

Study of Some Biochemical Parameters in Patients with Type 2 Diabetes Mellitus as an Early Detection of Diabetic Nephropathy in Al-Ramadi City

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ABSTRACT:

Background: Diabetes is a persistent medical disease that is rapidly spreading globally, and one of its most severe outcomes is diabetic nephropathy. Various markers may be used to detect renal disease at an early stage, which, if not treated, progresses to kidney failure, and often leads to death.

Aim of study: The present research aims to detect early signs of diabetic nephropathy by comparing renal function decline in patients with type 2 diabetes mellitus to that of healthy individuals without diabetes in Al-Ramadi City.

Materials: This research included a total of 80 blood samples, which were categorized into two distinct groups. Fifty samples were obtained from patients diagnosed with Type 2 Diabetes Mellitus (T2DM) who were recruited from a private clinic, while the remaining thirty samples were collected from individuals who were deemed to be in good condition and served as normal healthy controls. All participants had comprehensive history collection, meticulous clinical examination, and standard laboratory tests, which included fasting blood sugar, hemoglobin A1c, urea, and creatinine.

Results: The fasting blood sugar and HbA1c levels in the blood, as well as the levels of urea and creatinine in the serum, exhibited a substantial rise ($P < 0.001$) in patients with type II diabetes mellitus compared to the control group.

Conclusion: The diagnosis of renal failure arising from complications of T2DM might rely on examinations of FBS, HbA1C, Urea, and Creatinine as reliable prognostic indications.

Keywords: T2DM, FBS, HbA1C, Urea, Creatinine, and Diabetic nephropathy.



1. INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a complex disease with several causes, marked by high blood sugar levels due to insufficient insulin activity, insulin production, or both. A pancreas that is functioning properly to transfer glucose into cells produces a suitable amount of insulin. An ineffective pancreas produces little to no insulin, or the body cells may not react to the insulin that is generated. Consequently, blood glucose levels rise, it accumulates, and diabetes mellitus develops. It is estimated that the global population with diabetes mellitus will reach around 439 million by 2030 [1]. Data provided by the World Health Organization (WHO) indicated the presence of many forms of Diabetes Mellitus. Type 2 diabetes mellitus (T2DM) has the largest prevalence rate, accounting for 90–95% of all cases. Approximately 80% of T2DM patients reside in low- or middle-income nations, and their age typically falls between the range of 40 and 59 years [2]. Chronic diabetes is associated with the impairment, malfunction, and deterioration of several organs, including the blood vessels, kidneys, eyes, nerves, feet, and heart [3]. Diabetic nephropathy (DN) is a common consequence of diabetes mellitus, impacting around 30% of individuals with diabetes. It is a primary contributor to the development of end-stage renal disease. Evaluating a patient's renal function serves two distinct purposes: diagnosing compromised renal function and identifying the existence of progressive renal function decline [4]. Diabetic nephropathy, a kind of

microvascular complication, is a kidney condition that arises because of diabetes mellitus. This condition is a kidney dysfunction that is defined by a reduction in the glomerular filtration rate (GFR) and a subsequent rise in levels of urea and creatinine [5]. Nephrotic syndrome (NS) is a renal illness characterized by both impaired kidney function and significant loss of protein, particularly albumin. Albumin is a protein produced by the body and retained in the blood [6].

The goal of the current study was to identify kidney function impairment in type 2 diabetes patients in Al-Ramadi City by comparing them to healthy, non-diabetic control volunteers to detect early signs of diabetic nephropathy.

2. PATIENTS AND METHODS:

2.1 Study design

This investigation was conducted in Al-Ramadi City's private labs. Case-control research was conducted on 50 individuals diagnosed with Type 2 diabetes mellitus, including a patient group consisting of 27 females and 23 males and a control group of 30 non-diabetics, comprising 18 females and 12 men. The participants' ages ranged from 33 to 72 years. The mean age of the control group was matched to the mean age of diabetes patients. The research was carried out between February 2023 and May 2023. Expert doctors have seen them and made a diagnosis.

2.2 Blood samples collection

Each participant underwent a peripheral vein puncture to obtain a blood sample of about six millilitres. The blood sample was divided into two components. For the first step, a volume of 5 millilitres of blood was added to a gel tube and allowed to coagulate at a temperature of 37 degrees Celsius for about 15 minutes. Following this, the tube was subjected to centrifugation at a speed of 3000 times the force of gravity for a duration of 10 to 15 minutes. The collected sera were separated and kept at a temperature of -20°C for the assessment of various parameters. Part two consisted of a tube containing one millilitre of blood that was mixed with EDTA. This tube was used for measuring HbA1c levels and fasting blood glucose.

Using the GOD-POD (Glucose oxidase (GOD) oxidizes the specific substrate β -D- glucose to gluconic acid and hydrogen peroxide (H₂O₂) is liberated. Peroxidase (POD) enzyme acts on hydrogen peroxide to liberate nascent oxygen (O₂), then nascent oxygen couples with 4- aminoantipyrine and phenol to form red quinoneimine dye)approach, blood sugar levels were estimated [7, 8]. The Cobas Integra (Roche) fully automated analyser was used to measure creatinine using the modified Jaffe's technique [8,9] and urea using the Urease-Berthelot's method [9,10]. Fasting blood sugar levels should be 70–110 mg/dl, postprandial blood sugar levels should be 110–140 mg/dl, hemoglobin A1c levels should be 3.5–5%, serum urea levels should be 15–40 mg/dl, and serum creatinine levels should be 0.6–1.2 mg/dl for men and 0.5–1.1 mg/dl for women, according to the recommended normal limits.

2.3 Statistical analysis

The data was analyzed using SPSS statistical software version 23. Categorical variables were represented as percentages, whereas continuous variables were represented as the mean plus or minus the standard deviation. The student t-test was used to ascertain the disparities in means between the control and patient groups. A P value below 0.05 was deemed to be statistically significant.

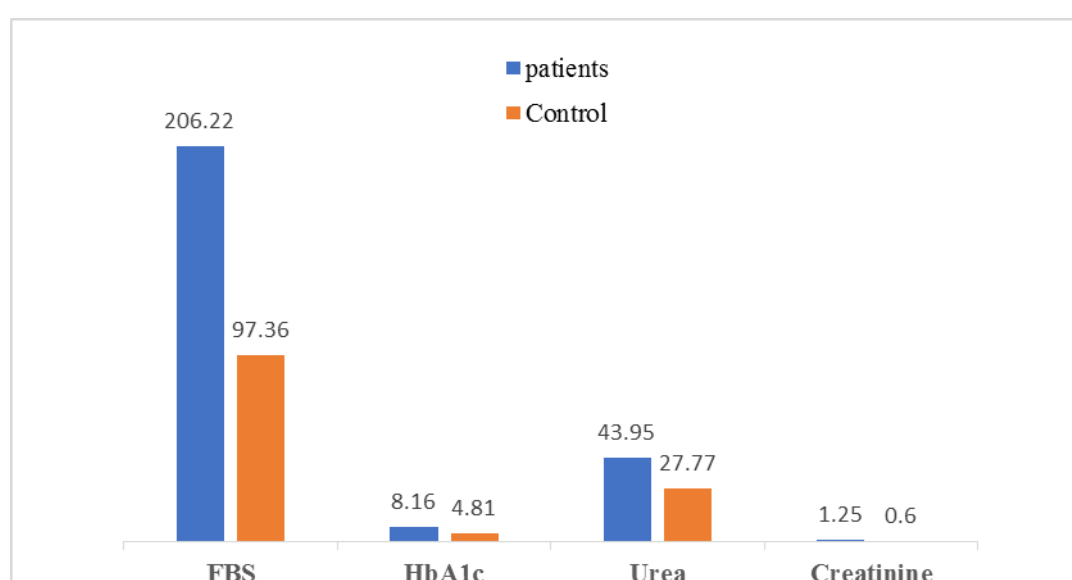
2. RESULT

A total of fifty patients with Type 2 Diabetes Mellitus (T2DM) from Al-Ramadi City were included in the study, with 27 being females and 23 being men. Their age ranges from 33 to 72 years, with a mean age of around 56.4 years. We included age-matched controls in our investigation. The findings of our research revealed substantial disparities between patients with type 2 diabetes mellitus (T2DM) and those without diabetes (the control group) in terms of many parameters, including fasting blood sugar (FBS), glycated hemoglobin (HbA1c), creatinine, and urea. The data shown in Table 1 and Fig. 1 displays the average values of the measured parameters in both groups.

Table 1: Means of biochemical parameters of study groups.

Parameters	Study groups	Number	Mean	Std. Error Mean	Sig.
FBS mg/dl	patients	50	206.22	± 12.0290	0.000***
	Control	30	97.36	± 2.7979	
HbA1c(%)	patients	50	8.16	$\pm .36119$	0.000***
	Control	30	4.81	$\pm .17137$	
Urea mg/dl	patients	50	43.95	± 3.14644	0.000***
	Control	30	27.77	± 1.77459	
Creatinine mg/dl	patients	50	1.25	$\pm .19033$	0.000***
	Control	30	0.60	$\pm .03883$	

*** highly significant (* ($P \leq 0.05$) **($P < 0.01$), ***($P < 0.001$))

**FIGURE 1.** Mean of FBS, HbA1c and serum urea, creatinine in patients and controls.

The findings indicate a substantial ($p < 0.001$) rise in fasting blood sugar (FBS) levels in individuals with T2DM compared to the control group, as seen in Fig. 1. The fasting blood sugar (FBS) level in the group of individuals with type 2 diabetes mellitus (T2DM) is 206.22, while it is 97.36 in the control group.

Glycated hemoglobin (HbA1c) levels were assessed in both diabetes patients and the control group. The data shown in Fig. 1 indicate a statistically significant rise ($P > 0.0001$) in the mean average of HbA1c levels. Specifically, the levels rose from (4.81) in the blood specimens of the apparent control group to (8.16) in the serum specimens of the T2DM patient group.

The urea results indicate that the average level in diabetes patients (43.95) was considerably ($P < 0.0001$) higher than the average level in the control group (27.77), as seen in Fig 1. The blood samples of both T2DM patients and the control group were analyzed to assess the amount of creatinine. The study found a substantial increase ($P < 0.0001$) in the creatinine level of diabetic patients compared to the control group. The mean average creatinine level in the blood samples of T2DM patients was 1.25, whereas it was 0.60 in the control group, as seen in Fig 1.

4. DISCUSSION

Diabetic nephropathy is a prominent global cause of mortality. Evaluation of diabetic-induced renal dysfunction may be conducted by assessing the levels of blood urea and serum creatinine. Assessing these indicators aids in the prompt identification of any dysfunction in the kidney.

In this research, the authors have selected subjects with elevated blood glucose levels, which is symptomatic of inadequate glycemic control and suggests the presence of renal nephropathy (RN). Glycemic control is an indicator of the likelihood of developing nephropathy and other problems associated with diabetes. An elevation in urea concentration signifies renal dysfunction or injury, whereas creatinine serves as an indicator of glomerular filtration rate (GFR). Elevated levels of both creatinine and urea, in conjunction with elevated blood sugar levels, unequivocally indicate renal impairment [11].

The study's results demonstrate a substantial rise in fasting blood glucose levels compared to the control group. Additionally, the study reveals that inadequately regulated blood glucose levels lead to an elevation in serum urea levels, hence increasing the likelihood of the patient developing diabetic nephropathy. This aligns with the results of earlier research that has shown that hyperglycemia is a significant contributor to the gradual deterioration of the kidneys [12]. Glycated hemoglobin (HbA1c) has been established as the gold standard for detecting and managing diabetes, particularly type 2 diabetes. The typical range for HbA1c values in individuals without diabetes is typically between 4.0 and 5.6 percent. The HbA1c values for individuals with pre-diabetes vary from 5.7 percent to 6.4 percent. However, those with HbA1c levels of 6.4 percent or above are diagnosed with diabetes. According to the study's findings, diabetes patients' total HbA1C increased significantly when compared to the control group. These findings align with those of a previous study [13] which reported an elevation in HbA1c levels among individuals with diabetes.

Based on the research results, individuals with diabetes had significantly higher blood urea and creatinine levels, which may be a symptom of pre-renal impairment. This research is comparable to the explanation of the association between blood urea level and long-term plasma glucose level in the study [14].

The glomerular filtration capacity of the kidneys is decreased by renal injury, which also raises the quantities of metabolic byproducts in the serum. Urea and creatinine are two of the byproducts that are significant markers of changes in renal function. In cases of renal failure, excess metabolic byproducts are removed using dialysis. Dialysis is determined by continuously measuring the serum levels of metabolic byproducts during renal failure [15].

5. CONCLUSIONS

Effective control of blood glucose levels is crucial in preventing the progression of renal impairment. Diabetic nephropathy is a leading cause of chronic renal failure. To avoid the progression of diabetes mellitus to diabetic nephropathy, it is required to closely monitor the levels of blood urea and creatinine, which are simple indicators, to prevent the formation of renal nephropathy in patients. Thus, blood urea and serum creatinine are straightforward and valuable indicators that may be used as predictive assays to evaluate kidney function.

Subjecting diabetes patients of both sexes, especially those in advanced stages of diabetic kidney disease, to periodic and regular blood tests for fasting blood sugar, HbA1c, urea, and creatinine to prevent kidney failure.

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