A Study of Correlation between some Blood Parameters and Diabetic Mellitus Type 2 in Diabetic Women

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Abstract

This study was contacted to evaluate the effects of diabetes mellitus disease type 2 on some blood parameters and red blood cells indices in women. Twenty women were used in this study. Their ages ranged between (20-40) years divided into two groups: group 1 included 10 women suffering from diabetes mellitus type 2, and (10) normal women as control. The results revealed a significant increase (P<0.05) in blood sugar level of women suffering from diabetes mellitus when compared with control and the results of blood parameters showed a significant increase (P<0.05) in PCV and Hb level, but there was a significant decrease (p<0.05) in some RBCs indices MCH, MCV, MCHC color index (CI) and saturation index(SI) in patients when compared with normal subject.

Keywords: Blood Parameters, Diabetic Mellitus disease type 2, Diabetic women

Introduction

Insulin is a hormone produced in the pancreas that helps transport glucose (blood sugar) from the blood stream into the cells, so they can break it down and use it for fuel. People cannot live without insulin. Diabetes results in abnormal levels of glucose in the blood stream. This can cause severe short stream and long stream consequences ranging from brain damage amputation and heart disease (American Diabetes Association (ADA), 2007). Type 2 diabetes accounts for 90-95% of diabetic cases, according to the U.S. national institutes of health(NIH) some of these patients have hard prediabetes that went uncontrolled once considered disease of middle and old age, type 2 is also becoming more common in youths as the incidence of childhood obesity grow. Diabetes mellitus (DM) is characterized by sustained hyperglycemia and sometimes hyperlipidaemia.

The chronic hyperglycemia often results in non-enzymatic glycosylation of some protein molecules, setting in motion a chain of reactions that may end in the distortion of proteins thus altering their structural conformation and physiological roles. These products often termed advanced glycosylation end products (AGEs) cause hardening of tissues and blood cells and thus lead to deteriorations similar to those observed in ageing AGEs have been linked to...
stiffening of connective tissues hardened arteries loss of nerve functions and deterioration of kidney functions (Cerami, 1985). The degree of glycosylation of hemoglobin, the oxygen carrying pigment of the red blood cells, has been shown to be useful index of glycaemic control (Chen, 1986). However, the effects of hemoglobin glycosylation on red blood cell structure and functions are not well known.

Oxidative stress in cells and tissue plays an important role in the pathogenesis of diabetes mellitus (DM). Oxidative stress manifests by increased levels of free radicals and Lpo, it suppresses glycolysis, protein and nucleic acid production, and enzyme activities and promotes oxidatio–phosphorylation uncoupling the rate of free surpasses the rate of their neutralization by the antioxidant system. Oxidative stress is regarded complication of DM, but also as a factor underlying the development of DM.

Toxic effects of glucose on erythrocyte manifest in restructuring of the erythrocyte membranes, disorders in hemoglobin oxygen–binding activity, modification of mechanical characteristics of the membrane and cell in general.

Erythrocytes are an important determinant of the rheological properties of blood because of their large number density (5×10⁹/mm³), particular mechanical properties, and aggregation tendency. Typically, a human RBC has a biconcave shape of 8 Mm in diameter and 2 Mm in thickness, and is highly deformable (Desouky, 2009).

The proteins of the RBC membrane are divided into two groups integral and peripheral. Integral proteins (glycophorin and band 3 proteins) are tightly bound to the member through hydrophobic interaction lipids in the bilayer (Desouky, 2009). A filamentation network of proteins is an choreo to the bilayer by the integral protein. This network has three principal components spectrin, actin and Ankyrin protein. The peripheral membrane proteins are located on the cytoplasmic surface of the lipid bilayer and can be readily released from the membrane by simple manipulation of the ionic strength of the milieu or variation in the concentrations of other protein (Desouky, 2009).

Robert et al. (2004) reported an inverse correlation with glycoemoglobin concentration in patients with diabetes. They interpret this as a reduced erythrocyte life span at higher blood glucose concentration. The hemoglobin(Hb) concentration depends not only on erythrocyte mass but also on plasma volume; hence, it is sensitive to variation in hydration and renal, liver, and cardiac function. Variations in plasma volume would act in one direction on [Hb] and in the opposite direction on blood volume.

Materials and methods

Twenty women subjects aged 20-40 years were prospectively studied and classified as group 1 (n=10) healthy woman group 2 (n=10) women suffer from diabetes mellitus type 2.

Collection of blood samples:

Blood samples were collected from healthy control and diabetic patients by vein puncture using 5 ml disposable syringes. Blood was divided into two parts, first part: 3ml was put in the centrifuge tube and allowed to clot for 15 minutes then it was centrifuged for approximately 10 minutes at a relative centrifugal force (RCF) of 3000 xg and separated the serum in plain tube for blood biochemical analyses.

Second part:

2 ml was put in EDTA tube, the blood was mixed gently and then used for haematological tests.
**Haematocrit determination**

The packed cell volume (PCV) was estimated by using the method of (Allexander and Griffithis 1993). Haematocrit capillary tubes were filled by capillary action to mark with whole blood and bottom end of the tubes were sealed with plasticine.

The tubes were centrifuged for 5min using haematocrit centrifuge. The percentage of cell volume was read by sliding the tube along the haematocrit reader until the meniscus of the plasma intersects the 100% line.

**Haemoglobin estimation**

Cymothaemoglobin (Drabkin) method (Alexander and Griffiths,1993) of hemoglobin estimation was employed. Twenty microlitres of EDTA anticoagulated whole blood was added to 5 ml of darbkin reagent mixed and incubated for 5 min at room temperature for the colour to develop. The absorbance was read against reagent blank at 450 nm using otima sp-300 spectro -photometer.

**Red blood cell count**

Red blood cells were counted by visual method using new improved Neubauer counting chamber. A 1 in 200 dilution of blood was made in formal citrate solution (haymen’s fluid) and the counting chamber with its cover glass in position was filled with the diluted blood using Pasteur pipette and ensuring that the chamber was filled in one action. The chamber was allowed to settle for 2 min for the cells to settle. Five squares ,the four corner and the central squares were counted using X 40 objective lens(Ekaidem,2010).

**Red blood cell indices**

- Mean corpuscular volume (MCV) – Average Is 90fL ; rang ,82-98 fl

\[
\text{MCV fl} = \frac{\text{Volume of packed red cells (L/L)}}{\text{Red cell count (X10}^{12} /L)}
\]

\[
\text{Volume index (VI) – normal is 0.9 – 1.1 (Besa et.al.,1992)}
\]

\[
\text{VI} = \frac{\text{observed red cell volum in % of normal}}{\text{observed red cell in % of normal}}
\]

- Normal volume (pcv)

\[
\text{VI} = \frac{\text{Red cells count found}}{\text{Normal red cells count}}
\]

- Mean corpuscular hemoglobin (MCH) (The is normal value = 30 pg) ranged between (27-33 pg ) (يوسف, 1989)

\[
\text{MCH} = \frac{\text{Hgb(g/l)}}{\text{Red cell count}}
\]

- Color index (CI)- Normal is 0.9 -1.1 (Besa et.al.,1992)

\[
\text{CI} = = 1.12
\]
• Mean corpuscular hemoglobin concentration (MCHC)- this is the amount of hemoglobin in terms of percent of the volume of corpuscle .Average is 33% ; range 32-36 %

\[
\text{MCHC} \% = \frac{\text{Hbg(g/L blood)}}{\text{pcv (L/L)}}
\]

• Saturation Index (SI) - normal is 0.9 – 1.1 (Besa et.al.,1992)

Statistical analysis

Statistical analysis of obtained data was performed according to Snedecor & Cochrar (1980).

Results

The results showed a significant increase at (P<0.05) in blood sugar level in women affected with diabetic mellitus type 2 when compared with normal women (Fig.1).

![Blood sugar level in diabetic patient and control](image)

Figure (1): Blood sugar level in diabetic patient and control (n=10).

Table(1).The results of blood parameters revealed a significant increase at (P<0.05) in some blood criteria such as PCV & Hb in patient with diabetic mellitus type 2 when compared with normal (Table-1), and in Table (2) there was significant decrease in MCH, MCHC, CI and in patient compared with normal, but SI, MCV and VI were not affected by diabetic mellitus when compared with normal.

Table (1): Effect of diabetes mellitus on some blood parameters. (n=10)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Blood parameters (Mean±S.D)</th>
<th>PCV (%)</th>
<th>HB (g/dL)</th>
<th>RBCs (million×mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td></td>
<td>39.45±1.46</td>
<td>12.44±0.49</td>
<td>4.14±0.20</td>
</tr>
<tr>
<td>Patient</td>
<td></td>
<td>41.05±2.05*</td>
<td>13.03±0.65*</td>
<td>4.22±0.15</td>
</tr>
</tbody>
</table>

* Significant difference at (P<0.05)
Table (2): Effect of diabetes mellitus on some RBCs indices. (n=10)

<table>
<thead>
<tr>
<th>Sample</th>
<th>RBCs indices (Mean±S.D)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SI (I.I)</td>
<td>MCV (fl)</td>
<td>VI (I.I)</td>
<td>MCH (pg)</td>
<td>CI (I.I)</td>
<td>MCHC (%)</td>
</tr>
<tr>
<td>Normal</td>
<td>0.97±0.06*</td>
<td>95.41±2.76</td>
<td>1.01±0.06</td>
<td>32.04±1.42*</td>
<td>0.99±0.01*</td>
<td>33.32±1.99*</td>
</tr>
<tr>
<td>patient</td>
<td>0.90±0.05</td>
<td>97.24±3.72</td>
<td>1.04±0.05</td>
<td>28.81±1.32</td>
<td>0.94±0.04</td>
<td>30.40±1.46</td>
</tr>
</tbody>
</table>

* Significant difference at (P<0.05)

The relationship among blood parameters and duration of blood sugar level revealed that there were positive relationship among PCV, Hb, MCV, VI and MCH, and duration of disease (Fig.2, 3, 4, 5, 6, 7); also there was positive relationship among SI, CI, MCHC and of blood sugar level (Fig. 8, 9, 10).

Figure (2): The relationship between PCV (%) and duration of disease in diabetic patients.

Figure (3): The relationship between Hb (g/dL) and duration of disease in diabetic patients.

Figure (4): The relationship between RBC (million/mm³) and duration of disease in diabetic patients.
Figure (5): The relationship between MCV (fI) and duration of disease in diabetic patients.

Figure (6): The relationship between VI (I.I) and duration of disease in diabetic patients.

Figure (7): The relationship between MCH (pg) and duration of disease in diabetic patients.
Figure (8): The relationship between SI (I.I) and sugar level in diabetic patients.

Figure (9): The relationship between CI (I.I) and sugar level in diabetic patients.

Figure (10): The relationship between MCHC (%) and sugar level in diabetic patients.

Discussion

The present study indicated that diabetes mellitus effect in some haematological parameters. The morbidity associated with diabetes mellitus results from a number of serious macrovascular and microvascular complications, accelerated atherosclerosis among diabetics is the major pathologic cause of these processes resulting in increased risk of myocardial infarction and stroke (ADA, 2007).

The results in this study showed that pcv&Hb increased significantly (P<0.05) in women patient when compared with control, while RBC count, MCV&VI did not significantly change. The increased in PCV value of diabetic women may be due to the dehydration and accumulation of protein, also Desouky (2009) showed that there are two important parameters of
the rheological properties of blood changes in diabetic patients there are yeild stress and viscosity ,the yeild stress is a sensitive index of blood fluidity at low shear rates,when no shear stress is applied ,the red blood cells placed in suspension adheren face to face and form aggregates called rouleaux, while the low shear viscosity is a function of the aggregability of the red blood cells ,the viscosity in the high shear region depends on their deformability,RBCs from diabetic patients were found to be more rigid than normal and have reduced deformability may be due to the interaction haemoglobin with the membrane that contributis to alteration thecellular rigidity membrane, this reduced appears as increas in the yeild stress and viscosity. The increased in Hb level may be due to the variation in plasma volum in diabetic patients that act in one diraction on Hb and in opposite diraction on blood volume because the Hb concentaration depends on plasma volum and erythrocyte mass (Cohen et al.2004).

The results of this study didn’t agreement with other studies that found decreased in hematological parameters (PCV, Hb, RBC) in patient diabetic type 2 such as (Vahalkar, 2008;Valilou et al.,2011) hadn’t found any significant effects on RBC,Hb,PCV,MCHC,MCH and MCV rates in dogs that treated by alloxan to induce diabetic mellitus.

Our studies show significantly decreased in SI,CI, MCH&MCHC,Some studies have been suggested that anaemia occurrence in diabetic mellitus is due to increase non-enzymatic glycosylation of RBC membrane proteins, which correlated with hyperglycaemic (Kennedy & Baynes, 1984). Oxidation of these glycosylated membrane proteins and hyperglycaemia in diabetes mellitus cause an increase in the production of lipid peroxides causing a hemolysis of RBCs (Meral et al., 2004), or diabetes mellitus may cause anemia as secondary disorders, for example after occurrence of diabetic nephropathy. Diabetes related anemia has been observed in the advanced anemia of diabetic nephropathy about 20% of those with type 2 diabetes eventually develop some kidney damage and later kidney failure (Raval et al., 2011); however, diabetic affects the hematologic system in several ways. It was suggested anemia occurrence in diabetic cases may be because of insufficient androgen releasing function of adrenal glands or less erythropoietin concentration (Anderson et al., 1994). In other previous study of Valilou et al. (2007) histopathological changes of dogs kidney include cell degeneration, vacuolization of endothelial cells and thickness of basal membrane were seen at glumerolar filtration surface and Bonakdaran et al.(2009) suggested that anemia has a high prevalence in type 2 diabetic patients and it has high correlation with kidney disorders, Livecchi et al.(2007) reported that diabetes incorporation with kidney nephropathy can cause anemia.

Inin the our study, the RBC count didnot change,while other studies such as (Mearal etal.,2004; Mansi,2006; Vahalker&Haldankar,2008) showed that hyperglycemia indiabetic patients and oxadation of glycosylated membrane protien cause an increase production of lipid peroxidase causing a hemolysis of RBC. Dallak&Bin(2010) showed that RBC count &PCV were significantly increased in diabetic rats treated with glibenclamide or the citrules colocynthis extract and these increases due to the lipid peroxidation level in RBCs membrane leading to a decrease susceptibility of RBCs to hemolysis.

References


