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Evaluation of Thyroid Hormones, Kidney Function and Lipids Profile in Sera Patients with Type II Diabetes Mellitus in Iraqi population

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Abstract

Introduction: Diabetes is a global problem and its cause is either a deficiency in insulin secretion (T1DM) or a defect in insulin action (T2DM). Type 2 diabetes is the most common, accounts for about 90-95% of all diagnosed patients of diabetes, and is caused by a defect in insulin action as a result of tissue resistance to the insulin secreted by the pancreas and sometimes Its secretion is also lacking.

Materials and methods: The study involved 37 T2DM patients and 37 control .Thyroid hormones(T3, T4, TSH) were measured by enzyme-linked immunosorbent assay (ELISA) by using the Vidas device. Total cholesterol(TC), triglycerides(TG), and high-density lipoprotein (HDL) were measured by a spectrophotometer by using UV-vis device. Very low density lipoprotein(VLDL) and low density lipoprotein(LDL) calculated from the equations.

Aim: Study the effect of T2DM on the thyroid gland and its hormones, on the kidneys and its functions, and lipid profile by measuring the concentration of some biochemical markers in the serum of patients and comparing it with their levels in healthy controls. Also, investigation from the correlation between the glucose and other biochemical parameters.

Conclusion: The concentrations of these biochemical markers concluded that the lipid profiles were affected and increased due to T2DM, the thyroid gland and its hormones were normal and were not affected by T2DM and the kidneys were normal and were there functions not affected by T2DM. there are did no statistically significant correlations between glucose and other parameters.

Keywords: Diabetes mellitus, thyroid gland, kidney function and lipids profile.

1. Introduction

Diabetes is a metabolic disease resulting from multiple causes, in which a person suffers from an increase in the level of glucose in the body because the pancreas does not produce enough insulin(T1DM) or the cells of the body do not receive the insulin that the pancreas secreted(T2DM), or both reasons. T2DM results from insulin resistance, a condition in which cells fail to use insulin made by the pancreas properly, sometimes associated with an absolute insulin lack. This type was previously referred to as non-insulin dependent diabetes mellitus(NIDDM) or "adult-onset diabetes"[**1**]. This type of diabetes accounts for about (90-95%) of all diagnosed patients with diabetes. This form of diabetes is highly related to obesity, increased age, physical inactivity, previous gestational diabetes, and poor glucose metabolism[**2**].

Many researchers studied the association of T2DM with thyroid disorders and found increase in occurrence of thyroid disorders among diabetics patient when compared to the public people. This suggests that diabetics patients may be develop to thyroid disorders which could be autoimmune diseases[**3**].

One of the most common microvascular complications in people with diabetic is diabetic nephropathy (DN), develops in nearly 40% of patients have T2DM. This may lead to increased creatinin and urea levels and decreased albumin level in blood[**4**].

Disorder of lipid metabolism usually occur in people with T2DM. Imbalances in insulin function and high levels of glucose in the blood in people have diabetes can cause changes in lipids profile. Increased free fatty acids (FFA) present lead to an increase in levels of cholesterol, triglycerides, very low density lipoprotein, low density lipoprotein and decreased in level of high density lipoprotein[**5**].

2. Experimental

2.1:patients and control :

The study involved 37 patients suffering from type 2 diabetes (14 man and 23 woman) of an age thirty to sixty years, and 37 healthy individuals (control) (18 man and 19 woman) of age thirty to sixty years.

2.2:Collection of samples and measurement of biochemical parameters

Samples of volunteer patients were collected from the AL- mawani General Hospital and AL-Qurna General Hospital, and a volume of blood was drawn approximately 5 ml from the hand of the volunteer patients who fasted 10-12 hours. Samples of healthy volunteers were collected from family, relatives, colleagues, and friends. They have put it in gel tubes, then separated by centrifugation for ten minutes, and then stored at -20 degrees until the time of examination. Thyroid hormones(T3, T4, TSH) were measured by enzyme-linked immunosorbent assay (ELISA) by using the Vidas device. Total cholesterol(TC), triglycerides(TG), and high-density lipoprotein (HDL) were measured by a spectrophotometer by using UV- vis device. Very low-density lipoprotein and low-density lipoprotein calculated from the following equation:

VLDL(mg/dl)= TG/5 LDL(mg/dl)= TC – (HDL+VLDL)

2.3:Statistical analysis

For statistical analysis, SPSS software, version 24, was used. To determine the level of statistical significance of a difference, p-value less than 0.05 was considered significant.

3. Results

3.1:The difference in the value of the variables between the Patients and Control

Table(1) and Figure(1) show the levels of all parameters which were investigated in this study such as glucose, thyroid stimulating hormone (TSH), thyroxine (T4), tri-iodothyronine(T3), creatinine, urea, albumin, cholesterol, triglyceride(TG), high density lipoprotein(HDL), very low density lipoprotein(VLDL) and low density lipoprotein(LDL) in type 2 diabetic patients and healthy control.

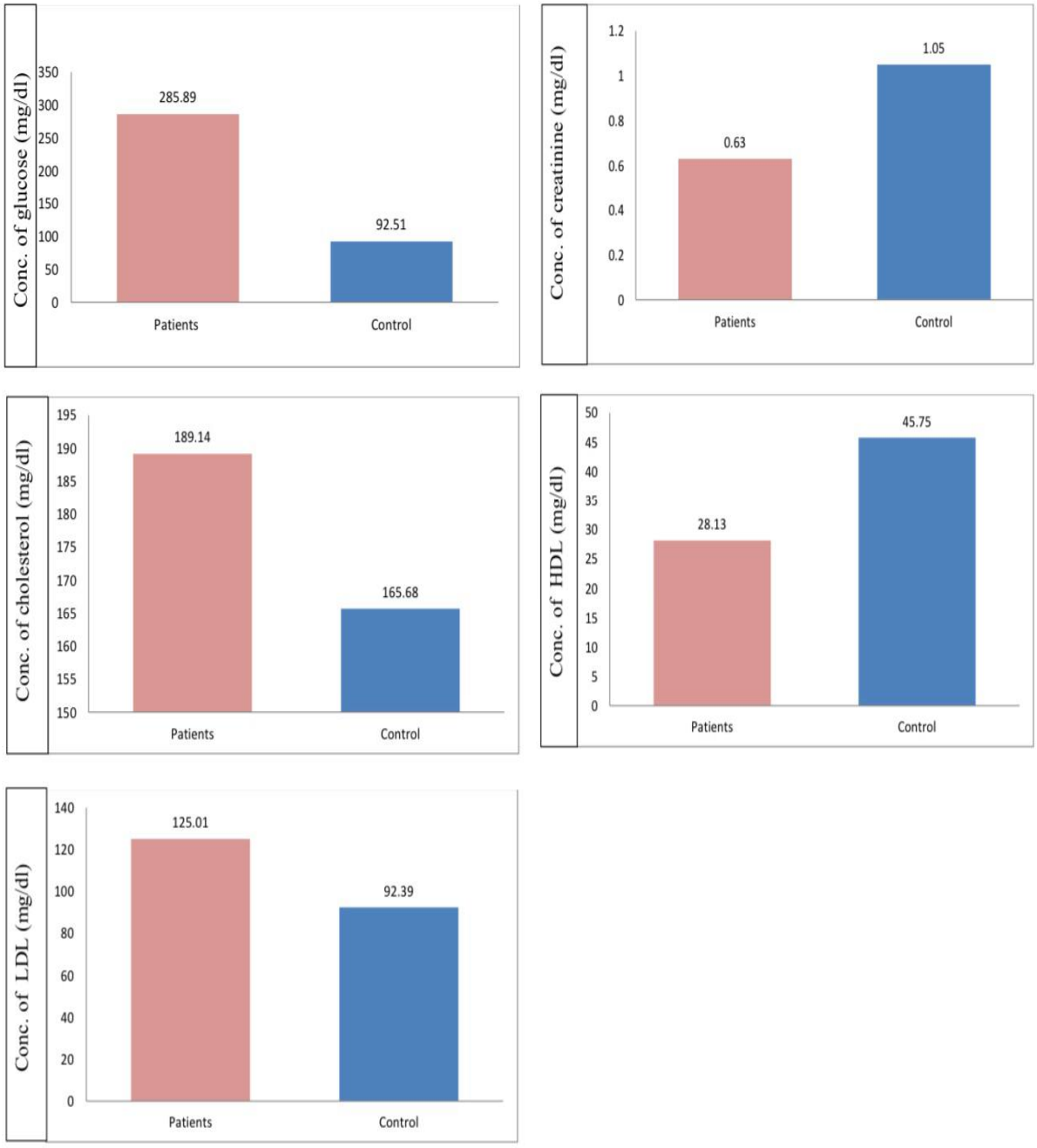
Table(1): The differences in the levels of biochemical markers between patients and control individuals.

Marker	Patients (No.= 37)			Control (No.= 37)			P-value
	Mean±SD	Median	Min-Max	Mean±SD	Median	Min-Max	
Glucose * (mg/dl)	285.89±108.11	258	166-521	92.51±14.35	91	63-124	0.0001
TSH* (µIU/ml)	2.32±1.66	2.11	0.41-9.67	2.94±2.19	2.24	0.62-10.79	0.20
T4* (nmol/ml)	95.73±16.59	91.81	73.19-140.03	93.12±40.83	88	60-320	0.09
T3* (nmol/l)	1.62±0.51	1.63	0.80-3.29	1.69±0.46	1.76	1-3.46	0.44
Cre* (mg/dl)	0.63±0.14	0.6	0.5-1	1.05±0.46	0.9	0.6-2.5	0.0001
Urea* (mg/dl)	33.73±10.11	35	8-49	39.84±19.17	36	17-95	0.40
Albumen** (g/dl)	4.34±0.38	--------	3.70-5.1	4.22±0.46	-------	3.2-5	0.21
TC* (mg/dl)	189.14±47.96	181	107-330	165.68±28.89	164	109-221	0.03
TG* (mg/dl)	200.08±166.93	159	51-770	141.92±79.33	136	37-391	0.12
HDL* (mg/dl)	28.13±13.36	26.1	10-72.7	45.75±18.48	38	21-105	0.0001
VLDL* (mg/dl)	40.11±33.33	31.8	10.2-154	28.21±15.78	27.2	7.4-78.2	0.10
LDL* (mg/dl)	125.01±41.79	120	53.7-200	92.39±24.39	92.9	36.4-141.6	0.002

* Mann-Whitney test, ** t-Test, significant(p-value<0.05), high significant(p-value≤0.001) and extremist or very high significant(p-value≤0.0001).

It is clear from the table (1) that there were statistically significant differences in the levels of glucose, cholesterol, HDL, LDL, and creatinine. Were significantly higher, for glucose very high significant (p-value= 0.0001), cholesterol significant (p-value<0.05) and LDL high significant (p-value<0.05) among patients than their levels among control individuals. While the levels of HDL and creatinine were significantly lower among the patient's group than their levels among the control group. Where the values of HDL very high significant (p-value=0.0001) and Creatinine very high significant (p-value= 0.0001).

The table showed that there is no significant difference in the level of thyroid stimulating hormone (TSH) (P-value>0.05), thyroxine (T_4) (P-value>0.05), tri-iodothyronine (T_3)(P-value>0.05), no significant difference in the level of urea(P-value>0.05) and no significant difference in the level of albumin (P-value>0.05) in patients with type 2 diabetes compared to healthy controls.



Figure(1):The mean levels of the parameters that have statistically

significant differences in the study.

3.2:The correlations between glucose and other biochemical markers in patients

Table(2) shows the correlation coefficient (R) between glucose and other biochemical parameters in patients.

Table (2): The Correlations between glucose and other biochemical markers in patients.

Correlations *	R	P-value
Glucose *vs.* TSH	0.013	0.938
Glucose *vs.* T4	-0.12	0.486
Glucose *vs.* T3	-0.18	0.292
Glucose *vs.* Creatinine	0.123	0.467
Glucose *vs.* urea	0.261	0.119
Glucose *vs.* Albumin	-0.02	0.882
Glucose *vs.* Cholesterol	0.18	0.28
Glucose *vs.* Triglyceride	0.28	0.09
Glucose *vs.* HDL	-0.07	9.68
Glucose *vs.* LDL	0.093	0.582
Glucose *vs.* VLDL	0.26	9.11

* Spearman's correlations test , R = strength of correlation or correlation coefficient , (-) inversely correlation, (+)proportional correlation, significant(p-value<0.05), high significant(p-value≤0.001) and extremist or very high significant(p-value≤0.0001).

When correlations were tested between glucose and other parameters as in table (2), we found there are did no statistically significant correlations between glucose and other parameters.

4. Discussion

4.1:Level of glucose in patients and control

This study shows a very high significant increase in the level of glucose (p-value=0.0001) in patients with type 2 diabetes(285.89±108.11) compared to healthy controls(92.51±14.35), table(1), figure(1).

(Al-Fartosy and Mohammed, 2017) obtained Similar result, he showed that T2DM patients had higher fasting glucose level[**6**].

In a fasting state, increase glucose is directly connected with increased hepatic glucose production. In postprandial state, more from glucose

excursions result from the combination of insufficient suppression of this increase in glucose production and defective insulin stimulation to glucose disposal in target tissues and skeletal muscle[**7**]. Defect or abnormal in islet cell function is important reason and requisite feature of T2DM. This functional islet defect is the main quantitative determinant of increased glucose (hyperglycemia) and progresses over time. In addition, in T2DM, pancreatic α-cells hyper-secrete glucagon, further promoting hepatic glucose production[**8**]. Recently identified more abnormalities of the incretin system (represented by Intestine hormones, glucagon-like peptide 1 (GLP-1) and glucose-dependent insulinotropic peptide (GIP) in T2DM have also been found, whether they constitute primary or secondary defects[**9**]. This form of diabetes is related with obesity, physical inactivity, increased age, history of gestational diabetes, impaired glucose metabolism[**2**]. T2DM caused by a condition known an insulin resistance(IR), which cells fail to use the insulin that made by pancreas properly, sometimes associated with an absolute insulin lack[**1**]. In most people patients with T2DM especially the obesity people, IR is a prominent feature in target tissues (liver tissue, muscle tissue, adipose tissue, myocardium). This condition results in both increase glucose production and decrease glucose utilization[**9**]. in addition of that, an increased delivery of fatty acids to the liver lade their oxidation, which contributes to increased synthesis of glucose from non-sugar sources (gluconeogenesis) [**10**].

4.2:Thyroid Hormones (TSH, T_4, and T_3)

The study showed that there is no significant difference in the level of thyroid stimulating hormone (TSH)(P-value>0.05) in patients with type 2 diabetes(2.32±1.66) compared to healthy controls(2.94±2.19), thyroxine (T_4) (P-value>0.05) in patients with type 2 diabetes(95.73±16.59) compared to healthy controls(93.12±40.83)and tri-iodothyronine (T_3)(P-value>0.05) in patients with type 2 diabetes (1.62±0.51) compared to healthy controls (1.69±0.46), table(1).

The results in this study partially agree with (Bhavthankar *et al*., 2013) because he found normal values of T3 and T4 but the elevated value of TSH [**3**]. and partially agree with (Ogbonna *et al*.,2019) because he found normal values of T_4 and TSH but the elevated value of T_3[**11**].

Studies have shown that (10-15%) of T2DM patients develop autoantibodies to islet cell antigens present in the liver in the first five years of a diabetes diagnosis. These patients represent a special subgroup of T2DM as seen

by their deficiency of insulin secretion, elevated human leukocyte antigen (HLA) genes, elevated of thyroid or gastric autoantibodies, and increased risk for requiring insulin treatment[**12**]. Patients with diabetes have a higher prevalence of thyroid disorders compared to normal people because people with an autoimmune disease specific to one organ have a risk of developing other autoimmune disorders in other parts or organs of the body. In the public people, approximately 6% of people have some type of abnormality thyroid gland. However, the prevalence of thyroid disorder increases to over (10%) in diabetes patients. the research found There is a higher occurrence of thyroid disorders, especially hypothyroidism in people with T2DM[**13**]. hyperglycemia may be an effect on the hypothalamus–pituitary–thyroid axis that ultimately affects concentrations of thyroid hormone (TSH,T4 and T3) [**11**]. The results in this study are evidence proof the concentrations of this hormones and thyroid gland is normal and did not affect diabetes mellitus.

4.3:kidney functions

4.3.1:Level of creatinine in patients and control

The result for creatinine in this research shows a very high significant decrease in the level of creatinine (p-value=0.0001) in patients with type 2 diabetes(0.63±0.14) compared with healthy controls(1.05±0.46), table(1), figure(1).

This result doesn't agree with that finding by(Al-Fartosy *et al*., 2020) because he found increased in creatinine level[**14**].

The increase in creatinine may occur in diabetic patients because of the basis of impairment in glomerular filtration as a result of low kidney function related to diabetes mellitus. In any case, it is hard to decide the beginning of such changes and this might prompt dubious outcomes. Accordingly, it should watch the creatinine levels cautiously to decide how kidneys have a function[**15**]. In this study, the creatinine level decreased in patients (but not increase) when compared with controls, this avidness proof the kidney are normal and did not affect by diabetes. can happen Changes in creatinine level in the blood, not dependently on the normal function of the kidney. There are many reasons causes of decreased creatinine concentration include liver problems, low muscle mass, wasting diseases, starvation, after surgical amputation of a limb, diet, pregnancy, or disease [**16**].

4.3.2:Level of urea in patients and control

The study showed that there is no significant difference in the level of urea(P-value>0.05) in T2DM patients (33.73±10.11)compared to healthy controls(39.84±19.17), table(1).

This study doesn't agree with that finding by (Al-Fartosy *et al*., 2020) because he found increased in urea level[**14**].

The height in urea level among diabetes patients might be clarified based on impairment in glomerular filtration because of weakness in kidney work that is related to diabetes mellitus. It is hard to decide the beginning of the changes that happen and this might lead to inaccurate results[**17**]. This study did not find significant deferens for urea concentration between patients and control, this evidence proof the kidney is normal and did not affect diabetic. The limitation the use of urea levels in ensuring the working of the kidneys is that in some cases the concentration of urea in the blood is not sufficiently indicative of the glomerular filtration rate GFR. Therefore, urea levels are considered an inaccurate sign of low renal filtration rate, the renal filtration rate must be reduced by 50% before urea levels in the blood increase from normal levels. It is also possible to increase urea levels despite the normal renal filtration rate, so urea lacks the specificity or accuracy in ensuring the normal functioning of the kidneys[**18**].

4.3.3:Level of albumin in patients and control

The result for the estimation of the albumin is showing no significant difference in the level of concentrations (P-value>0.05) in T2DM patients (4.34±0.38) compared to healthy controls(4.22±0.46), table(1).

This result does not agree with (Li, 2021)because he showed decreased in albumin level[**19**].

In normal states, a small amount of Alb is filtered in the glomerulus and almost all of it is reabsorbed by the tubules. But in the abnormal states, as in kidney disease or nephropathy and a decline in its filtering function for the blood, as in diabetic patients, then high quantities of albumin will be excreted through the kidneys, and thus the level of albumin in the blood will decrease[**20**]. An increase in general blood pressure and blood pressure in the kidneys negatively and significantly affect the renal glomeruli and thus leads to a decline in the work of the kidneys[**21**]. nephrotic syndrome may Causes by decreased albumin concentration in the blood(hypoalbuminaemia)

[**22**]. The result in this study show albumin level is normal or there is no significant difference between the patients and control, this proof the kidney is normal and did not affect by diabetic.

4.lipid profile

The result for estimation cholesterol showed a significant increase in the level of cholesterol (p-value<0.05) in patients with type 2 diabetes (189.14±47.96) compared to healthy controls(165.68±28.89), very high significant decrease in the level of high density lipoprotein (HDL) (p-value=0.0001) in patients with type 2 diabetes (28.13±13.36) compared with healthy controls(45.75±18.48), a significant increase in the level of low density lipoprotein (LDL) (p-value<0.05) in patients with type 2 diabetes (125.01±41.79) compared to healthy controls (92.39±24.39), table(1), figure(1).

The results of this study agreement with that reported by (Artha *et al.*, 2018) because he also showed increased in level of cholesterol, low density lipoprotein (LDL) and decreased in high density lipoprotein (HDL) level[**23**].

Eestimation of Triglyceride show that there is no significant difference in the level of Triglyceride (Tg) (P-value>0.05) in T2DM patients (200.08±166.93) compared to healthy controls (141.92±79.33), no significant difference in the level of very low density lipoprotein (VLDL) (P-value>0.05) in T2DM patients (40.11±33.33) compared to healthy controls (28.21±15.78), table(1).

This results are in accordance with(Artha *et al*., 2018) because he also does not found difference in triglyceride and very low density lipoprotein (VLDL) level between the patients and control[**23**].

Most of the glucose is stored as glycogen in muscle cells and the liver, but when these cells and other body cells are saturated with glycogen, the excess glucose is converted into fat and stored in adipose tissue[**24**]. High levels of lipids profile in the blood of people with diabetes may be generally due to the excess of fatty acids from adipose tissue during the increase of the hormone insulin, which inhibits the lipase enzyme. After that, the high concentrations of fatty acids in the blood are changing to triglycerides, cholesterol and phospholipids in the liver. Finely, these three compounds are linked with the protein and formation lipoproteins in blood[**25**]. Many people have diabetes mellitus suffer from reduced ability to control glucose

and also suffer from disorders of lipid levels (dyslipidemia) such as high in Triglyceride, LDL, and low in high density lipoprotein(HDL)[**26**]. The state of lipid disorder is known by an imbalance in the levels of two or more fats[**27**]. There are many causes that lead to the imbalance of lipid levels in diabetes, including the effects of the hormone insulin in the production of Apo protein in the liver, regulation of LPL lipase, cholesterol ester transport protein CETP, and the effects of insulin working on peripheral tissues (adipose and muscle tissue)[**28**]. High lipolysis in fat cells and tissues as a result of reducing insulin action leads to high in the secretion of fatty acids from adipocytes, thus increasing their transport to the liver, which is a known disorder presence in T2DM (insulin resistant) result more secretion of very low density lipoprotein[29]. In type 2 diabetes, insulin resistance leads to decreased high-density lipoprotein(HDL), decreased apoA-1 protein, increased triglyceride breakdown, increased liver lipase, and increased maid of the smallest high-density lipoprotein. Since the smaller and denser high-density lipoprotein molecules are removed faster by the liver unlike the larger HDL particles, this process significantly reduces high-density lipoprotein(HDL) and apoA-1 as a fat reabsorption compound In the blood vessels[**30**].

Conclusions :

the present results show an increase in the level of glucose, cholesterol, and low density lipoprotein(LDL) in the patient comparing with healthy controls, while there is a decrease in the level of high density lipoprotein(HDL) and creatinine in comparison between the two groups. there are no significant differences in the level of urea, albumen, and thyroid hormones(TSH, T4, T3) in patients with type 2 diabetes when compared with a healthy control group. The results of the concentrations of these biochemical markers concluded that the lipid profiles were affected and increased due to T2DM, the thyroid gland and its hormones were normal and were not affected by T2DM, the kidneys and their functions were normal and were not affected by T2DM. there are did no statistically significant correlations between glucose and other parameters.

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تقييم هرمونات الغدة الدرقية ووظائف الكلى وصور الدهون في مصل المرضى المصابين بداء السكري النوع الثاني في السكان العراقيين

مصطفى عبدالحسين خلف و داود سلمان علي

جامعة البصرة- كلية العلوم- قسم الكيمياء

الخلاصة

المقدمة: داء السكري هو مشكلة عالمية وينتج إما عن نقص في إفراز الأنسولين (T1DM) أو خلل في عمل الأنسولين (T2DM). داء السكري من النوع الثاني هو الأكثر شيوعًا ، ويمثل حوالي 90-95٪ من جميع مرضى السكري الذين تم تشخيصهم ، وينتج عن خلل في عمل الأنسولين نتيجة مقاومة الأنسجة للأنسولين الذي يفرزه البنكرياس وأحيانًا نقصه أيضًا.

الهدف: دراسة تأثير T2DM على الغدة الدرقية وهرموناتها وعلى الكلى ووظائفها وعلى مستوى الدهون عن طريق قياس تركيز بعض المركبات الحيوية في مصل المرضى ومقارنتها مع مستوياتها في الاصحاء. أيضا، التحقيق من العلاقة بين الجلوكوز والمركبات البيوكيماوية الأخرى.

المواد وطرق العمل: شملت الدراسة على 37 مريضًا يعانون من T2DM (14 رجلاً و 23 امرأة) تتراوح أعمارهم بين 30-60 عامًا ، و 37 فردًا سليمًا (مجموعة التحكم) (18 رجلاً و 19 امرأة) تتراوح أعمارهم بين 30-60 عامًا. تم قياس هرمونات الغدة الدرقية (T3، T4، TSH) عن طريق مقايسة الممتز المناعي المرتبط بالإنزيم (ELISA) باستخدام جهاز Vidas. تم قياس الكوليسترول الكلي (TC) والدهون الثلاثية (TG) والبروتين الدهني عالي الكثافة (HDL) بواسطة مقياس الطيف الضوئي باستخدام جهاز UV-vis. تم حساب البروتين الدهني منخفض الكثافة جدًا (VLDL) والبروتين الدهني منخفض الكثافة (LDL) من المعادلات.

النتائج: أظهرت الدراسة ان هناك فروق ذات دلالة إحصائية في مستوى الكلوكوز و الكوليسترول و HDL و LDL والكرياتينين في هذه الدراسة مقارنة بين المرضى والمجموعة الضابطة. تظهر النتائج الحالية زيادة في مستوى الجلوكوز والكوليسترول والبروتين الدهني منخفض الكثافة (LDL) في المرضى مقارنة بالأصحاء، بينما هناك انخفاض في مستوى البروتين الدهني عالي الكثافة (HDL) والكرياتينين في المرضى مقارنه بالأصحاء. لا يوجد اختلاف كبير في مستوى اليوريا ، الالبومين ، وهرمونات الغدة الدرقية (TSH، T4، T3) في مرضى السكري من النوع 2 عند مقارنتهم بمجموعة الاصحاء.

الاستنتاج: استنتجت نتائج تراكيز هذه المركبات الحيوية أن صور الدهون قد تأثرت وزادت بسبب T2DM ، وكانت الغدة الدرقية وهرموناتها طبيعية ولم تتأثر بالـ T2DM ، وكانت الكلى ووظائفها طبيعية ولم تتأثر بالـ T2DM. لا توجد ارتباطات ذات دلالة إحصائية بين الجلوكوز والمركبات الأخرى.