HEMATOLOGICAL AND BIOCHEMICAL CHANGES IN FEMALE DIABETES MELLITUS TYPE-2 PATIENTS ATTENDING TERTIARY CARE HOSPITAL QUETTA

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Abstract

Diabetes mellitus is notoriously known around the globe for its pathological problems and it is mostly linked with metabolic, cellular, and blood disorders. In the previous studied the biochemical and hematological anomalies have been associated with type 2 diabetes disorder. In studying this, we compared and analyzed the hematological and biochemical parameters between non-diabetic and diabetic patients from Quetta, Pakistan and highlighted the anomalies. The results of this studies discovered significant anomalies in the biochemical and hematological parameters of diabetic type 2 patients are compared with non-diabetic patient. In this study, we conducted a comparative cross-sectional analysis on 100 volunteers among them 50 volunteers were diabetic type 2 patients and the remaining 50 were taken as control these volunteers were selected by applying a systematic random sampling technique. For hematological and biochemical analysis 5ml of blood from the patients and control group was drawn and subsequently analyzed using an automated cell counter. That was analyzed by using SPSS 22 version. In this study, majority of subjects in both groups were females. The results of this study displayed that the level of MCV, PVC, RBCs, and hemoglobin was significantly lower compared
to diabetic-free individuals. Whereas; mean WBCs and MCHC were highly significant in diabetics patients than the diabetic-free individuals. We did not observe any difference in the level of MCH between both groups. In the case of biochemical parameters comparison, the mean of LDL, TC, creatinine, and urea was higher in the diabetic group as compared to the control group and the value of HDL was lower in the diabetic group.

Keywords: Diabetes Mellitus, Biochemical, Hematological, Blood Count

I. INTRODUCTION

The diabetes-mellitus is a heterogeneous metabolic illness and it is a non-communicable disease with increasing frequency worldwide. The patients with diabetes are also expanding in Pakistan day by day furthermore it is reckoned that Pakistan will become home to a huge number of diabetic patients due to the unhealthy lifestyle of its population. In 2002, WHO reported that 170 million people were suffering from diabetes and this number will reach to 366 million or more by 2030 (Mahmoodi et al., 2013). Humankind relies on plants and animals for its nutrition, which is mainly comprised of carbohydrates, fats, and proteins, but due to the insufficient production of insulin, the metabolism of carbohydrates, fats, and protein is also disturbed. The insufficient production of insulin by the human body results in numerous metabolic disorders, such as increased blood pressure, cholesterol level, creatinine, transaminase level, WBCs, and decreased protein content (Nada, 2015). In diabetic patients, the insufficient secretion of insulin or production of inactive insulin results in increased glucose levels in blood and urine, and this pathological condition is termed hyperglycemia in which numerous metabolic disorders subsequently damage different organs and body parts such as kidneys, nervous system, eyes, and many other body systems.

In 2017, 451 million diabetes mellitus type 2 patients have been reported throughout the world. The pre-diabetes is termed used for people with harmed fasting glucose levels, and glucose tolerance and such types of individuals are highly risky of having diabetes mellitus. Diabetes mellitus is classified on the basis of its pathological properties, such as type 1 is a genetic disorder that appears early in life and type 2 is mainly related to lifestyle (Naziroğlu et al., 2004). The beta cells of the pancreas are responsible for the production of insulin, but they are destroyed in patients with diabetes mellitus type 1, while diabetes mellitus type 2 patients become resistant to insulin. Gestational diabetes mellitus is the third type of diabetes which
normally occurs during the third or fourth trimester of pregnancy while monogenic diabetes occurs in younger individuals (less than 25 years of age), it is a rare disorder that is caused by a genetic defect in the purpose of beta cells and it is insulin free dependent (Griffin et al., 2019).

Diabetes mellitus type-2 is a metabolic disorder, which is distinguished by resistance or impairment in insulin secretion. In diabetes mellitus type 2, there is excessive risk of cardiovascular disease due to low serum and higher concentrations of high-density lipoproteins. Insulin resistance is developed due to the alteration in insulin receptors, which subsequently deregulate their phosphorylation and de-phosphorylation process. The phosphorylation of tyrosine results in the reduced transfer of glucose through glucose transporter 4 across the cell membrane. The epidemiological studies of diabetes mellitus show that leukocytes (WBC) have an important role in the inflammation and development of diabetes mellitus. Moreover, the hemoglobin level is also reduced in the diabetic patient (Antwi-Baffour et al., 2018).

The objective of this study is to comparatively analyze the biochemical and hematological characteristics of diabetes mellitus type-2.

II. MATERIALS AND METHODS

This analysis was aimed to determine the hematological and biochemical pathological properties of diabetes mellitus type-2. All the procedures were carried out with prior approval by especial ethical committee of health care center of Pakistan. All the patients’ voluntary participated and data obtained in this study was only used for research purpose.

Study subject

The study consisted of 50 subjects with diabetes mellitus type-2 (Group-A) and 50 nondiabetic subjects (Group-B) (sex: female and age: 30-60 years). A specialized clinician diagnosed the all diabetics’ cases.

Blood sample collection

The subjects were needed to fast overnight for 8 to 12 hours and next day by venipuncture the blood samples were collected from both diabetic and nondiabetic subjects. The analysis was carried in the departmental laboratory. Centrifuged the blood samples for 10 min at 2500 rpm at room temperature and samples of serum were collected and were stored at -20°C.
until tested. The hematological methods were conducted to analysis the blood. The blood was stored in vacuum tubes containing EDTA anticoagulant for CBC test, glucose and lipid.

**Anthropometric measurements and blood pressure**

The height and weight of participants were scaled without shoes wearing light clothing. The BMI (body mass index) was calculated as dividing weight by square of individual height (kg-m).

**Hematological and biochemical tests**

The CBC (complete blood count) test included the determination of white blood cells (eosinophils, basophiles, neutrophils, lymphocytes, monocytes, platelets, total number mean platelets volume, platelets components distribution width, and mean platelets dry mass, number of RBCs (red blood cells), the distribution of red blood cells, and concentration of hemoglobin.

The different enzymes were used to measure the urea, total cholesterol, creatinine, and blood glucose levels. The total cholesterol (TC) was determined by enzymatic method, which was consisted of three enzymatic reagents such as peroxidase, esterase and cholesterol oxidase. After the completion of reaction, the final produced was measured by spectrophotometer. The blood glucose level was measured via glucose6-phosphate dehydrogenase method. The blood triglyceride level was determined through using glycerol 3-phosphate oxidase. The polymer poly anion method was used for determination of high density lipoprotein values. The level of low density lipoprotein was determined by fried Ewald method.

**III. RESULTS**

The diabetes mellitus is a complex disease, that effect the glucose utilization by body from the blood and irregularities in the blood glucose utilization leads to various pathological conditions, which can damage the major body organs such as kidney. The diabetes mellitus is characterized by the inability of human body to produce and respond to the insulin to regulate the blood glucose level. The pathological conditions produced due to the diabetes mellitus are main cause of illness and mortality (death rate), although these pathological conditions were not immediately produced from diabetes mellitus, but these pathological conditions develop because of chronic diabetes mellitus. The pathological conditions produced due to diabetes mellitus include big blood vessel (vessels (macro vascular illness, including coronary heart disease and
peripheral arterial disease) and small blood vessels (microvascular disease, including renal and retinal vascular disease), as well as of nerves diseases.

Table 1: Demographic findings and characteristics of the study participants

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unit</th>
<th>Reference range</th>
<th>Controls (M±SD)</th>
<th>T2DM (M±SD)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>years</td>
<td></td>
<td>47.6±4.9</td>
<td>46.6±5.6</td>
<td>0.113</td>
</tr>
<tr>
<td>BMI</td>
<td>kg/m²</td>
<td>overweight: &gt;23.0 to 24.9; obese: &gt;25.0 kg/m²</td>
<td>22.8±1.87</td>
<td>23.36±1.5</td>
<td>0.005</td>
</tr>
<tr>
<td>SBP</td>
<td>mm Hg</td>
<td>&lt;120</td>
<td>122.4±2.9</td>
<td>136.9±3.9</td>
<td>0.042</td>
</tr>
<tr>
<td>DBP</td>
<td>mm Hg</td>
<td>&lt;80</td>
<td>78.3±1.9</td>
<td>87.2±1.62</td>
<td>0.037</td>
</tr>
</tbody>
</table>

Data are presented as mean±standard deviation; *p<0.01.

The above results displayed that the mean levels of diastolic and systolic BP of nondiabetic (control) groups were significantly lower compare to type 2 diabetes mellitus (Table 1). The body mass index (BMI) showed a no significant distinction between the two groups.

Table 2: Biochemical assessments of T2DM and control subjects

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Reference range</th>
<th>Control group</th>
<th>T2DM</th>
<th>Significance value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDL</td>
<td>mg/dL</td>
<td>&lt;40</td>
<td>35.05±1.12</td>
<td>30.40±2.31*</td>
<td>0.042</td>
</tr>
<tr>
<td>Urea</td>
<td>mg/dL</td>
<td>&lt;50</td>
<td>29.4±1.2*</td>
<td>44.2±2.2*</td>
<td>0.022</td>
</tr>
<tr>
<td>Creatinine</td>
<td>mg/dL</td>
<td>&lt;1.5</td>
<td>0.68±0.04**</td>
<td>1.03±0.035**</td>
<td>0.008</td>
</tr>
<tr>
<td>LDL</td>
<td>mg/dL</td>
<td>&gt;130</td>
<td>135.5±5.20*</td>
<td>191.4±5.44*</td>
<td>0.011</td>
</tr>
<tr>
<td>FBG</td>
<td>mg/dL</td>
<td>70-110</td>
<td>82.6±5.14**</td>
<td>172.2±12.25**</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>TG</td>
<td>mg/dL</td>
<td>&gt;150</td>
<td>160.2±3.23*</td>
<td>188.5±4.04*</td>
<td>0.036</td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>mg/dL</td>
<td>&gt;200</td>
<td>182±4.22*</td>
<td>214.26±5.24*</td>
<td>0.040</td>
</tr>
</tbody>
</table>

Data are showed as mean ± standard deviation; *p<0.01.
The above results displayed that there was a rise in the biochemical parameters of T2DM group contrasted to the control group (Table 1, Figure 1). The following biochemical parameters such as urea (44.2±2.2) creatinine (1.03±0.035), total cholesterol (214.26±5.24), triglyceride (188.5 3±4.04), LDL (191.4±5.44) of T2DM group were evaluated and found increased compared with control group such as urea (29.4±1.2), creatinine (0.68±0.04), total cholesterol (182±4.22), triglyceride (160.2±3.63), and LDL (135.6±5.14), respectively. However, HDL level in T2DM group (30.40±2.31) was significantly lower compared with control group (35.05±1.12) (Table 1, Figure 1).

### Table 3: Complete blood count test result of control and diabetic group

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Units</th>
<th>Control group</th>
<th>Diabetic group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC</td>
<td>ul</td>
<td>6.39±1.40</td>
<td>8.70±0.94</td>
<td>.394</td>
</tr>
<tr>
<td>RBC</td>
<td>ul</td>
<td>6.06±0.54</td>
<td>6.01±2.16</td>
<td>.328</td>
</tr>
<tr>
<td>HGB</td>
<td>gdl</td>
<td>13.00±1.24</td>
<td>15.0±2.45</td>
<td>.089</td>
</tr>
<tr>
<td>HCT</td>
<td>%</td>
<td>42.6±6.12</td>
<td>43.6±5.40</td>
<td>.046</td>
</tr>
<tr>
<td>MCV</td>
<td>fL</td>
<td>84.4 ± 0.67</td>
<td>84.7±7.48</td>
<td>.000</td>
</tr>
<tr>
<td>MCH</td>
<td>pg</td>
<td>27.66 ± 0.28</td>
<td>30.8±3.43</td>
<td>.000</td>
</tr>
<tr>
<td>MCHC</td>
<td>gdl</td>
<td>30.62 ± 0.18</td>
<td>35.2±1.87</td>
<td>.034</td>
</tr>
<tr>
<td>PLT</td>
<td>uL</td>
<td>229.74±76.45</td>
<td>226± 72.9</td>
<td>.015</td>
</tr>
</tbody>
</table>
Figure 2: Comparative analysis of histological parameters

The above result shows the mean value of hematological parameter’s which are given below as white blood cells (WBC) of control group (6.39±1.40) and diabetic group (8.70±0.94), red blood cells of non-diabetic group (6.06±0.54) and diseased group (6.01±2.16). The mean value of hemoglobin in the control group was 13.00±1.24 and diabetic group 15.0±2.45. The mean value of hematocrit (HCT) in the diabetic group (was 43.6±5.40) and control group (42.6±6.12). The value of mean corpuscle hemoglobin (MCH), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration(MCHC), and platelet (PLT) in the diabetic group were as follows; 84.7±7.48, 43.6±5.40, 30.8±3.43, 35.2±1.87, 226±72.9, respectively. The value of MCV, MCH, MCHC, PLT in control group was recorded as follows; 42.6±6.12, 84.4±0.67, 27.66±0.28, 30.62±0.18, 229.74±76.45, respectively.

IV. DISCUSSION

In this study, it was found that the lipids profile including triglyceride (TG), total cholesterol (TC), and low-density lipoprotein (LDL) of a diabetic patient was increased, but the value of HDL was considerably decreased. The results of this study endorse the findings of earlier studies in which it has been reported that the type 2 diabetes mellitus is concerned with prolonged lipolysis, synthesis of triglycerides, and hepatic assimilation of fatty acids, and accumulation of hepatic triglycerides, which is as a result to insulin resistance (Barbieri et al., 2015). The level of TC in women is higher which is perhaps due to the sex hormone, especially E3, and has been reported to inflict an effect on lipid metabolism. The women produce a lower amount of HDL in their puberty, but the level of HDL-C is higher in the women due to the production of estrogen. The accumulation of LDL increases in women after menopause and it is
due to the lack of production of estrogen. The estrogen stimulates the production of LDL receptors on the hepatic cells, and due to this, the clearance of LDL particles also increases in non-menopause women. On the other hand, the clearance of LDL is reduced in women with menopause, which is due to the reduced production of estrogen and consequently LDL receptors on the hepatic cells.

The conclusions of this study show that the level of blood glucose, urea of blood, and serum creatinine increases in diabetic patients perhaps due to the damage inflicted to the kidney. The abnormal function of the kidney is associated with several factors, such as changes in the excretion rate of urinary albumin, glomerular filtration rate, and glycosylated hemoglobin (HbA1c) level (Blaslov et al., 2018). Diabetes is a major causative agent of progressive renal damage and it is considered one of the main causes of kidney failure. Therefore, the level of serum creatinine, blood urea, and urine albumin of diabetic patients should be regularly checked to avoid kidney failure (Punthakee et al., 2018).

In addition, we observed a decreased level of red blood cell count, hemoglobin, mean corpuscular volume, hematocrit, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration in the T2DM patients compared with the control group (Figure 2).

The morphological changes in the morphology of RBCs have also been strongly associated with higher blood glucose levels in diabetic patients, and these morphological changes include anisocytosis, poikilocytosis, and hypochromia. The changes in the morphology of RBCs can directly interfere with the normal function of the erythrocytes and also complicate the pathology of diabetes mellitus. The other studies have also endorsed the results such as a substantial decrease in the hemoglobin concentration, RBC counts, MCHC, and MCH level, of this study. The lifespan of red blood cells in diabetes mellitus type 2 patients decreases perhaps due to the irregular hematopoietic environment, which includes chronic hyperglycemia and hyperosmolarity (Biadgo et al., 2016). Chronic hyperglycemia and hyperosmolarity increase the internal viscosity and make the RBCs membrane more rigid than the normal RBCs, which consequently decrease the number of RBCs in diabetes mellitus patient.

The results of our study about the deformation of RBCs and other indices of diabetes mellitus are endorsed by the findings of a study performed by Agrawal LR. The decrease in the
red blood cells, MCV, and PCV levels and rise in MCHC levels in diabetic patients are associated with hepatotoxic effects (Sunitha et al., 2015).

The level of WBCs and other leukocytes such as neutrophils, lymphocytes, eosinophils, monocytes, and basophils was enhanced in the diabetes mellitus type 2 patients of this analysis, and Vozarova et al., (2002) have also reported a similar finding, they explained that it might be due to release of inflammatory mediator because of diabetes mellitus. The inflammatory agents, insulin, and abnormalities in the components of human blood are crucial indicators of invasion by foreign agents or inflammation due to other pathological conditions such as diabetes mellitus (Alam et al., 2015). The abnormalities in the components of human blood induce the defense mechanism, which further changes the level of mean platelet count, white blood cell count, and phagocyte percentage. It is a well-established phenomenon that the higher WBCs level displays chronic inflammation and this is explained due to the microvascular complications in type 2 diabetic patients (Tamariz et al., 2008).

The findings of our study display the strong connection between increased WBC count and type 2 diabetes mellitus and detection of the inflammatory markers can be a cost-effective approach to identifying diabetic patients, such as the quantification of WBCs can be done in any clinical setting and it was highly significant in our patients with diabetes.

The previously published literature has revealed the vital role of BMI to establish a synergistic relationship between WBCs and diabetes. The results of a six-year follow-up of healthy Japanese displayed no connection between diabetes and WBCs in volunteers with normal BMI. The results of another study, which was conducted for 5.5 years on the Japanese population displayed that the crude and adjusted HRs was significantly increased in participants (9,706) with higher WBCs level compared with lower WBCs level (Al Seraty et al., 2014). The difference in the results of the abovementioned studies is perhaps due to the difference in sample size and data analysis.

Ford et al conducted a study on US adults that comprised 20 years of follow-up and they aimed to discover a connection between leukocyte count and incidents of diabetes. For this purpose, they modified all potential surprising variables such as age, systolic blood pressure, smoking status, cholesterol concentration, physical activity, alcohol use, use of antihypertensive medication, and BMI. The Iranian researcher discovered no connection between WBCs count
and insulin resistance in type 2 patients (Al Shehri and Zafer Saad, 2017). The results of the current study are concomitant with the vital role of swelling in the etiology of diabetes.

V. CONCLUSION

Diabetes mellitus type 2 is a severe problem for public health. Fundamental biochemical and hematological changes in T2DM patients may lead to the evolution of long-term difficulty and dull quality of life or death. Therefore, it is hypercritical to follow up and monitor carefully hematological and biochemical parameters in a patient of diabetes.

References


