Evaluation of Some Physiological Parameters in Type 2 Diabetes Mellitus Patients With Hypertension and Non-Hypertension According to Body Mass Index

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ABSTRACT: Diabetes mellitus (DM) is a common metabolic condition characterized by high blood sugar levels caused by decreased tissue sensitivity to insulin, inadequate insulin synthesis, or a combination of both factors. Insulin Resistance (IR) enhances the liberation of unbound fatty acids from adipocytes, resulting in elevated levels of circulating unbound fatty acids. The aim of this study is to evaluate some biochemical parameters in the sera of T2DM and compared between T2DM patients with and without hypertension. Material and method: 60 T2DM patients participated in the current study; these patients were split into two groups, 30 T2DM with HP and 30 T2DM without HP. Patient samples were obtained at the Diabetes Research Centre Al-Mustansiriyah University in Baghdad, Iraq, between January and April of 2021. the two study groups in comparison with thirty healthy control subjects. Results: results obtained from this study showed that there is a significant difference in (Age, BMI, WHR, FBS, HbA1c, TC, TG, HDL, LDL, VLDL, C-peptide, HOMA-IR, Cortisol), while there is non-significant difference in urea and creatinine between patients without HP and control, in the other hand, there is a significant difference in all parameters determined in this study between T2DM with HP and control. Last but not least, there is a significant difference in WHR, FBS, urea, creatinine, C-Peptide, HOMA-IR and cortisol and there is non-significant difference in the other parameters determined in the study. Conclusion: From the results obtained in this work, it is concluded that the relationship between T2DM and HP is proportional, patients with PH shows higher WHR and FBS and that’s back to the higher body fats, urea and creatinine is significantly increased in patients with HP because of the damage in the kidney due to the high pressure, there is direct relationship between age and T2DM infection, the BMI and WHR is one of the most affected risk factors for the injury of T2DM, lipid profile parameters is associated with T2DM because the elevation in the body fat will raise the BMI and WHR and cause insulin resistance that leads to T2DM, renal function parameters will be raised as a response for the damage that effect the nephrons of the kidney, level of C-peptide increased due to the body’s try to keep the level of glucose in the normal range and HOMA-IR is increased because of the insulin resistance occurs in the body. last conclusion is that the level of cortisol is effect by some of inhibitory drugs so it is drop down to a low levels. More studies should be done in this subject to improve the outcomes and find new ways to control and have a good way to diagnose T2DM.

Keywords: T2DM, Dyslipidemia, Hypertension, HOMA-IR, Cortisol in T2DM

1. INTRODUCTION

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood glucose. Hyperglycaemia, also called raised blood glucose or raised blood sugar, is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels.[1]. Diabetes mellitus (DM) gives rise to a range of occurrences, encompassing both micro and macro-vascular problems. It explains a significant prevalence of illness or disease[2]. There is a lot of reasons and risk factors for T2DM including (age, wrong nutrition, hormonal, obesity, genetic and low level physical activity) all of these factors may cause T2DM.
Over than 50% of individuals with diabetes mellitus (DM) have hypertension (HTN), which has a crucial role in the development of both micro and macro-vascular complications in DM. Patients who have both diabetes mellitus (DM) and hypertension (HTN) have a four times greater risk of developing cardiovascular disease (CVD) compared to individuals who do not have diabetes and have normal blood pressure[3].

Diabetes is a chronic ailment that can cause various complications like vision loss, kidney disease, low red blood cell count, heart problems, cognitive impairments, and reduced ability to do daily tasks independently, eventually impacting a person's overall well-being. Glycosylated hemoglobin (HbA1c) is measured to examine and treat persons with diabetes mellitus[4]. HbA1c assesses and appraises the extended-term control of glucose levels and anticipates the probability of microvascular complications in patients suffering from diabetes. The HbA1c level in the blood sample provides information about the average lifespan of red blood cells and serves as a measure of glycemic management over time. The prolonged effects of DM might potentially impair other organs, leading to various physiological changes in the body depending on the severity and length of the disease[5].

Insulin resistance (IR) enhances the liberation of unbound fatty acids from adipocytes, resulting in elevated levels of circulating unbound fatty acids. This, in turn, triggers the production of very low-density lipoprotein (VLDL) particles that are rich in triglycerides in the liver, ultimately leading to an increase in high-density lipoprotein (HDL) and low-density lipoprotein (LDL) particles that are rich in triglycerides[6]. The elevation of triglycerides within lipid particles alters their metabolic processes. [7]. Elevated lipid deposition in the pancreas impairs its ability to respond to elevated levels of glucose in the blood and diminishes the production of insulin. HOMA-IR is the best indicator to detect insulin resistance in people with T2DM [8]. C-peptide is a commonly employed indicator of the functionality of pancreatic beta cells. The production of this substance is equivalent in quantity to the naturally occurring insulin, but it is excreted at a more consistent pace and for a longer duration. C-peptide levels in individuals with type 2 diabetes mellitus (T2DM) generally fall within the normal to elevated range. [9]. Cortisol, a glucocorticoid produced by the adrenal cortex, has a significant impact on the metabolism of glucose, fat, and protein. Hyper-cortisolism is linked to several disorders, such as diabetes, obesity, hypertension, osteoporosis, and cardiovascular disease. The incidence of hyper-cortisolism in diabetes patients exceeded that in the general population[10].

The aim of this study is to evaluate some biochemical parameters in the sera of T2DM and compared between T2DM patients with and without hypertension.

2. Material and method

2.1 The Study Population

The current study designed to identify the biochemical difference between DM patients and healthy people and the difference between DM with HP compared with DM without HP patients. So the patients participant In the study were divided into 2 patients groups, 30 patients in group of patient with DM who have high BP and 30 patient with DM who have normal BP Diabetes Research Center Al-Mustansiriyah University in Baghdad / Iraq for the time from January 2021 to April 2021, the sum of patients in this study were 60 participant patient. Those 60 patients in the two groups compared with 30 healthy participant who have not DM

2.2 Inclusion criteria

The study included patient having T2DM and one group included hypertension more than 9/13 mmHg, all groups has been divided after take the health condition and results parameters from the physician responsible on the patients.

2.3 Exclusion criteria

All patients that suffer from renal failure or cardiovascular disease, anemia and smokers are excluded.

2.4 Anthropometric study

patients and control participants has been going to measure the gender, age, weight, height waist and hip to evaluate the body mass index and waist to hip ratio, BMI measurement studied by the utilize of the mathematical equation, it is calculated by dividing the weight by the square of height. WHR is calculated by dividing waist circumference by the hip circumference.

2.5 Sample collection

Ten milliliter venous blood samples were collected from patients with T2DM and control A volume of 3 milliliter was placed in a EDTA for determination of HbA1c%. The remaining blood was putted in a gel tube and left at a temperature (22-26) °C for 45 minutes to separate the clot, then, the collected blood centrifuged at 3000 rpm for 10 minutes to separate serum. The collected serum then used to evaluate the biochemical parameters (TC, TG, HDL, LDL, VLDL, FBS, urea, Creatinine, C-peptide and cortisol).
2.6 Biochemical tests

The evaluation of C-peptide and cortisol were done by using direct ELISA technology by the using of the information provided from (Sunlong / China) kit absorbance were determined to be 450 nm and the standard curve calculated by the using of standard concentration and it is dilutions provided with the kit.

Other chemical parameters (TC, TG, HDL, LDL, VLDL, FBS, Urea and Creatinine) were evaluated by the using of kits provided from (Human company / Spain) each parameter was measuring in a different wave length as it is provided in the kits.

2.7 Study design

The study model has been designed to show the study map that used in this study.

2.8 Statistical analysis

The data has been analyzed using IBM statistics SPSS 26 version. The descriptive statistics for each parameter included the calculation of the mean and the standard deviation (SD). The T-test was employed to compare the chemical variables between patients and control groups and two groups of patients between each other at a significance level of probability (P < 0.05)[11].

3. Results

3.1 Anthropometric and biochemical parameters between control and T2DM without HP

The mean and SD for the studied parameters used the statistical study and the results showed that there is a significant increase in age (P < 0.05) between patients (49.3±4.7) as compared with control (38.7±7.4), there is a significant difference in BMI between patients (29.47±5) as compared with control (25.89±3.5), there is a significant increase (P < 0.05) in WHR between patients (0.97±0.051) as compared with control (0.86±0.055) there is a significant increase (P < 0.05) in the level of FBS in patient (155.7±27.7) as compared with control (96.7±5.0), there is a significant increase (P < 0.05) in the level of HbA1c% in patients (8.65±1.45) as compared with control (4.8±0.31) there is a significant difference (P<0.05) in lipid profile (TC, TG, HDL, LDL, VLDL) among patient (231.8±53.9 216.8±65 38±4.37 154.1±52.8 44.6±16.3) as compared with control (158.9±28.8, 93±9.2, 52.7±5.47, 82.5±30.4, 18.6±1.8) respectively, there is a non-significant increase in the level of urea between patients (33.9±9.3) as compared with control (30.1±9.2), there is a non-significant difference in the level of creatinine in patients (0.79±0.19) as compared with control (0.73±0.22), there is a significant increase (P < 0.05) in the level of C-peptide between patients (3.85±1.2) as compared with the control (1.82±0.33), there is a significant difference in the level of HOMA-IR between patients (3.56±1.2) as compared with control (2.07±0.37) in the last, there is a significant decrease (P<0.05) in the level of cortisol between patient (56.23±10.75) as compared with control (100.1±6.7).

The result of the study shown in table 3-1.
Table 1. - T-Test result for the studied parameters between control and T2DM without HP patients

<table>
<thead>
<tr>
<th>The studied parameters</th>
<th>Mean ±SD for T2DM without HP (N=30)</th>
<th>Mean ±SD for control (N=30)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>49.3±4.7</td>
<td>38.7±7.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BMI, Kg/m²</td>
<td>29.47±5</td>
<td>25.89±3.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>WHR</td>
<td>0.97±0.051</td>
<td>0.86±0.055</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>FBS mg/dl</td>
<td>155.7±27.7</td>
<td>96.7±5.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HbA1c</td>
<td>8.65±1.45</td>
<td>4.8±0.31</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>TC mg/dl</td>
<td>231.8±53.9</td>
<td>158.9±28.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>TG mg/dl</td>
<td>216.8±65</td>
<td>93±49.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HDL mg/dl</td>
<td>38±4.37</td>
<td>52.7±5.47</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LDL mg/dl</td>
<td>154.1±52.8</td>
<td>82.5±30.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>VLDL mg/dl</td>
<td>44.6±16.3</td>
<td>18.6±1.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Urea, mg/dl</td>
<td>33.9±9.3</td>
<td>30.1±9.2</td>
<td>0.127</td>
</tr>
<tr>
<td>Creatinine, mg/d</td>
<td>0.79±0.19</td>
<td>0.73±0.22</td>
<td>0.333</td>
</tr>
<tr>
<td>C-peptide ng/ml</td>
<td>3.85±1.2</td>
<td>1.82±0.33</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HOMA-IR</td>
<td>3.56±1.2</td>
<td>2.07±0.37</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cortisol ng/ml</td>
<td>56.23±10.75</td>
<td>100.1±6.7</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

3.2 Anthropometric and biochemical parameters between control and T2DM with HP

The mean and SD for the studied parameters used the statistical study and the results showed that there is a significant increase (P<0.05) between patients (49.7±7.4) as compared with control (38.7±7.4), there is significant difference (P<0.05) in BMI between patients (30.6±4.97) as compared with control (25.89±3.5), there is a significant increase (P<0.05) in WHR between patients (1.01±0.055) as compared with control (0.86±0.055) there is a significant increase (P<0.05) in the level of FBS in patient (195.1±56.4) as compared with control (96.7±5.0), there is a significant increase (P<0.05) in the level of HbA1c% in patients (8.4±1.48) as compared with control (4.8±0.31) there is a significant difference (P<0.05) in lipid profile (TC, TG, HDL, LDL, VLDL) between patient (253±41, 230±72.5, 37±4.38, 150±46.5, 45.2±14.8) as compared with control (158.9±28.8, 93±9.2, 52.7±5.47, 82.5±30.4, 18.6±1.8) respectively, there is a significant increase (P<0.05) in the level of urea between patients (59.9±7.9) as compared with control (30.1±9.2), there is a significant difference (P<0.05) in the level of creatine in patients (1.27±0.41) as compared with control (0.73±0.22), there is a significant increase (P<0.05) in the level of C-peptide between patients (3.4±0.84) as compared with control (1.82±0.33), there is a significant difference (P<0.05) in the level of HOMA-IR between patients (3.4±0.95) as compared with control (2.07±0.37) in the last, there is a significant decrease (P<0.05) in the level of cortisol between patient (34±7.12) as compared with control (100.1±6.7).

Table 2. - T-Test result for the studied parameters between control and T2DM with HP patients

<table>
<thead>
<tr>
<th>The studied parameters</th>
<th>Mean ±SD for T2DM with HP (N=30)</th>
<th>Mean ±SD for control (N=30)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>49.7±7.4</td>
<td>38.7±7.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BMI, Kg/m²</td>
<td>30.6±4.97</td>
<td>25.89±3.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>WHR</td>
<td>1.01±0.055</td>
<td>0.86±0.055</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>FBS mg/dl</td>
<td>195.1±56.4</td>
<td>96.7±5.0</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
3.3 Anthropometric and biochemical parameters T2DM patients (with and without HP)

The mean and SD for the studied parameters going for statistical study and the result showed that there is a significant difference (P<0.05) in FBS between T2DM with HP (195.1±56.4) as compared with T2DM without HP (155.7±27.7), there is a significant increase (P<0.05) in the level of Urea and Creatinine between T2DM with HP (59.9±7.9, 1.27±0.41) as compared with T2DM without HP (33.9±9.3, 0.79±0.19) respectively, there is a significant difference (P<0.05) in the level of cortisol between T2DM with HP (34±7.12) as compared with T2DM without HP (56.23±10.75) from the other hand, there is non-significant differences between all other parameters for the comparison between T2DM with and without HP. The result of the study shown in table 3-3.

Table 3. - T-Test result for the studied parameters between T2DM with and without HP.

<table>
<thead>
<tr>
<th>The studied parameters</th>
<th>Mean ±SD For T2DM with HP (N=30)</th>
<th>Mean ±SD for T2DM without HP (N=30)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>49.7±7.4</td>
<td>49.3±4.7</td>
<td>0.788</td>
</tr>
<tr>
<td>BMI, Kg/m²</td>
<td>30.6±4.97</td>
<td>29.47±5</td>
<td>0.363</td>
</tr>
<tr>
<td>WHR</td>
<td>1.01±0.055</td>
<td>0.97±0.051</td>
<td>0.004</td>
</tr>
<tr>
<td>FBS mg/dl</td>
<td>195.1±56.4</td>
<td>155.7±27.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HbA1c</td>
<td>8.4±1.48</td>
<td>8.65±1.45</td>
<td>0.529</td>
</tr>
<tr>
<td>TC mg/dl</td>
<td>253±41</td>
<td>231.8±53.9</td>
<td>0.92</td>
</tr>
<tr>
<td>TG mg/dl</td>
<td>230±72.5</td>
<td>216.8±65</td>
<td>0.454</td>
</tr>
<tr>
<td>HDL mg/dl</td>
<td>37±4.38</td>
<td>38±4.37</td>
<td>0.483</td>
</tr>
<tr>
<td>LDL mg/dl</td>
<td>150.3±46.5</td>
<td>154.1±52.8</td>
<td>0.769</td>
</tr>
<tr>
<td>VLDL mg/dl</td>
<td>45.2±14.8</td>
<td>44.6±16.3</td>
<td>0.882</td>
</tr>
<tr>
<td>Urea, mg/dl</td>
<td>59.9±7.9</td>
<td>33.9±9.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Creatinine, mg/d</td>
<td>1.27±0.41</td>
<td>0.79±0.19</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>C-peptide ng/ml</td>
<td>3.4±0.84</td>
<td>3.85±1.2</td>
<td>0.108</td>
</tr>
<tr>
<td>HOMA-IR</td>
<td>3.4±0.95</td>
<td>3.56±1.2</td>
<td>0.594</td>
</tr>
<tr>
<td>Cortisol ng/ml</td>
<td>34±7.12</td>
<td>56.23±10.75</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
For anthropometric studies the results shows that there is a significant difference in age between the T2DM with and without HP as compared with control. This result is in agreement with another studies like Suastika et al [12], who said that age is one of the most effect risk factors for T2DM infection, when people get older the functionality of the body and organs will be less affected than in younger people, from the other hand there is non-significant difference between people with and without HP because patient will suffer from high HP after the infection with T2DM so the primary disease (T2DM) occurs in the same age period.

There is a significant difference in the level of BMI and WHR between T2DM patients with and without HP as compared with control. This result is even agreed with the studies of Yasser et al. [13], BMI and WHR are the most accurate parameters for the determination of body obesity, the elevated levels of BMI and WHR clarify that the appearance of T2DM is related with the accumulation of body fats and going to affect various functions in the body. Insulin resistance is responsible for a substantial portion of the raised fasting sugar levels in the bloodstream. The emergence of insulin resistance in obesity can be related to the constrained ability of enlarged adipocytes to handle and metabolize glucose. This condition may also occur in muscle, liver, and β-pancreatic cells when there is an accumulation of lipids [14]. There is a significant difference in WHR between T2DM with HP and T2DM without HP and that is back to the reality of raising the WHR increase the concentration of fats and the heart will need to bump more blood to make oxygen reaches the body cells and organs [15].

The level of FBS and HbA1c is significantly elevated in patients as matched with control and that is in agreement with studies like Elimam et al and Nazari et al [16, 17]. The level of FBS is directly proportional with the HbA1c level, level of FBS is elevated due to the impaired destruction of beta cell in pancreas, the level of HbA1c is elevated when BS is elevated and the poor control of glucose in body will cause a high elevation in the level of the two parameters. Hence HbA1c level measure the level of glucose in 3 months, it conceded as the pest parameter to diagnose and monitoring T2DM. there is a significant elevation in FBS in patient with HP, Fasting blood sugar (FBS) independently poses a risk for the onset of hypertension within a 5-year period in a healthy population without diabetes. The study also demonstrated a strong correlation between elevated fasting blood glucose (FBG) levels and the development of hypertension. These findings suggest that researchers should consider FBG as a potential risk marker for hypertension [18].
In diabetes, blood lipid levels can be influenced by several factors due to the interplay between glucose and lipid metabolism. Consequently, any disruption in the process of glucose metabolism results in a disruption in the process of lipid metabolism, and vice versa[21]. Most of people with T2DM have insulin resistance as a main problem. Insulin resistance, when combined with hyperinsulinemia, is highly indicative of the future development of type 2 diabetes in individuals without diabetes[22]. Multiple studies have demonstrated that insulin impacts the production of liver apolipoprotein and adjusts the effect of lipoprotein lipase and cholesterol ester transport protein, leading to dyslipidemia in diabetes mellitus[23]. In addition, a lack of insulin decreases the functioning of hepatic lipase and other stages involved in the synthesis of physiologically active lipoprotein lipase. Hypertriglyceridemia commonly coexists with reduced levels of HDL cholesterol, which is a notable characteristic of aberrant lipid profiles observed in persons with diabetes. The lipid abnormalities associated with type 2 diabetes mellitus (T2DM) are characterized by elevated levels of triglycerides (TG) and small, dense low-density lipoprotein (LDL) particles, as well as reduced levels of high-density lipoprotein (HDL) cholesterol[24]. The correlation between decreased levels of HDL cholesterol and heightened susceptibility to heart disease is firmly established, regardless of TG levels and other risk factors. The potential cause of hypertriglyceridemia may be attributed to heightened hepatic excretion of very low density lipoprotein (VLDL) and sluggish removal of lipoproteins rich in triglycerides. This is primarily caused by elevated levels of substrates for triglyceride synthesis, namely FFA and glucose. The current investigation found substantial relationships between serum concentration of total cholesterol, triglycerides, LDL cholesterol, and hepatosteatosis, and blood concentrations of HbA1c[25]. The correlation studies indicate a strong link between high blood sugar levels (hyperglycemia) and the development of abnormal lipid levels (dyslipidemia). Our results corroborated a prior investigation indicating that the total cholesterol level tends to be within the normal range or close to it when glycemic control is sufficient, and a deterioration in control leads to an increase in the level. Hence, enhancing glycemic control could significantly diminish the likelihood of cardiovascular events in individuals with diabetes[26].

![Graphs showing lipid profile comparison among control, T2DM with HP and T2DM without HP](image)

**FIGURE 4.** - mean and SD for Lipid profile (CG, CT, HDL, LDL and VLDL) among control, T2DM with HP and T2DM without HP

Level of urea and creatinine is significantly elevated in patients as matched with control, this results is in agreement with studies of kene et al[27].

The kidneys would experience a failure to efficiently excrete serum creatinine, leading to an excessive elevation in its concentrations. Intensive therapy has the ability to significantly decrease increased HbA1c levels[28]. Nevertheless, the elevated concentrations of serum urea and creatinine, resulting from irreversible renal impairment, are challenging to reverse. Kidney damage in diabetes mellitus is a chronic and irreversible condition[29]. Elevated levels of serum urea and creatinine are reliable markers of glomerular injury, which is irreversible even with an intensive treatment plan. The only way to manage the growing glomerular damage and the subsequent rise in serum and creatinine levels is by early detection and action[30].
The level of C-peptide and HOMA-IR were significantly increased in patients as matched with control and this results is in agreement with Jones et al [31].

The increasing prevalence of IR and metabolic syndrome has sparked significant interest due to their rising incidence and the resulting cardiovascular events, which can lead to both death and morbidity, even in those without diabetes [32]. Therefore, it is crucial to promptly identify insulin resistance (IR) in individuals without diabetes, as part of a community-based approach to mitigate the future prevalence of type 2 diabetes mellitus (T2DM). It has been proposed that the preferred method for screening insulin resistance (IR) should be appropriate for a study involving a large population, necessitate only one blood sample, and exhibit a high degree of reproducibility and predictive capability. It was noted that levels of C-peptide were significantly elevated in patients with metabolic syndrome, regardless of gender [34]. The fasting C-peptide exhibits a substantial correlation with many indicators of metabolic syndrome in obese adults. Therefore, C-peptide can function as a versatile biomarker to identify persons at risk for insulin resistance (IR) [35], type 2 diabetes mellitus (T2DM), atherosclerosis, and metabolic syndrome. Current guidelines suggest initiating T2DM screening at the age of 45 and repeating it every 3 years. However, for persons at higher risk, screening should commence earlier and be conducted more frequently [36].

Level of cortisol is significantly lowered in patients with T2DM as compared with control, this results is not agreement with the other studies, most previous studies showed that cortisol levels is increased with T2DM [37]. Although the cortisol in general elevated with T2DM because of the elevating stress, there is a reason of the decrease in the level of cortisol in ours work, the decrease could be explained by the use of specific drugs that help to reduce blood glucose and reduce cortisol level. In the study of vincent et al [38] He states that the combination of steroidogenesis inhibitors can enhance the management of hypercortisolism. Previously, combinations of ketoconazole and metyrapone were primarily documented in patients with severe Cushing’s syndrome (with a median urinary-free cortisol level 30- to 40-fold above the upper limit of normal) and life-threatening coexisting medical conditions.

FIGURE 5. - mean and SD for urea and creatinine among control, T2DM with HP and T2DM without HP

FIGURE 6. - mean and SD for urea and creatinine among control, T2DM with HP and T2DM without HP

4. Conclusion

From the results obtained in this work, it is concluded that the relationship between T2DM and HP is proportional, patients with PH shows higher WHR and FBS and that’s back to the higher body fats, urea and creatinine is significantly increased in patients with HP because of the impair damage in the kidney do to the high pressure, there is a direct relationship between age and T2DM infection, the BMI and WHR is one of the most affected risk factors for the injury of T2DM, lipid profile parameters is associated with T2DM because the elevation in the body fat will raise the BMI and WHR and cause insulin resistance that leads to T2DM, renal function parameters will be raise as a response for the damage that effect the nephrones of the kidney, level of C-peptide increased due to the body’s try to
keep the level of glucose in the normal range and HOMA-IR is increased because of the insulin resistance occurs in the body. Last conclusion is that the level of cortisol is effected by some of inhibitory drugs so it is drop down to a low level and this drugs will cause a defect in the physiological parameters in patients. More studies should be done in this subject to improve the outcomes and find new ways to control and have a good way to diagnose T2DM.

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**CONFLICTS OF INTEREST**

The authors declare no conflict of interest

**REFERENCES**


