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Original Research Article

A Comparative Study of Hematological, Renal and Liver Function Criteriain Type I and Type II Diabetes Mellitus

Zainab Hadi Kamil
College of Dentistry, University of Babylon, Hilla, IRAQ

E- mail: zainabh76@yahoo.com

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Abstract

Diabetes mellitus (DM) is a metabolic syndrome resulting from a deficiency in insulin secretion leading to disorders of carbohydrate metabolism.Two distinguish types of DM are found (type I; insulin dependent, and type II; insulin independent).The chronic, long period complications of diabetes, associate withvascular diseases and dysfunction of kidney and liver.

The current study was considered to comparebetweentype I and type II Diabetes Mellitus (DM) and healthy adults insomehematological and biochemicalcriteria.

The study was carried out at laboratories of Merjan Hospital and involved 80Diabetic patients (33 type I diabetes mellitus; 14 males and 19 females, and 47 type II diabetes mellitus; 19 males and 28 females) aged between 30-65 years and 35 healthy subjects (10 males and 25 females) aged between 33-60 years.The study included three groups; healthy subjects, type I DM and type II DM.

Hematological criteria including red blood cell count (RBC), hemoglobin concentration (Hb), hematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC),red cell distribution width (RDW), white blood cell count (WBC), platelet count (PLT) and mean platelet volume (MPV) were determined by using hemato-analyzer.

Serum glucose, serum urea and serum creatinine were measured.Additionally the liver enzymes Glutamic pyruvate Transaminase (GPT) and Glutamic Oxalatetransaminase (GOT) were obtained.

The results of this study revealed significant differences ($p<0.01$) in serum glucose concentration, MCH (in males), RDW (in females) and MPV between the three groups involving in the study.

Significant differences ($p<0.05$) in MCV, RDW (in males), MCHC (in females), serum creatinine, S.GPT and S.GOT within the three groups of the study.

Diabetes mellitus is a high prevalent metabolic disease resulting in many health complications. RDW and MPV represent appropriate indicator for vascular complication due to DM.

Serum creatinine is more sensitive test for renal dysfunction rather than serum urea in diabetic patients.

Elevation in liver enzyme (GPT and GOT) levels is higher in type II DM as compared with type I DM. Hence non-insulin diabetic patient should be examine annually.

Key words: Diabetes Mellitus, renaldysfunction,liver dysfunction, RBC, WBC, PLT, urea, creatinine, GPT, GOT.

الخلاصة

يعرف داء السكري بمتلازمة التمثيل الغذائي الناجمة عن نقص في إفراز الأنسولين مما يؤدي إلى اضطرابات في التمثيل الغذائي للكربوهيدرات. يشمل داء السكري نوعين هما: النوع الأول (type I) المعتمد على الانسولين والنوع الثاني (type II) غير المعتمد على الانسولين. منالمضاعفات الطويلة الأمد لمرض السكري المزمن حدوث أمراض الأوعية الدموية و خلل في وظائف الكلى والكبد.

تهدف الدراسة الحالية لمقارنة المعايير الدموية و البيوكيميائية لدى النوع الأول والنوع الثاني مرض السكري و الأصحاء.

شملت الدراسة ٠٨ شخصاً مصاباً السكري (٣٣ مريضاً بداء السكري من النوع الاول (عدد الذكور ٤١ وعدد الاناث ٩١)و ٧٤ مريضاً بالنوع الثاني من داء السكري (عدد الذكور ٩١ وعدد الاناث ٨٢) وتتراوح أعمارهم بين ٠٣-٥٦ عاما و ٥٣ شخصاً سليماً (عدد الذكور ٠١ وعدد
الاناث ٥٢) تتراوح أعمارهم بين ٣٣-٠٦ عاما. أجريت الدراسة في مختبرات مستشفى مرجان التعليمي, وشملت الدراسة ثلاث مجموعات .
الاشخاص الاصحاء ، النوع الأول من داء السكري و النوع الثاني من داء السكري. تم قياس معايير الدموتشمل عدد خلايا الدم الحمراء (RBC) ، وتركيز الهيموغلوبين (Hb) ، الهيماتوكريت (Hct) ، مدل حجم الكرية (MCV) ، تركيز الهيموغلوبين الكريي(MCH) ، معدل تركيز الهيموغلوبين الكريي (MCHC) و عرض توزيع الخاية (RDW) ، وتم قياس عدد خلايا الدم البيضاء (WBC) ، عدد الصفائح الدموية (PLT) و معدل حجم الصفائح الدموية (MPV). كما تم قياس مستوى السكر واليوريا والكرياتينين في مصل الدم . بالإضافة إلى ذلك تم قياس انزيمات الكبد (GPT) و (GOT).
أظهرت نتائج هذه الدراسة فروق معنوية ($p<0.01$) في تركيز السكر في الدم، و MCH (في الذكور) ، RDW (في الإناث) و MPV بين المجموعات الثلاث المشمولة في الدراسة.
كما بينت الدراسة ظهور فروق معنوية ($p<0.05$) في MCV، RDW (في الذكور) ، MCHC (في الإناث) ، والكرياتينين في الدم ، S.GPT و S.GOT ضمن المجموعات الثلاث من الدراسة.

مفاتيح الكلمات: داء السكري, اضطراب وظائف الكبد, اضطراب وظائف الكلى, خلايا الدم الحمر, خلايا الدم البيض, الصفيحات الدموية, اليوريا, الكرياتنين, انزيمات الكبد.

Introduction

Diabetes mellitus (DM) is a metabolic syndrome resulting from a deficiency in insulin secretion, insulin action, or both. Insulin insufficiency may leads to prolonged hyperglycaemia with disorders of carbohydrate metabolism [1].

The incidence of diabetes is increasing speedily global and the World Health Organization (2006) has expected that by 2030 the number of adults with diabetes would have practically augmented worldwide, from 177 million in 2000 to 370 million [2]. Two distinguish types of DM are found (type I; insulin dependent, and type II; insulin independent.Type I DM is a chronic autoimmune disorder when immune system attacks and destroy the beta-cells of the pancreas and leading to failure in insulin production [3]. Type II DM considers for 90% of the people with diabetes. There are varying degrees of insulin resistance or insulin secretary defects and its complication occurs after many years of uncontrolled hyperglycemia[4].

The chronic, long period complications of diabetes, associate withvascular diseases; micro vascular disease (includingretinopathy, nephropathy and neuropathy) and macro vascular disease [5].

Blood asa transporter of metabolic products from and to the different regions of the body, is influencedby thecondition of the tissue environment andthe functional characteristics of erythrocytes are altered because of staying in hyperglycemic environment for long time leading to its deformability[6].

Excessive activity of platelet can play a role in the advancement of vascular complications of this metabolic disorder. Meanplatelet volume (MPV), which represent a measurement of the platelet function and activation, may be effected by diabetes mellitus as a risk factor of expansion of vascular diseases [7].

Diabetes mellitus is one of the main causes of the kidney dysfunction [8]. Diabetic nephropathy is the kidney disease that occurs as a result of diabetes,the risk to develop nephropathy are quite similar in both types of diabetes [9]. About 40% of type I diabetic patients and 20-40% of the type II diabetic patients will consequently develop diabetic nephropathy[10].

The liver has an important main role in regulation of carbohydrate metabolism it has the ability to store glucose as glucagon and synthesize glucose from non-carbohydrate source, that making

liver susceptible to metabolic disorder specially diabetes [11].

Diabetes development can damage liver and the heart muscle cells by effecting in levels of the liver enzymes;serum glutamate oxaloacetate transaminase (GOT) and serum glutamate pyruvate transaminase (GPT) [12].

Mild chronic raises of transaminases often reveal underlying insulin resistance in type II DM. Hence antidiabetic agents have mostly been revealed to reduce alanine aminotransferase levels[13].

Materials and Methods

Subjects

Bloodsamples of diabetic patients (32 type I diabetes mellitus and 47 type II diabetes mellitus) aged between 30-65 years were collected from Merjan Teaching Hospital from May to October 2014. They were distributed into two groups (Type I and Type II) as well 35 healthy subjects represent control group as shown in the following table:

Gender	Health subjects	Age range (year)	Diabetic Patients			
			Type I	Age range (year)	Type II	Age range (year)
Male	10	33-60	14	44-64	19	40-65
Female	25	30-67	19	30-64	28	34-65
Total	35	30-67	33	30-64	47	34-65

The subjects in this study were not suffering from any chronic disease,hypertension, alcoholism and smoking and never took drugs (accept Antidiabetic Agent;glibenclamide and metformin, for type II diabetic patients) in the last month. Diabetes mellitus were diagnosed according to WHO criteriawhen fasting plasma glucose ≥7.0mmol/L [2].

Hematological criteria

The blood samples were collected in tubes with EDTA as anticoagulant and analyzed by Automated hemato-analyzer.Red blood cell count (RBC), hemoglobin concentration (Hb), hematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC),red cell distribution width (RDW), white blood cell count (WBC), platelet count (PLT) and mean platelet volume (MPV) were determinedby using automatic hematology analyzer (CELL-DYN Emerald by Ruby).

Biochemical criteria

Serum was collected for biochemical criteria.Serum glucose, serum urea and serum creatinine were measured**,**additionallythe liver enzymes Glutamic pyruvate Transaminase (GPT) and Glutamic Oxalatetransaminase (GOT) were obtained by using chemistry analyzer (Cobas c 111 by Roche).

Statistical analysis

All data were subjected to ANOVA: single factorto determine the level of significance between healthy, type I and type II diabetic patients.Data are reported as mean ± standard deviation (±SD).The significant differences were considered when p value were < 0.05 and 0.01.

Results

1. Serum glucose concentration

The three groups in this study showed significant differences ($p<0.01$) in serum glucose concentration (figure 1). It was significant increase in type I diabetic patients (13.88 ± 2.88mmol/L) as compared with type II diabetic patients (12.72± 2.74mmol/L) and with healthy subjects (5.1 ±0.36mmol/L). Also the concentration was significant increase in type II diabetic patients as compared with healthy subjects.

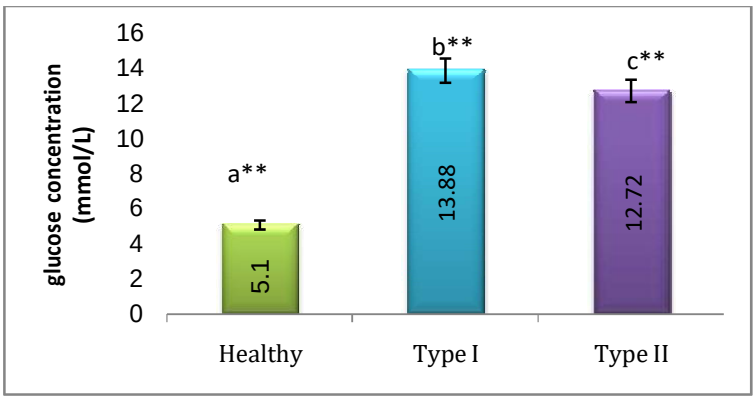

Figure 1: Serum glucose concentration in type I and type II diabetic patients as compared with healthy subject.
****** Significant differences at P< 0.01
Differentletters mean significant differences

2. Red Blood Cells parameters

The results showed (figure 2) significant differences ($p<0.05$) in MCV of the males in the three groups of this study. Significant increase in MCV of type I diabetic males (92.64± 1.85fL) as compared with MCV of type II diabetic males (90.64± 2.0fL) and of healthy males (85.69 ± 3.56fL). Additionallysignificant increase in MCV of type II diabetic males as compared with MCV of healthy males.

The study (figure 2) revealed significant increased($p<0.001$) in RDW of type I diabetic males (13.2 ± 0.43) as compared with RDW of type II diabetic males (12.77± 0.43) and RDW of healthy males (12.4 ± 1.06).

Figure -3 demonstrate significant decrease ($p<0.05$) in MCHC of type I diabetic females (32.71 ± 0.34 g/100 ml) as compared with type II diabetic females (33.15 ± 0.96 g/100ml) and healthy females (33.96 ± 1.07 g/100ml).

In figure (3), RDW of type I and type II diabetic females (13.54 ± 0.72&13.55 ± 0.84 respectively) was significant augmented ($p<0.05$) as compared with healthy females (11.32 ± 0.94).

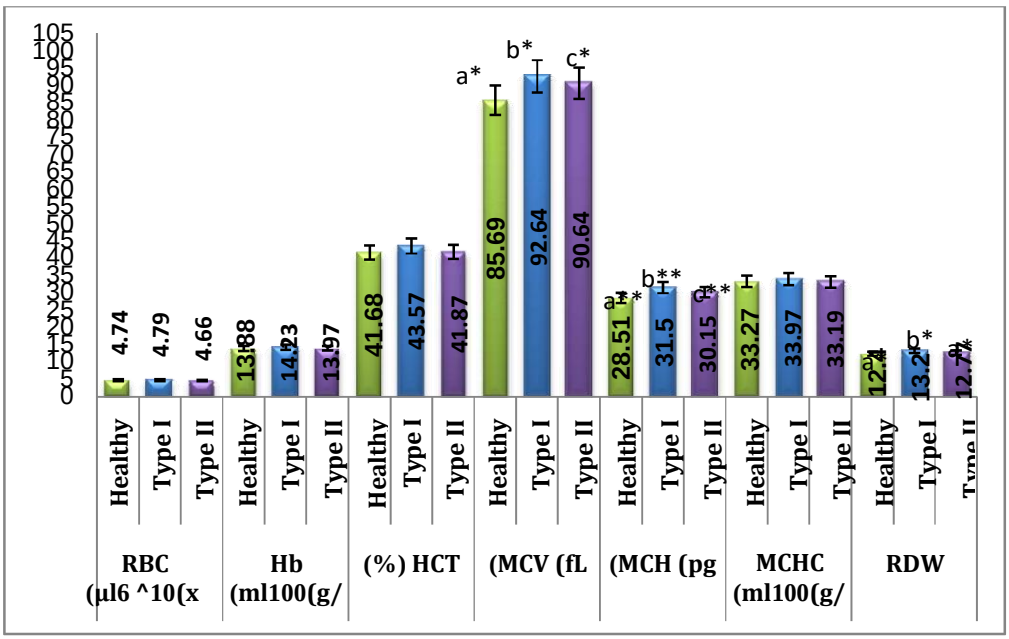

Figure (2): Red Blood Cells criteria of type I and type II diabetic male patients as compared with healthy males.

***** Significant differences at P< 0.05

****** Significant differences at P< 0.01

Differentletters mean significant differences

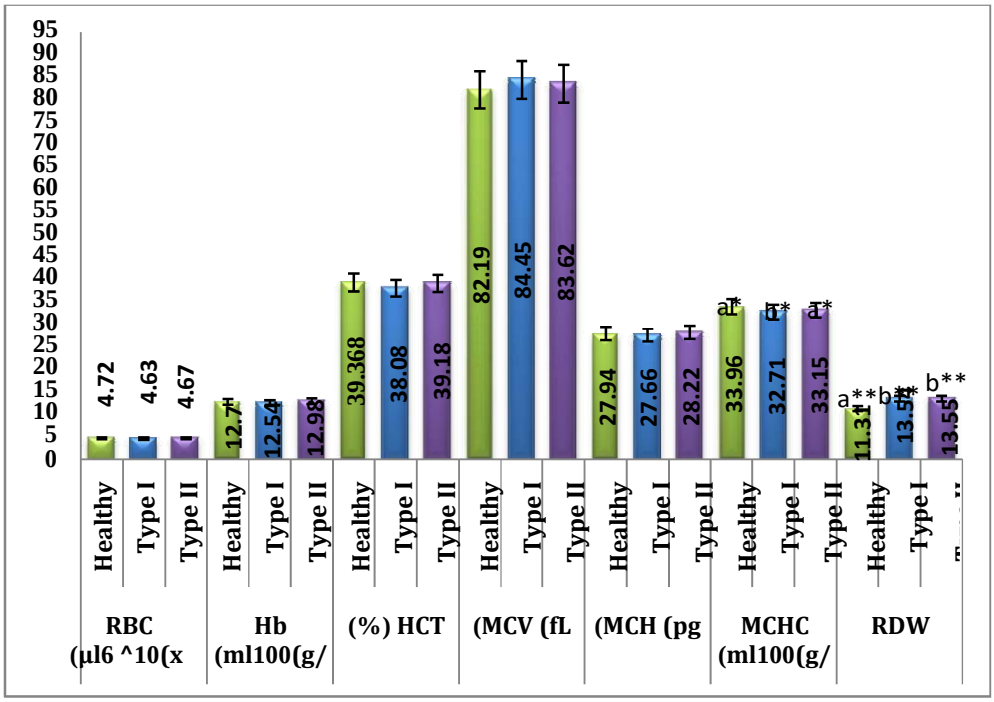

Figure 3: Red Blood Cells criteria of type I and Type II Diabetic female patients as compared with Healthy female.

***** Significant differences at P< 0.05

****** Significant differences at P< 0.01

Differentletters mean significant differences

3. WhiteBlood Cells and Plateletscriteria

The results showed (figure 4) significant increase ($p<0.01$) in MPV of type I diabetic patients (8.82 ± 0.52 fL) and type II diabetic patients (8.83 ± 0.56 fL) as compared with healthy subjects (7.51 ± 0.33 fL). There were no significant differences in WBC count between the three groups of this study.

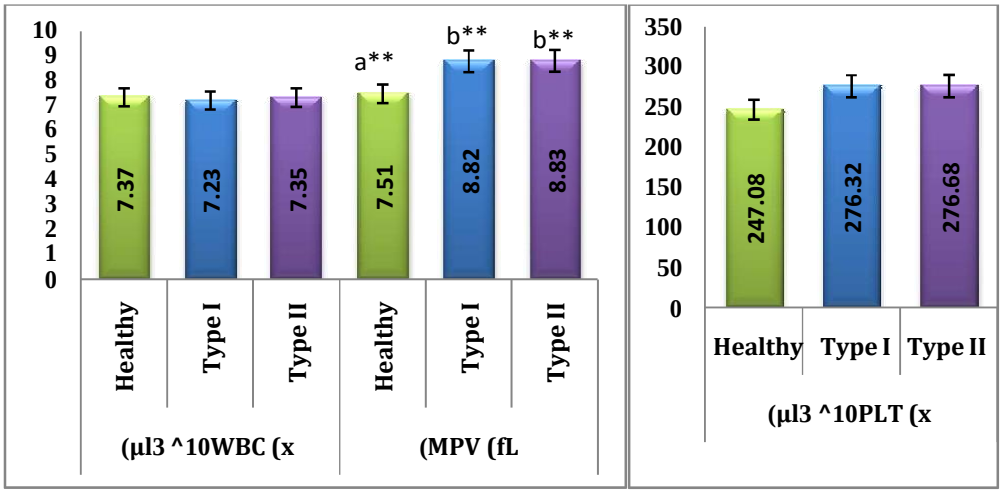

Figure 4: White Blood Cells and platelets criteriaof type I and type II diabetic patients as compared with healthy subject.
****** Significant differences at P< 0.01
Differentletters mean significant differences

3. Renalfunctioncriteria

Statistical analysis showed (figure 5) significant differences ($p<0.05$) between the three groups.

Significant increase was observed in serum creatinine (63.28 ± 8.03 µmol/L) in type II diabetic patients as compared withtype I diabetic patients (62.5 ± 6.19µmol/L) and healthy subjects (56.6 ± 6.36µmol/L).

4. Liver functioncriteria

Serum GPT was significant increased (figure 5) in type II diabetic patients (26.12 ± 3.15 I.U/L) as compared with type I diabetic patients (24.14± 2.73 I.U/L) and healthy group (20.85 ± 2.52 I.U/L).

Significant increase was detected in serum GOTin type II diabetic patients (23.42 ± 2.55 I.U/L) as compared with type I diabetic patients (21.78 ± 2.78 I.U/L) and healthy group (19.22 ± 2.64 I.U/L).

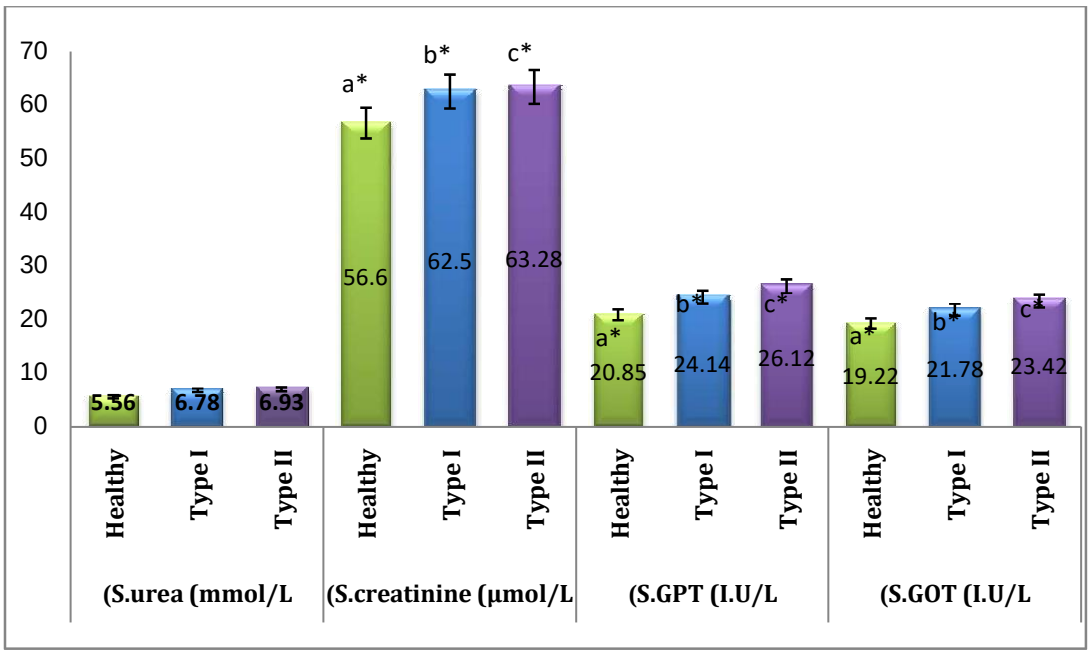

Figure 5: Biochemicalcriteriaof type I and type II diabetic patients as compared with healthy subject.
***** Significant differences at P< 0.05
Different letters mean significant differences

Discussion

Current study showed elevation in fasting glucose in both types DM (type I and type II).Thisis agree with other studies [14-17]. It was highly increased in type I DM as a result of uncontrolled or unwell controlled diabetes[18].According to the results it is found that diabetes mellitus may be associated with variations in hematological and biochemical criteria.The study indicated highly altitude in RBC criteria in diabetic patients especially MCV, MCH and RDW, these criteria were much indicated in type I DM. These results were agree with the previous study of Jabeen*et al* [6].

On the other hand the study signifya reduction in MCHC in females. In general RBCs criteria were decreased in females and increased in males, except RDW which elevated in both gender of diabetic patients. Many prior studies [19,20] mentioned thattypeI diabetes mellitus caused significant drop in RBCs indices except RDW. In reverse direction Meisinger*et al*., reported significant increase in RBCs indices in diabetic adults [21]. In general the decreasing of RBC criteria were observed in type I DM as diabetes is the most common cause of kidney disease which lead to decreasing in erythropoietin level [22] and cause un obvious renal normochromic normocytic anemia [23].

Type II DM was relevant with the elevation of RBC parameters [6,21]. Increasing in glucose concentration is one of the main feature that effects the erythrocyte morphology[24]. Hence increasing of erythrocyte criteriacould be used as probable indicators to discover the risk of developing vascular complications in diabetic patients[25].

Generally any change in glycemic control parameters is reflected by erythrocyte indices that can be used as indicator for diabetic complications.Jabeen et al. indicatedsignificant positive correlation between fasting blood glucose and HbA1c [6]. Furthermore the elevation of erythrocyte criteria could be reflected an indirect particularity of insulin resistance syndrome [26] as an raised glucose level is related to the insulin resistance syndrome or loss of insulin sensitivity

causing vascular complications due to diabetes [27].

The current result didn't show increasing in all the RBC criteria in type II DM especially RBC count, Hb and Hct, this could be caused by the effect of antidiabetic drug (metformin) which minimize the levels of the RBC criteria that already elevated in type II DM making them within normal range [28].RDW elevation found to be associated with a raising risk of macro-vascular complications in type II diabetes mellitus[29].

The result showed no differences in white blood cell count within the three groups of the study which correspond with other study [6]. Previous studies indicate increasing in peripheral leukocyte count as a result of diabetes mellitus [20,30,31].Ford suggested that elevation of leukocyte provide partial support to the supposition that inflammation is an pathogenesis aspect for diabetes [32].Raisedcirculating WBC count was related with decay of glucose metabolism and could indicate higher risk of type II DM[33]. The un increasing of WBC in recent study may be caused bythe effect of antidiabetic drug (metformin) which minimize the increasing of WBC count in type II [28].

The study included significant increase in MPV as a result of diabetes mellitus in both types (type I & II) which it was compatible with other previous studies [6,31]. TypeI diabetes mellitusisrelatedto platelet count elevation as a role of the microvascular complications in diabetes[34]. MPV was associated with type II DM and it is a substitute indicator of platelet activation as DM is characterized as subclinical inflammation [35]. Poor glycemic control causes elevation in MPV since hyperglycemia speeds up vascular complication in diabetes [36].

Determination of the serum urea and creatinine is extensively observed as a test of renal function[14].This study revealed significant changes in serum creatinine as a result of diabetes. It was significant increase in type II DM as compared with type I DM which correspond with other studies [15,16,17,37,38] whom confirm serum creatinine elevation as a result of DM. In the meantime current study indicates no significant variations in serum urea level in diabetic patient which agree with [16,17,39] because serum creatinine is more delicatesignal of renal function test [10,40].

The liver has a main role in glucose homeostasis and hepatic carbohydrate metabolism[41]. Many different biochemical parameters are useful in determine hepatic dysfunction including liver enzymes; GPT and GOT [11]. The results of the study signify elevation of GPT and GOT in both types of diabetes mellitus.It was much higher in type II DM. it was found that type II diabetic patients more frequently had abnormal liver function test results than did type I diabetic patients[41].Many previous studies [11,16,41] identified with these results. Salih mention the serum glucose level correlated with biochemical parameters including GPT and GOT [16].

Conclusion

Diabetes mellitus is a high prevalent metabolic disease resulting in many health complications. The study revealed that hematological criteria changed as a result of DM, especially RDW and MPV were highly elevated in type I as compared with type II. RDW and MPV represent appropriate indicator for vascular complication due to DM.

Serum creatinine is more sensitive test for renal dysfunction rather than serum urea in diabetic patients.

Elevation in liver enzyme (GPT and GOT) levels is highly in type II DM as compared with type I DM. Hence non-insulin diabetic patient should be examine annually.

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