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Estimating the Some Biochemical Variables in Patients with Diabetic Kidney

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Abstract: The research sought to evaluate the efficacy of the arginase enzyme in patients with type 1 diabetes mellitus in Samarra city. Ninety samples were obtained from male and female patients aged 30 to 70 years at Samarra General Hospital, covering the period from January 10, 2024, to December 30, 2024. The investigation included the assessment of urea, creatinine, uric acid, total protein, albumin, glucose, iron, glutathione, glutathione peroxidase, and superoxide dismutase (SOD). The results showed an increase in the activity of arginase enzyme, urea, creatinine, iron, total protein, glucose and antioxidants in the group of patients compared to healthy people at the probability level $p<0.0001$. Regarding gender, there was a notable elevation in uric acid and SOD levels in the female cohort, with $p<0.005$ in comparison to men. Creatinine and glucose levels were elevated in men relative to healthy individuals. The other factors did not exhibit significant changes based on sex.

Keywords: Diabetic kidney, arginase, urea, creatinine, uric acid, total protein, albumin, glucose, iron, glutathione, glutathione peroxidase and SOD

Introduction

Diabetes mellitus is a clinical condition that is characterized by high levels of glucose in the blood. This occurs when there is a complete or partial lack of insulin secretion or when there is a problem with the way insulin works. As a consequence, there are disruptions in the metabolism of carbohydrates, proteins, and lipids, as well as in the absorption of water and electrolytes. Insulin lowers blood glucose levels by encouraging glucose molecules to go into cells, where they are then broken down to produce energy. The pancreas stops producing insulin either completely or partially for reasons that are not understood. 3 When the concentration of glucose in the urine surpasses 180 mg per 100 cm^3 of blood, the disease may be identified by either a clinical examination or laboratory testing. The blood sugar level of a healthy individual is between 70 to 110 mg per 100 cm^3 of blood. When blood sugar levels rise, the body produces a hormone called insulin. Its purpose is to convert any excess sugar into glycogen, which is then stored in the liver and muscles. Diabetes may be classified into two main types: type 1 and type 2. Gestational diabetes is the third kind of diabetes, and it may occur during pregnancy. Type 1 diabetes is characterized by a person's dependence on insulin, which is how this ailment is defined. This occurs when the beta cells in the islets of Langerhans in the pancreas that create insulin are destroyed, leading to a lack of insulin. Juvenile diabetes is a disorder that often affects children and teenagers. High blood glucose levels are a characteristic of type 2 diabetes, which is sometimes referred to as non-insulin-dependent diabetes. This happens when the body does not make enough insulin and does not respond well to it [8]. It is thought that obesity is the main reason why people who are genetically prone to type 3 diabetes get the condition [9]. As stated in [10], it is believed that 7% of diabetes diagnoses are caused by a lack of physical exercise. A number of different illnesses may be diagnosed using enzymes. Arginase (Ureohydrolase 3.5.3.1 E.C) is one example of an enzyme. It assists in the conversion of the amino acid L-arginine into L-ornithine and urea. The urea cycle is the last phase in the cycle, and arginase is the last enzyme in the urea cycle. It helps with the fifth and last phase of metabolic processes in mammals, which is the one that removes harmful ammonia from the body. There are two different kinds of arginase: type I arginase and type II arginase. These two varieties have their active cellular sites in separate locations. The first form is mostly found in the cytoplasm of hepatocytes and is the main enzyme in the urea cycle. The second type is found in the mitochondria outside of the liver, primarily in the kidneys, prostate, seminal vesicle plasma, and testes. The mammary glands, brain, and sperm cells may contain smaller amounts of the substance.

Materials and Methods:

Between October 1, 2024, and December 30, 2024, samples were collected at Samarra General Hospital. The samples were taken from participants of both genders who were between the ages of 30 and 70. In order to get samples, five milliliters of blood were taken, put into gel tubes, and allowed to clot for ten minutes. After that, the sample was spun in a centrifuge at a speed of 3000 revolutions per minute for 10 minutes in order to separate the serum. The serum that was extracted was then kept at a temperature of -20 °C. The activity of arginase in the serum was then assessed in accordance with (21). An ELISA kit was used.

A ready-made analytical kit from BioLaBO France was used to evaluate the levels of glucose, urea, creatinine, uric acid, total protein, albumin, and iron.

Methods 17-20 were used to assay glutathione, glutathione peroxidase, and SOD, respectively.

Results and Discussion:

Mean ± standard deviation of the parameters under study for patients compared to healthy controls

Table 1

Groups / Parameters	Mean ± SD		p-value
	Control	Patients	
Argnase µmole/L	0.386±0.125	2.501±0.161	<0.0001*
Creatinine mg\dl	1.153±0.399	7.077±1.038	<0.0001*
Ferritin µmole/dl	128.187±22.686	49.047±3.417	<0.0001*
Urea mg\dl	8.883±1.560	130.538±5.011	<0.0001*
T.Protein mg\dl	6.427±1.388	5.384±0.740	<0.0001*
Albumin mg\dl	4.795±0.612	6.563±0.941	<0.0001*
Glucose mg\dl	84.337±9.811	161.203±23.271	<0.0001*
SOD IU\ml	8.634±0.266	2.554±0.106	<0.0001*
Gpx IU\l	7.332±0.307	3.601±0.230	<0.0001*
GSH IU\l	8.168±0.150	2.698±0.315	<0.0001*
Uric acid mg\dl	4.667±1.187	8.083±1.689	<0.0001*

Table 2 shows the mean ± standard deviation of arginase, ferritin, urea, creatinine, total protein, and uric acid for healthy and patient groups by sex

Groups / Parameters	Mean ± SD		p-value
	Male	Female	
Uric acid mg\dl	7.567±1.191	8.600±1.957	0.005*
Creatinine mg\dl	7.463±1.040	6.690±0.895	0.005*
Ferritin µmole/dl	49.205±2.930	48.888±3.888	0.005*
Urea mg\dl	130.550±4.890	130.527±5.213	N.S
T.Protein mg\dl	5.431±0.881	5.336±0.576	N.S
Albumin mg\dl	6.638±0.892	6.488±0.998	N.S
Glucose mg\dl	173.898±17.676	148.509±21.351	0.005*
SOD IU\dl	2.516±0.098	2.591±0.101	0.005*
Gpx IU\L	3.585±0.171	3.617±0.279	N.S
GSH IU\L	2.685±0.348	2.710±0.285	N.S
Arg. µmole/L	2.497±0.162	2.504±0.162	N.S

The activity s of arginase e in diabetic patients

The average + standard deviation of arginase enzyme in the control group (healthy) was (0.386±0.125) µmole/L, while in type 1 diabetic patients it was (2.501±0.161) µmole/L. The findings of the research demonstrate that the efficacy of the arginase enzyme in the blood serum of diabetes patients is much higher than that of the control group, as shown in Table 1. It was discovered that there are no significant variations in the level of arginase between females and men with diabetes, as it reached (2.497±0.162) µmole/L in males and (2.504±0.162) µmole/L in females. The literature did not mention the study of the effectiveness of the enzyme in patients with type 1 and type 2 diabetes. However, the increase may be due to the direct relationship between the enzyme and glucose levels, as high glucose levels may lead to an increase in arginase enzyme activity. [21].

Serum glucose of the studied samples

The mean standard deviation of the serum glucose level of healthy individuals was (84.337±9.811) mg/100 cm3, while its level in diabetic patients was (161.203±23.271) mg/100 cm3. The results showed that the average glucose level increased significantly in type 1 diabetic patients compared to type 2. The probability level ($p>0.05$) in the serum of people with type 1 and type 2 diabetes compared to healthy individuals, as shown in Figure (2). The glucose level

also increased significantly in the serum of people with diabetes compared to healthy individuals.

It was also found that the glucose level in infected males (173.898 ± 17.676) mg/100 cm3 was higher than in infected females (148.509 ± 21.351) mg/100 cm3.The results of the current study are consistent with the results of [22,23], who indicated that the high level of glucose in patients with type 1 diabetes is due to the destruction of most or all of the beta cells in the pancreas that secrete insulin in the heart of that secretion or its complete absence [24]. The results of the current study are also consistent with the results of [25,26], who indicated an increase in the level of glucose in the blood serum in patients with type 2 diabetes. The reason for the high level of glucose in patients with type 2 diabetes is a deficiency in insulin secretion or a defect in the resistance of insulin receptors in the body [27], as it occurs as a result of the association between poor insulin secretion when the concentration of glucose in the blood is high with insulin resistance by the target tissues due to the decreased sensitivity of these tissues such as the liver, muscle cells and adipose tissue [28].

Serum urea level

The means and standard deviation of urea level in healthy individuals was (8.883±1.560) mg/100 cm3, while its level in individuals with diabetes was (130.538±5.011) mg/100 cm3. It is noted from the results that there are significant differences between individuals with diabetes and healthy individuals, as it was higher in diabetic patients than healthy individuals.

High serum urea level in diabetic patients is affected by the long duration of the disease and failure to control it leads to the emergence of serious complications such as diabetic nephropathy, which causes a high mortality rate, especially among young diabetic patients. Decreased kidney efficiency results from a disturbance in the effectiveness of hormones such as angiotensin or a structural disorder due to a decrease in the number of nephrons or the filtration area, which is associated with the effectiveness of the glomerulus [29.]

Uric acid levels

The results showed that the average level of uric acid recorded significant differences in type 1 diabetes patients compared to healthy individuals

The average standard deviation of uric acid level in healthy individuals was (4.667±1.187) mg/100 cm3, while its level in type 1 diabetes patients was (8.083±1.689) mg/100 cm3.

It was also found that the uric acid level in infected males was (7.567±1.191) mg/100 cm3, higher than in infected females (8.600±1.957) mg/100 cm3.

Uric acid is the final product of purine metabolism, which can be considered a marker of oxidation and can have a therapeutic and antioxidant role. Therefore, there is no clear evidence of increased uric acid in diseases with high oxidation such as diabetes. Rather, this increase is considered a protective response to the disease, as studies have indicated that high uric acid in the blood is associated with obesity and insulin resistance, especially in type 2 diabetes [30-36].

Serum creatinine level of the individuals under study

The average standard deviation of creatinine level in healthy individuals was (1.153±0.399) mg/100 cm3, while its level in individuals with diabetes was (7.077±1.038) mg/100 cm3. The results showed that the average creatinine level recorded a significant increase at the probability level ($p<0.05$) in the serum of individuals with diabetes compared to healthy individuals, as shown in Figure (5). It was also found that the creatinine level in infected males (7.463±1.040) mg/100 cm3 was higher than in infected females (6.690±0.895) mg/100 cm3.

The high creatinine level is due to the decrease in renal plasma clearance of creatinine due to the decrease in blood flow through the kidneys as a result of acute inflammation in the renal tubules caused by diabetes. Diabetes also leads to an increase in the level of creatinine in the blood

plasma [37,38]. Or the increase may also be due to increased oxidative stress as a result of increased blood sugar concentration, [39.[

Serum iron level of the subjects under study

Serum iron level: The mean ± standard deviation (mean ± standard deviation) of the patients was (49.047±3.417) µg/100 cm3 and of the healthy subjects was (128.187±22.686) µg/100 cm3, as shown in Table (1) and Figure. It is clear from the results above in the figure that the iron level decreased significantly at the probability level ($p<0.05$) in patients compared to healthy subjects. Ferritin levels were found to be higher in affected males (49.205±2.930) µg/100 cm3 and females (48.888±3.888) µg/100 cm3. Ferritin deficiency occurs in more than 50% of patients diagnosed with chronic kidney disease [40], and appears early in individuals with diabetes [41]. The cause may be a deficiency of the hormone erythropoietin (EPO), which is produced in the renal cortex and is responsible for stimulating red blood cell formation, leading to the hypothesis that its deficiency may be the main cause of anemia in patients with chronic kidney disease [42]. The results of our current study are in agreement with the researcher(Ganz)43.

Total Protein

The mean ± standard deviation (mean ± standard deviation) of the patients' level was (5.384±0.740) g/100 cm3 and of the healthy individuals (6.427±1.388) g/100 cm3 as shown in Table (2). Total protein levels were found to be higher in affected males (5.431±0.881) µg/100 cm3 and females (5.336±0.576) µg/100 cm3.

The results showed that the total protein level decreased significantly at the probability level ($p<0.05$) in patients compared to healthy individuals, which may be due to the inefficiency of the renal tubules and their ability to retain proteins and not filter them; as large amounts of protein are excreted through urine, which leads to a decrease in its level in the blood serum in patients with renal failure.

Glutathione

The results according to Table (1) showed that the level of glutathione decreased significantly in the serum of diabetic kidney disease patients (2.7620±0.43 µmol/L) compared to healthy individuals (8.1426±0.38 µmol/L) at a probability level ($P<0.05$) and according to Figure (8). Glutathione is one of the most important non-enzymatic antioxidants that work to remove free radicals and their products (44). Glutathione is an important cellular reducing agent in protecting against free radicals, peroxides and toxic compounds. Depletion of this agent is one of the factors that allow lipid oxidation, in addition to directly protecting cell membrane proteins and maintaining their stability. Low levels of glutathione lead to a decrease in sulfhydryl groups (SH) that can be produced in the event of oxidation of membrane sulfhydryl groups and thus losing their stability (45). The reason for the low level of glutathione may be attributed to a deficiency in the raw materials necessary for its construction, especially the coenzyme (NADPH) resulting from the pentose phosphate sugar pathway, which is the stimulating substance for the action of the enzyme glutathione reductase, which works to restore the active form of glutathione from the inactive form (46). Glutathione peroxidase level The results showed according to Table (1) that the level of glutathione peroxidase decreased significantly in the serum of diabetic kidney disease patients (3.601±0.230 units/liter) compared to healthy individuals (7.332±0.307 units/liter) and according to Figure (1) as the glutathione peroxidase enzyme is an enzymatic antioxidant as it protects biological membranes and the rest of the cell components from oxidative damage and it also plays a fundamental role in removing the peroxyl radical (POO) from various peroxides, especially hydrogen peroxide H2O2, forming the glutathione reductase enzyme as glutathione peroxidase works as an electron donor (47). The results in Table (2) showed that, according to sex, the level of glutathione peroxidase increased significantly at the probability level ($P<0.05$) in the serum of males with diabetic kidney disease (3.585±0.171 UL) compared to females (3.617±0.279 UL). The results of the current study do not agree with

(Brian) (48) and his group, as the latter found that there is no significant difference between males and females in the level of glutathione peroxidase until reaching the stage of sexual maturity, as its percentage increases in females to reach levels 80% higher than in males.

Superoxide dismutase (SOD) level The results according to Table (1) showed that SOD decreased significantly in the serum of diabetic kidney patients (2.554±0.106 units/ml) compared to healthy individuals (8.634±0.266 units/ml) . These results are consistent with the findings of (49) who studied oxidative stress and antioxidant systems in kidney patients and recorded a decrease in SOD in patients compared to healthy individuals. The results in Table (2) and according to gender showed that SOD decreased in the serum of male patients (2.516±0.098 units/ml) and female patients (2.591±0.101 units/ml) compared to healthy male and female individuals (2.6450±0.413 units/ml). At the probability level (P) < 0.05, there is no significant difference. This is consistent with what was stated by (50), who noted an overlapping effect between gender and superoxide dismutase activity in individuals with diabetic kidney disease, as he recorded a correlation between superoxide dismutase activity and the mortality rate in females more than males.

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