; the results indicates no significant differences except for SUA and HbA1c, where uric acid is significantly higher in female compared with male for patients in type-2 DM, while for HbA1c the result showed that the male patients had significantly higher level compared with female patients as shown in table 5.

Table 5: (Patient) male vs female

Parameter	Male n = 22	Female n= 26
Uric acid mg/dl	6.25 ± 0.97	8.67 ± 1.36
TG mg/dl	192.63 ± 22.7	189.00 ± 34.76
Cholesterol mg/dL	202.75 ± 22.2	189.83 ± 21.22
Total protein mg/dl	6.25 ± 0.98	5.93 ± 1.506
GLU	188.5 ± 23.08	159.19± 18.23
HbA1c	8.852 ± 0.5803	7.18 ± 1.01

$P \leq 0.05$

Conclusion

SUA has an adverse impact on glycemic control since there is a positive correlation with HbA1c. In addition, SUA concentrations significantly higher in type-2 DM patients in compassion with healthy subjects.

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both environmental and health and higher education and scientific research ministries in Iraq

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