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Original Research Article

Assessment of Plasma Levels of Urea Nitrogen, Creatinine and Albumin among Sudanese Patients with Type 2 Diabetes Mellitus

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ABSTRACT

Objective: to assess plasma levels of urea nitrogen, creatinine and albumin in Sudanese patients with Type 2 Diabetes Mellitus in comparison with healthy Sudanese volunteers.
Methods: A total of 100 patients with type 2 diabetes mellitus and 50 age and gender matched healthy controls were included in this study. Blood specimens were collected from both groups, and Biosystem spectrophotometeric methods were used for measurement of the plasma levels of urea nitrogen, creatinine, albumin, fasting glucose and glycated hemoglobin. Statistical Package for Social Science (SPSS version 16) computer software was used for data analysis.
Results: urea and creatinine were significantly elevated with significant positive correlation with each of body mass indexes, duration of diabetes, and glycated hemoglobin. Albumin was significantly reduced with significant negative correlation with duration of diabetes, body mass indexes, and glycated hemoglobin. There was significant strong positive correlation between fasting blood glucose and glycated hemoglobin.
Conclusion: plasma levels of urea, creatinine, and albumin can be used as prognostic markers and predictors of renal failure in diabetic patients especially those with complications such as hypertension and ischemic heart disease.
Key Words: Type 2 Diabetes Mellitus; Urea Nitrogen; Creatinine; Albumin.

INTRODUCTION

Diabetes mellitus (DM) is a group of disorders of carbohydrate metabolism in which glucose is underutilized producing hyper glycemia.[1,2] The prevalence of type 2 DM has been increasing significantly in all countries during the last century and estimated 285 million people. This number is expected to hit 438 million by the year 2030.[2]

As DM is usually a long-standing disorder, complications are common. These complications include blindness, renal failure, nerve damage, and atherosclerosis.

[3,4] Epidemiological studies and clinical trials strongly support the notion that hyperglycemia is the principal cause of diabetic complications. Thus, effective blood glucose control is the key for preventing or reversing complications and improving the quality of life for patients with diabetes.[4,5]

Renal insufficiency or failure is a serious complication of type 2 DM. It is usually due to reduction in blood flow to the kidneys caused by renal artery stenosis.[6,7] Patients known to have diabetes mellitus and diagnosed with coronary artery disease or peripheral artery disease are at greater risk for renal insufficiency.[8] The serum creatinine level increases as kidney damage gets worse.[9] Very high level of blood urea nitrogen (BUN) accompanied by renal failure (uremia) is fatal if not treated by dialysis.[10] Albumin (when ionized in water at pH 7.4, as found in the body) is negatively charged. The glomerular basement membrane is also negatively charged in the body; some studies suggest that this prevents the filtration of albumin in the urine. That charge, according to this theory, plays a major role in the selective exclusion of albumin from the glomerular filtrate. A defect in this property results in glomerular damage and nephrotic syndrome, leading to albumin loss in the urine.[11]

MATERIALS AND METHODS

This was a quantitative, descriptive, analytic, cross- sectional and hospital-based study conducted at Jabir-Abulizz Khartoum Diabetes Centre during the period between February and May 2012. A total of 100 patients with type 2 diabetes (57 males and 43 females) and 50 healthy age and sex matched volunteers as a control group (29 males and 21 females) were enrolled in this study. Thirty three patients were with hypertension (HTN), 15 had ischemic heart disease (IHD), and 29 were obese according to body mass index (BMI>30Kg/m^2). Patients with type 1 diabetes mellitus and those with thyroid disease or renal failure were excluded from this study.

About 6 ml of venous blood was obtained from each participant and put into three containers, one with fluoride oxalate anticoagulant for fasting blood glucose (FBG), one with EDTA for glycated hemoglobin (HbA1c), and one plain container for separation of plasma to measure BUN, creatinine and albumin (the plasma separated in plain container was kept at 20° C until used). Colorimetric methods were used for measuring glucose, urea, creatinine, and albumin.[12] HbA_{1C} was measured by using chromatographic spectrophotometric ion exchange method.[13] The precision and accuracy of all methods used in this study were checked each time a batch was analyzed by including commercially prepared control sera. Statistical Package for Social Science (SPSS version 11.5) computer software was used for data analysis. Levels of significance were set at $P \leq 0.05$.

RESULTS

Plasma levels of BUN and creatinine were significantly raised in patients with type 2 DM either with or without ischemic heart disease and/or hypertension; whereas albumin was significantly reduced in these patients (tables 1, 2, and 3).

Table (1): Means of plasma levels of BUN, creatinine, and albumin of both test and control groups.

Variable	Test group n=100	Control group n=50	P value
BUN (mg/dL)	17.25 ± 4.41 (8.4 – 25.4)	14.62 ± 3.17 (8.5 – 20.7)	0.009
Plasma Creatinine (mg/dL)	1.01 ± 0.33 (0.6 – 1.5)	0.74 ± 0.26 (0.5 – 1.0)	0.001
Plasma Albumin (g/dL)	4.38 ±1.04 (2.4 – 6.4)	4.83 ± 0.47 (4.0 – 5.5)	0.027

Table (2): Means of plasma levels of BUN, creatinine and albumin of Diabetic Patients with or without ischemic heart disease.

Variable	Patients with IHD (n=15)	Patients without IHD (n=85)	P value
BUN (mg/dL)	22.01 ± 1.55	16.47 ± 4.19	0.006
Plasma Creatinine (mg/dL)	1.37 ± 0.42	1.02 ± 0.34	0.001
Plasma Albumin (g/dL)	3.22 ± 0.47	4.54 ± 0.89	0.000

Table (3): Means of plasma levels of BUN, creatinine and albumin of DM patients with or without hypertension.

Variable	Patients with HTN (n=34)	Patients without HTN (n=66)	P value
BUN (mg/dL)	22.44 ± 1.63	14.61 ± 2.54	0.004
Plasma Creatinine (mg/dL)	1.44 ± 0.12	0.92 ± 0.29	0.002
Plasma Albumin (g/dL)	3.48 ± 0.47	4.79 ± 0.85	0.000

- Tables show the mean ± SD deviation and probability (P value)
- t-test was used for comparison
- P-value ≤ 0.05 is considered significant.

Plasma levels of BUN and creatinine showed significant positive correlation with duration in years of type 2 DM (figures 1 and 2), HbA1c (figures 4 and 5), and BMI (figures 7 and 8); whereas albumin showed significant moderate reverse correlation with these parameters (figures 3, 6, and 9).

There was significant moderate positive correlation between FBG and HbA_{1C} (figure 10).

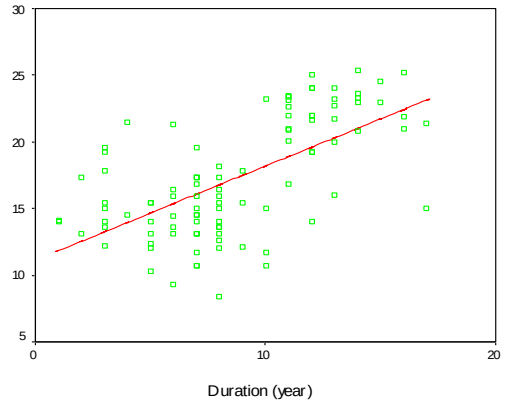

Fig.1: A scatter plot shows the relationship between the duration of diabetes (year) and plasma levels of urea nitrogen (mg/dL) (r=0.63, P=0.000).

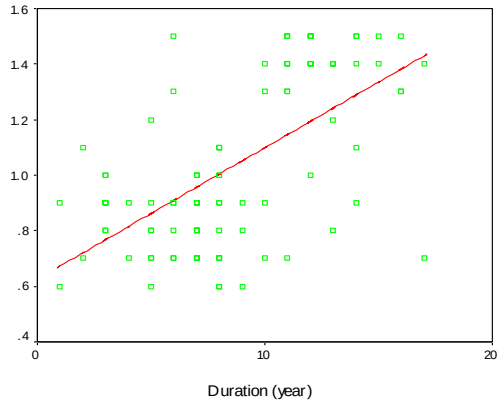

Fig.2. A scatter plot shows the relationship between the duration of diabetes (year)and plasma level of creatinine (mg/Dl) (r=0.68, P=0.000).

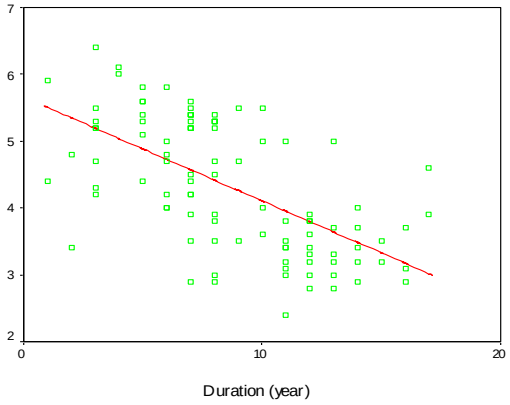

Fig.3. A scatter plot shows the relationship between the duration of diabetes (year) and plasma levels of albumin (g/dL) (r= - 0.62, P=0.000).

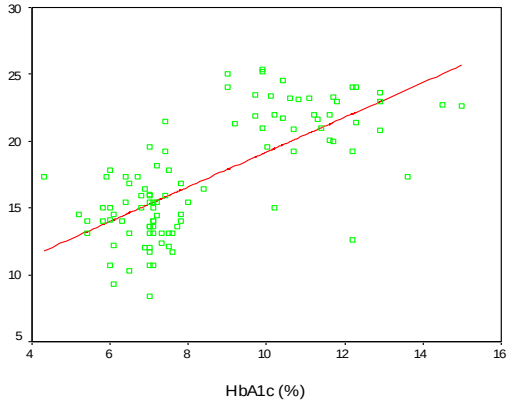

Fig.4. A scatter plot shows the relationship between the HbA_{1C} (%) and plasma levels of urea nitrogen (mg/dL) (r=0.71, P=0.000).

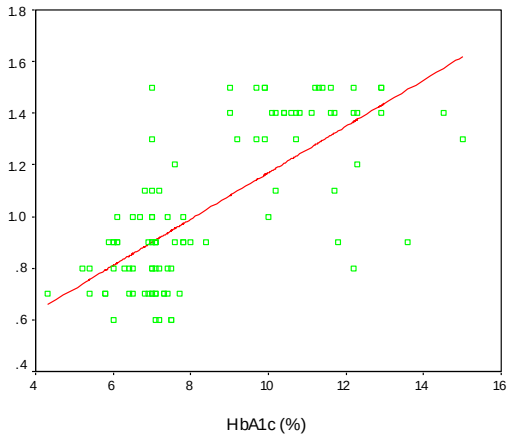

Fig.5. A scatter plot shows the relationship between the HbA_{1C} (%) and plasma levels of creatinine (mg/dL) (r=0.72, P=0.000).

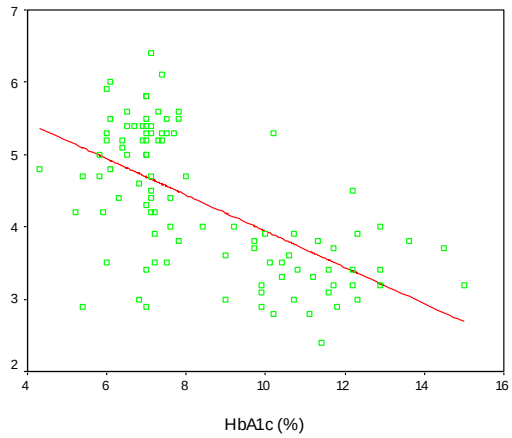

Fig.6. A scatter plot shows the relationship between the HbA_{1C} (%)and plasma levels of albumin (g/dL) (r= - 0.61, P=0.000).

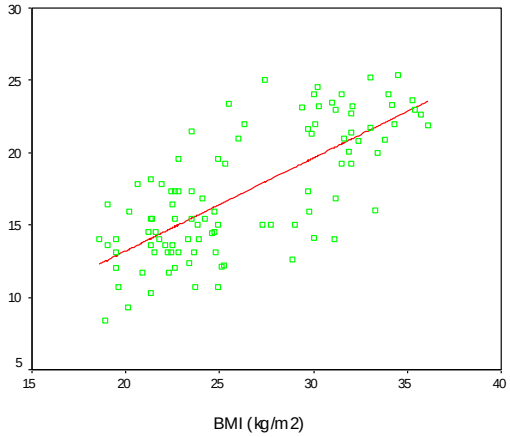

Fig.7. A scatter plot shows the relationship between the BMI (Kg/m^2) and plasma levels of urea nitrogen (mg/dL) (r=0.73, P=0.000).

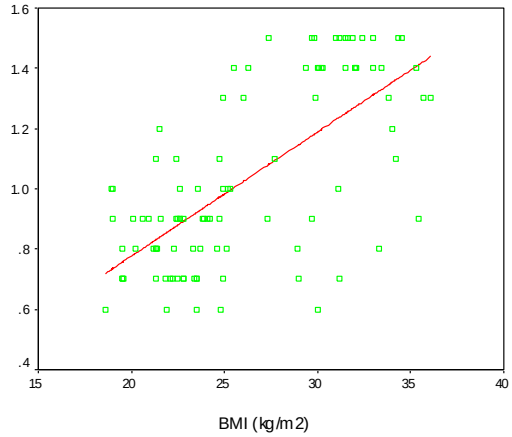

Fig.8. A scatter plot shows the relationship between the BMI (kg/m^2) and plasma levels of creatinine (mg/dL) (r=0.73, P=0.000).

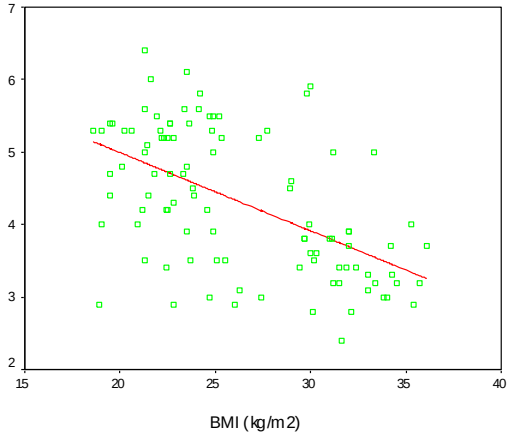

Fig.9. A scatter plot shows the relationship between the BMI (Kg/m^2) and plasma levels of albumin (g/dL) (r= - 0.55, P=0.000).

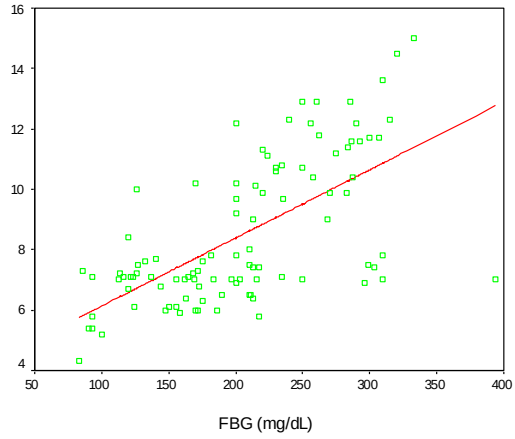

Fig.10. A scatter plot shows the relationship between the FBG (mg/dL) and HbA_{1C} (%) (r=0.64, P=0.000).

DISCUSSION

Results of this study are in agreement with several other studies. Remuzzi G et al [14] reported significant elevation of the plasma levels of BUN (mg/dL) in diabetic patients compared with non- diabetic controls(P=0.037). Alberti KG and Zimmet PZ [15] found an elevation in BUN (mg/dL) of diabetic patients with acute ischemic heart disease compared with those without ischemic heart disease (P =0.002). Wilmer WA et al [16] reported significant elevations in BUN (mg/dL) in diabetic patients with hypertension when compared to non –hypertensive diabetic patients (p=0.006).

Luepker RV et al [17] found significant elevations of the mean of plasma levels of creatinine in diabetic patients when compared with non diabetics (p=0.046). Antman EM et al [18] reported high and significant plasma levels of creatinine in diabetic patients with ischemic heart disease (P=0.010). Wilmer WA et al [16] reported that the means of the plasma levels of creatinine were significantly increased in hypertensive diabetic patients (p=0.021).

Adler AI et al [19] found significant correlation between the BMI and duration of DM with the plasma levels of creatinine (r=0.73).

Mattix H et al [20] found a significant difference in the plasma levels of albumin (mg/dL) in diabetic patients when compared to non –diabetics (p=0.036). Coresh J et al [21] reported reduction of the mean of the plasma levels of albumin (mg/dL) in diabetic patients with ischemic heart disease when compared to those without ischemic heart disease (p=0.014). Wilmer WA et al [16] found significant decrease in the mean of the plasma levels of albumin (mg/dL) in diabetic patients with hypertension when compared with those not hypertensive (p=0.017).

In the current study, there was a significant moderate reveres correlation between duration of type 2diabetes mellitus and the plasma levels of albumin (mg/dL) (r=-0.62, p=0.000),but Warram et al [22] found significant weak positive correlation between the duration of disease and the plasma levels of albumin (mg/dL) (r=0.36). Luepker RV et al [17] found significant positive correlation between FBG (mg/dL) and the plasma levels of HbA_1c (r=0.63).

CONCLUSION

Plasma levels of BUN, creatinine, and albumin in type 2 diabetic patients can be considered as important prognostic markers for evaluation of renal disease, especially in those with complications such as hypertension or ischemic heart disease.

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