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# Assessment of biochemical markers in diabetic foot ulcers patients At Thi-Qar provence

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***Abstract*---**The current study was conducted at the center for Diabetes and Endocrinology of the Health Directorate at Thi-Qar province, during the period from January to July (2022). The study aimed to evaluate Biochemical Markers of diabetic foot ulcers patients by measuring the levels HbA1c, Urea, and Creatinine in the serum. The study included a total of 50 patients with diabetic foot ulcers they were (39 males and 11 females) and they were aged between 40-80 years. When compared with 50 apparently healthy people as control. The results showed a significant increase (P≤0.01) in the levels of HbA1c, urea, and creatinine in the serum of all patients with diabetic foot ulcers compared to the control group.

***Keywords*---**Diabetic Mellitus (DM), Diabetic Foot Ulcers (DFU), Hemoglobin $A_1c$ ($HbA_1c$), Urea, Creatinine.

## Introduction

Diabetes Mellitus (DM) is a group of metabolic disorders, characterized by elevated blood glucose levels (hyperglycemia), resulting from defects in insulin secretion, insulin action, or both, accompanied by greater or lesser impairment in the metabolism of carbohydrates, lipids and proteins [1]. The chronic hyperglycemia of diabetes is linked with long-term damage, dysfunction, and failure of various organs, including the eyes, kidneys, nerves, heart, and blood vessels [2].

Diabetic foot ulcers (DFUs) are a common consequence of diabetes mellitus that significantly increase the risk of morbidity, mortality, and healthcare costs. It is estimated that 19–34% of patients with diabetes are likely to be affected with a diabetic foot ulcer in their lifetimes, and the International Diabetes Federation reports that 9.1–26.1 million people will develop DFUs annually [3]. The pathology of Diabetic foot ulcers development occurs in phases: The first phase is callus formation, followed by multiple foot traumatization due to loss of the protective sensations secondary to neuropathy. Dry skin on the diabetic foot caused by autonomic neuropathy only worsens the condition. The ensuing subcutaneous hemorrhaging delivers the final insult to the skin, resulting in skin ischemia and then ulceration [4].

Elevated $HbA_1c$ is a significant indicator of diabetes mellitus. It gives an indication of chronic glycaemia rather than being a test of glycaemia at a single point in time. Furthermore, it gives an integrated index of glycaemia over the entire 120-day lifespan of the red blood cell, but within this period of 120 days, recent glycaemia has the largest influence on the $HbA_1c$ value, with 50% of $HbA_1c$ formed in the month prior to sampling and 25% in the month before that [5]. In diabetic nephropathy, bio-markers such as serum urea and creatinine are known to be raised with hyperglycemia in uncontrolled diabetics and usually correlate with severity of kidney damage [6]. Creatinine is the breakdown product of creatinine phosphate which released from skeletal muscle at a steady rate. It is filtered by the glomerulus, and a small amount is also secreted into the glomerular filtrate by the proximal [7]. This study was aimed to evaluate the level of biochemical parameters in patient with diabetic foot ulcers.

## 1. Materials and Methods

### 1.1. Design of Study

The study is conducted at the Diabetes and Endocrinology Center in Thi-Qar Provence, at the period between January to July (2022). It included (100) cases, (50) healthy control and (50) patients. They divided into two groups as the following:

**Group1:** Patients group comprised of 50 volunteers from Type 2 Diabetic patients with Diabetic Foot Ulcer (DFU) were collected from Diabetes and Endocrinology Center at Thi-Qar Province.

**Group2:** Healthy control group comprised of 50 healthy individuals free of T2DM and DFU. They were chosen randomly from the general population; they were visiting AL-Hilal laboratory for checkup.

### 1.2. Collection of Blood Sample

Five (mL) of venous blood were drawn from all participants by using a disposable syringe. Drawn blood was divided into two parts:

1. Two (mL)of blood was collected in EDTA tube and used to analyze Hemoglobin $A_1c$ ($HbA_1c$).

2. Three (mL) of blood was transferred into gel tube and allowed to clot at room temperature to get serum and centrifuged to separate it at 4000 RPM for 10 min and used to analyze serum urea and creatinine.

### 1.3. Statistical analysis

Data were expressed as mean ± standard deviation (SD) or median (interquintile range). Differences between groups were tested with the student's t-test and non-parametric Chi-Square at P.value ≤ 0.05 were considered significant.

## 2. Results

### 2.1. The Demographic Characteristics of Patients

Concerning age, about half of the patients 21 (42%) with a range from 60-69 years. The mean age of the two groups were (35.3 ± 14.3) and (58.9 ± 12.1) for control and DFU, respectively, as shown in Table (1). The results of this study showed there was significant differences (P<0.001), among the studied groups. In the current study, all of the DFU patients were older than 41 years.

Fifty patients' group, 40-80 years, were included in this study, as shown in Table (1). Of them, 39 (78%) were male and 11 (22%) were female in patients. Fifty healthy control group 29 (58%) were male, and 21 (42%) were female in control. There was significance different (P≤0.05) among of the studied groups.
**Table (1):** Comparing the mean age of the two studied groups

| Case | Mean ± SD | P value |
|---|---|---|
| Healthy control | 35.3±14.3 | <0.001* |
| DFU | 58.9 ±12.1 | |

***** Significant association

| **Characteristics** | **Frequencies** (%) | |
|---|---|---|
| **Case:** | | |
| DFU | 50 (50%) | |
| Healthy control | 50 (50%) | |
| **Age:** | | |
| < 40 years | 35 (35%) | CalX² = 17.7 |
| 40-49 years | 16 (16%) | TabX² = 9.49 |
| 50-59 years | 17 (17%) | P. value 0.001 |
| 60-69 years | 22 (22%) | |
| 70-80 years | 10 (10%) | |

| | | |
|---|---|---|
| **Sex:**<br>Male<br>Female | <br>68 (68%)<br>32 (32%) | <br>CalX$^2$ = 12.96<br>TabX$^2$ = 3.84<br>P. value 0.000 |

**Table (2):** Demographic Data of the Patients and Controls Involved in the Study

### 2.2. Biochemical Characteristics of the Studied Subjects

#### 2.2.1. $HbA_1c$

HbA1c status, all of the healthy control had good glycemic control. Only 1 (2%) patient from DFU group had good glycemic control, whereas 49 (98%) had poor glycemic control. Cross tabulation for analyzing the association of $HbA_1c$ control among the studied groups and significant correlation was found, as shown in Table (3).

**Table (3):** Cross Tabulation of HbA1c Control among the Two Studied Groups

| Case | Healthy control | DFU | Total | P value |
|---|---|---|---|---|
| ≤ 7% | 50 (100%) | 1(2%) | 51 (51%) | <0.001* |
| > 7% | 00 | 49 (98%) | 49 (49 %) | |
| Total | 50 (100%) | 50 (100%) | 100 (100%) | |

*Significant association

#### 2.2.2. Blood Urea

The results of the current study demonstrate that the patients had impairment of serum urea were 20 (40%) in DFU group and 3 (6%) in control group, as shown in Table (4). The results of the current study of urea showed that there were significant differences (P<0.001) among the groups. Impaired serum urea: participants whose serum urea greater than 40 mg/dl.

#### 2.2.3. Serum Creatinine

Serum creatinine level, patients with impairment serum creatinine were 34 (68%) in DFU groups, respectively, as shown in Table (4). The results of the current study of urea showed that there were significant differences (P<0.001) among the groups Impaired serum creatinine: participants whose serum level of creatinine were greater than 1.2 mg/dl.

This study shows high significance of $HBA_1c$, urea and creatinine among the studied groups (P<0.001), (P<0.001) and (P<0.001).

**Table (4):** Biochemical markers in DFU and healthy control

| Biochemical Markers | Healthy control No (50) | DFU No (50) | p-value |
|---|---|---|---|
| | Mean ± SD | | |
| HBA1C | 5.36 ± 0.344 | 9.74 ± 1.89 | <0.001 |
| UREA mg/dl | 29.5 ± 7.04 | 45.5 ± 15.5 | <0.001 |
| Creatinine mg/dl | 0.796 ± 0.109 | 1.29 ± 0.642 | <0.001 |

**Discussion**

Diabetic foot ulcer is one of the leading causes of severe and high mortality in diabetics. It is known that wound healing in diabetics is a very complicated process due to the direct severe effect of diabetes mellitus on blood vessels, causing difficulty in wound healing [8,9]. Pathogenesis of diabetic foot ulcers is complex and multifactorial and it is well known that these lesions rarely result from a single pathology. Several causes work together leading to foot ulceration in diabetic patient. There are three types of diabetic foot ulcer described namely neuropathic, neuroischaemic, and ischemic origin [10].

The current study had shown that DFU disease was most common in age >60 years (42%) followed in age groups 50-59 years (24%), as shown in Table (1). The result showed there was significance difference among the groups. Several previous studies documented that maximum number of DFU patients occur within age range 40-60 years, Kadhim, 2021 [5] Ali, 2022; SALEH and HADI, 2019; ANYIM *et al.*, 2019 [11,12,13]. [11] Ali, 2022 obtained that DM- foot ulcer is more common in older age groups particularly those above 60 years of age. Age is associated with presence of risk of DM-foot ulcer because increasing age linear with increasing risk of neuropathy and angiopathy the common etiopathology of DFU.

Patients with DFU from both sexes may differ the way to handle the disease and the way they adhere to the care necessary to keep the disease under control. Men in particular, are care less about their feet. The results of the current study were in agreement with results of Ali, 2022 [11]. The result showed there was significance difference among the patients, they observed that male more frequency than female 78% vs 22%, as shown in Table (2). While, Kadhim, 2021; QADIR *et al.*, 2020 [5],[14] contrasted with present results showed there was no significance different between male and female in studied groups. Male predominance in DFU could be linked to factors such as sex-related differences in life styles and professional roles that require the feet to tolerate more pressure. Increased level of outdoor work and poor compliance to foot care practices [15].

Patient characteristics such as poor glycaemic control as measured by $HbA_1c$, urea, creatinine has been found to be strongly predictive of subsequent ulceration and amputation. This study shows high significance of $HbA_1c$, urea and creatinine among the studied groups (P<0.001), (P<0.001) and (P<0.001), as shown in Table (4), respectively. Similar findings were reported by Kadhim, 2021 [5].

Regarding $HbA_1c$ status, Cross tabulation for analyzing the association of $HbA_1c$ control among the studied groups and significant correlation was found, as shown in Table (4). This result is in agreement with previous study conducted by Kadhim, 2021; LI *et al.*, 2021 [5],[16]. Poor glycemic control was potential risk factor for non-healing ulcers and amputations and good glycemic control is important to reduce amputation risk in diabetic patients [5].

The results of the current study there was significance different in the studied groups, demonstrate that the patients had impairment of serum urea were (45.5 ± 15.5) in DFU group, and (29.5 ± 7.04) in healthy control group, as shown in Table (4). Impaired serum urea: participants whose serum urea greater than 40 mg/dl.

Regarding serum creatinine level, patients with impairment serum creatinine were (1.29 ± 0.642) in DFU, and (0.796 ± 0.109) in healthy control group, respectively. Impaired serum creatinine: participants whose serum level of creatinine were greater than 1.2 mg/dl [5],[16].

## Conclusions

The current study revealed, elevated level of $HbA_1c$, Urea and Creatinine in patients with diabetic foot ulcers compared with healthy control.

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