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Hematological Parameters in Type 2 Diabetes Mellitus

Conflict of interest: nothing to declare.
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Abstract

Introduction. Disturbances of hemostatic mechanism have been frequently described in patients with diabetes mellitus and have been associated with the development of diabetic complications and increased incidence of cardiovascular events in diabetic subjects.
Purpose. Aim of the study is to assess the hematological parameters in CVD patients with type 2 diabetes mellitus.
Materials and methods. During the period of three months October, November and December 2010, forty-nine patients from Baghdad Teaching Hospital / Medical City were included in this study. All of them were adults with type 2 diabetes mellitus having different duration of illness. Twenty four normal healthy volunteers who were included as a control group. For each subject in the study and control group, the following tests were investigated: Total white blood cell count, packed cell volume and platelet count.
Results. The study revealed a high WBC count in diabetics versus control group with a mean value of $8.6\pm2.4\times10^9$/L versus $7.3\pm1.7\times10^9$/L. The difference between hematological parameters of control and study groups was statistically insignificant, though there were a slightly raised WBC counts and platelet counts in some diabetic patients. The difference between all diabetic patients and control in mean WBC count was statistically significant (p=0.02). While the difference in mean PCV and platelet count were statistically insignificant (p=0.6 and 0.7) respectively.
Conclusion. The present study revealed a significantly high WBC count in diabetic type 2 patents versus control subjects. Further studies with larger number of patients are needed to confirm these findings.
Keywords: hemostasis, diabetes mellitus, white blood cell count, packed cell volume, platelet count

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Гематологические параметры при сахарном диабете 2-го типа

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Резюме

Введение. Нарушения механизма гемостаза часто описываются у пациентов с сахарным диабетом и ассоциируются с развитием диабетических осложнений и увеличением частоты сердечно-сосудистых событий у пациентов с сахарным диабетом.
Цель. Оценить гематологические показатели у пациентов с ХСН и сахарным диабетом 2-го типа.
Материалы и методы. В течение трех месяцев (октября, ноября и декабря) 2010 г. в исследование были включены 49 взрослых пациентов с сахарным диабетом 2-го типа с различной продолжительностью заболевания из Багдадской учебной больницы / Медицинского города. Здоровые добровольцы (n=24) были включены в контрольную группу. Для каждого испытуемого в исследуемой и контрольной группе были проведены следующие исследования: общее количество лейкоцитов, гематокрит и количество тромбоцитов.
Результаты. Исследование выявило высокий уровень лейкоцитов у диабетиков по сравнению с контрольной группой: среднее значение $8,6\pm2,4\times10^9$/л против $7,3\pm1,7\times10^9$/л. Разница между гематологическими параметрами контрольной и исследуемой групп была статистически незначительной, хотя у некоторых пациентов с диабетом наблюдалось незначительное повышение уровня лейкоцитов и тромбоцитов. Разница между всеми пациентами с диабетом и контролем в среднем количестве лейкоцитов была статистически значимой (p=0,02). В то время как разница в средних значениях PCV и количества тромбоцитов была статистически незначимой (p=0,6 и 0,7 соответственно).
Заключение. В настоящем исследовании выявлено достоверно высокое количество лейкоцитов у пациентов с сахарным диабетом 2-го типа по сравнению с контрольной группой. Для подтверждения полученных результатов необходимы дальнейшие исследования с большим числом пациентов.
Ключевые слова: гемостаз, сахарный диабет, количество лейкоцитов, гематокрит, количество тромбоцитов

■ INTRODUCTION

Increasing attention has been paid to disordered hemostatic mechanisms in the pathogenesis of vascular disease in diabetics and such disorders may be of importance in determining the increased risk of large vessel and small vessel disease in diabetes. Blood vessels play an important role in control of hemostasis, thrombosis and inflammation. Endothelial cells (ECs) which form the lining of all blood vessels are particularly important in this process because of their intimate association with flowing blood; and it serves as interface between circulating blood and smooth muscle cells [1, 2].

Platelets are small anucleated cells formed from megakaryocytes and play a critical role in hemostasis and thrombosis. They are extremely small with discoid shape [3]. Following vascular injury, platelets activated and followed by formation of hemostatic plug. The functional response of activated platelets involves four different processes [4]. Activation of platelet by powerful agonist and entry of $Ca^{\pm 2}$ will lead to formation of microparticles that increase platelet surface area for binding of tenase and prothrombinase [5].

About 80% of diabetic patients die from the major thrombotic complications of atherosclerosis, stroke and myocardial infarction. Plasma and cellular components of the hemostatic system are often abnormal in diabetic patients, and some of these abnormalities may play a role in the high risk of thrombosis in these patients [6].

The endothelium is a complex organ with a multitude of properties essential for control of vascular functions. Dysfunction of the vascular endothelium is regarded as an important factor in the pathogenesis of diabetic micro- and macroangiopathy [7].

Platelet dysfunction in patients with diabetes mellitus is caused by several mechanisms [8]: Hyperglycemia; Insulin deficiency and resistance; Associated metabolic conditions; Other cellular abnormalities.

The role of other platelet anomalies common in DM patients that may account for global hyperreactivity state, including dysregulation of calcium metabolism, oxidative stress, upregulation of P_2Y_{12} signaling pathway and accelerated platelet turnover [8].

An accelerated platelet turnover represented by presence of higher number of reticulated platelets has been observed in patients with DM. Reticulated platelets are larger and more sensitive, resulting in platelet hyperactivity and lower response to antiplatelet therapies including aspirin and clopidogrel [9].

In addition, platelets of DM patients are larger, and thus hyperactive, as platelet size correlates with greater platelet reactivity measured by aggregation and total release of granular content [10].

Aim of the study is to assess the hematological parameters in CVD patients with type 2 diabetes mellitus.

■ MATERIALS AND METHODS

During the period of three months from 1st October to 30th December 2022, forty-nine patients from Baghdad Teaching Hospital were included in this study. All patients were adults with type 2 diabetes mellitus having different duration of illness.

The following data were documented for each patient: patient's name, age, sex, duration of diabetes mellitus, and past medical history of cardiovascular and cerebrovascular diseases including: the diabetic patients were divided into two study groups according to the presence (23 patients) or absence (26 patients) of CVD. PCV, WBC, and platelet count were done for each patient at Teaching Laboratories in Medical City. This study included

a control group of twenty four normal healthy volunteers, who were PCV, WBC, platelet count were also done for the control group.

A total of 5.5 ml of venous blood was collected by clear venipuncture into three collecting plastic tubes: first tubes: 1.8 ml of blood was added to 0.2 ml of 0.11 M aqueous trisodium citrate dihydrate, platelet poor plasma (PPP) was obtained by centrifugation of blood at room temperature (18–25 °C) at 2000 g (approximately 4000 rpm) for 15 minutes [11]. 2.5 ml of blood was dispensed into dipotassium ethylene diamine tetra acetic acid (K2-EDTA) containing tube and was used for the measurement of PCV, WBC, and platelet count. Positive control and negative control were used with each series. Their results were compared with those of patients and control group sera to distinguish possible granularity from agglutination.

Statistical analysis was done using SPSS (Statistical Social Sciences). Hematology Package for Chi-square test was used for testing association between categorical variables. P-value of less than 0.05 level of significance was considered statistically significant.

■ RESULTS

Results were based on the analysis of 49 patients; all were presented with type 2 diabetes mellitus. The difference between hematological parameters of control and study groups was statistically insignificant, though there were a slightly raised WBC counts and platelet counts in some diabetic patients (table 1).

The difference between all diabetic patients and control in mean WBC count was statistically significant (p=0.02). While the difference in mean PCV and platelet count were statistically insignificant (p=0.6 and 0.7) respectively, as shown in (table 2).

Table 1
Hematological parameters of control and study groups

Hematological parameters	Groups	No.	Mean±SD	Range	p-value
PCV (L/L)	DM with CVD DM without CVD Control	23 26 24	40±6.7 41.9±4.8 41.5±2.5	17.3–49 30.7–52 36.2–47	0.3
Total (WBC×10^9/L)	DM with CVD DM without CVD Control	23 26 24	8.6±2.1 8.6±2.7 7.3±1.7	5.1–14 3.6–13.1 4.3–10.5	0.6
Platelet count (×10^9/L)	DM with CVD DM without CVD Control	23 26 24	249.5±98 258.6±91.3 248.6±42.6	167–590 133–483 171–349	0.8

Table 2
Hematological parameters of diabetic patients and control

Parameter	N	Mean±SD	p-value
PCV Patients Control	 49 24	 41±5.8 41.5±2.5	0.6
WBC Patients Control	 49 24	 8.6±2.4 7.3±1.7	0.02
Platelet count Patients Control	 49 24	 254.3±93.6 248±42.6	0.7

■ DISCUSSION

Analysis of hematological results in this study revealed that WBC count was significantly higher in diabetic group than in control group. These results were close to that of Bonakdaran study on 190 patients with type 2 diabetes who reported significantly higher count with p-value of <0.001 [12]. This finding is consistent with the hypothesis that a chronic activation of the leucocytes may play a role in pathogenesis of type 2 diabetes [12].

Upon vascular injury, platelets become exposed to subendothelial matrix protein, particularly collagens, to which they initially adhere via the GPIb-V-IX complex and vWF bound to immobilized collagen. This mediates stable adhesion and further activation of GPVI [3, 13].

Platelet undergo a characteristic set of morphological changes on contact with a surface, known collectively as spreading, the pattern of which is agonist dependant. The intimal shape changes are rounding, followed by generation of finger-like projections (filopodia) and lamellopodia. Actin-myosin stress fibers strengthen the spread platelet and granules and organelles are squeezed into the center of the cells. These changes help to secure the platelet and thrombus against the flow shear forces of vascular system [3].

No significant difference in PCV was found between diabetic patients and control group because anemia usually occurs in diabetic patients with nephropathy. No significant difference in platelet count was found between diabetic and control group, which agree with Tucker et al. study who reported a p-value (0.8) [13] and agree with Sobczak and Stewart [14] and with Arkew et al. [15].

■ CONCLUSIONS

The present study revealed a significantly high WBC count in diabetic type 2 patents versus control subjects. Further studies with larger number of patients are needed to confirm these findings.

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