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Research Article

Altered Platelets Morphological Parameters in Obese Adults with Type 2 Diabetes Mellitus in Sudan

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Abstract:

Background: Obesity and diabetes are growing global health problems that significantly affect patient quality of life and associated with an increased risk factor for cardiovascular diseases. Accumulating evidence indicates that platelet hyperactivity is a contributing factor to the cardiovascular complications. This study aimed to evaluate the platelet morphological parameters and platelets count in obese type 2 diabetes mellitus in adult patients.

Method: A total of 190 subjects, 90 types 2 diabetes mellitus patients without known cardiovascular diseases [60 obese with BMI ≥30 kg/m2 and 30 non-obese] and 100 age and the sex-matched non-diabetic control group included from adults undergoing routine investigation for other problems in the same center. Venous blood samples were collected in EDTA. Platelet counts and Platelet morphological parameters [MPV, PDW] were performed using the Sysmex KN-21N.

Results: The mean platelet counts in the diabetic group were higher than in the non-diabetic group, but the difference was not statistically significant (275.7±70 vs. 261.9±59 × 10^9 /L; $P > 0.05$). The mean MPV was significantly higher in type 2 diabetic group as compared with the non-diabetic group to (9.7 ± 0.4 fl vs. 7.4 ± 0.1 fl; P =000). The mean PDW was significantly higher in Type 2 diabetic group as compared to the non-diabetic group (11.7± 0.4 fl vs 9.3± 0.1 fl P = 0.000). Among the Type 2 diabetic patients, MPV and PDW were significantly higher in Type 2 diabetic obese group as compared with a non-obese group (9.8± 0.5fl vs. 8.4± 0.2 fl; P= 0.000) and (11.8±0.4 vs. 10.4±0.3fl; P= 0.000) respectively.

Conclusion: Sudanese type 2 diabetic obese individuals manifest evidence of high platelet reactivity which may further subsequently increase their risk of cardiovascular complications.

Keywords: Obesity; Mean Platelet Volume (MPV); Platelet Distribution Width (PDW); platelet count; type 2 diabetes mellitus; cardiovascular complications

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1. Introduction

Obesity is a growing global health problem affecting over 650 million adults in 2016 [1]. It is characterized by the accumulation of abnormal or excess body fat that may significantly affect patient quality of life and is associated with an increased risk factor for non-communicable diseases such as diabetes and cardiovascular diseases, which are leading causes of morbidity and mortality [2, 3].

Obesity-driven adipose tissue dysfunction has been documented to lead to a chronic vascular inflammatory state and to contribute to cardiovascular complications [4, 5]. Adipose tissues normally secrete adipokines, modulators of inflammation [6]. Obesity typically leads to the dysregulation of pro-inflammatory and anti-inflammatory adipokines, thereby contributing to the pathogenesis of cardiovascular diseases [6-8].

Obesity-associated type 2 diabetes accounts for 85–90% of all diagnosed diabetes in adults [9, 10]. Type 2 diabetes is known to be associated with increased risk of cardiovascular disease by at least 4 folds, leading to 80% of all causes of mortality [11, 12]. The prevalence of obesity among Sudanese individuals with Type 2 Diabetes was 24.5% [13]. The Non-Communicable Disease Risk Factor Collaboration (NCD-RisC) in 2017, found that both obesity and diabetes in all African countries is increasing rapidly, and place further pressure on African health systems [14]. Sudan experiences the same pressure than other African countries with diabetic patients going through medical examination and follow-up. Hence, this research was carried out to identify a reliable, accurate, and cost-effective biomarker for predicting cardiovascular events.

Several studies stated that platelet hyperactivity is a crucial process in the pathophysiology of cardiovascular complications [15-18]. Mean platelet volume (MPV) and platelet distribution width (PDW), are determinants of platelet function and activation [19]. Mean Platelet Volume (MPV) is the parameter informing about the platelet size and activation. Elevated MPV values indicate the presence of large platelets, which are newer, denser, and more active [20]. The Platelet distribution width (PDW) gives an indication of variation in platelet size and can be a sign of active platelet release[21]. MPV and PDW are now an integral part of an automated Complete Blood Count (CBC). It is the most routinely ordered tests in clinical laboratories and available on all automated hematology analyzers.

Higher MPV and PDW were related to acute myocardial infarction, unstable angina, vascular and cardiac mortality [15-18]. On the other hand, low PDW and MPV were associated with impaired production rather than the increased destruction of platelet and were related to a range of diseases, including vascular dementia, Alzheimer's, pulmonary arterial hypertension and osteoporosis [21-24].

Altered platelet indices in Type 2 diabetic non-obese individuals have been observed in many studies [25-28]. Few published studies showed an increased MPV, PDW in obese individuals without diabetes in comparison to non-obese individuals [29-31] However, little is known about the platelet indices in Type 2 diabetic obese individuals. Therefore, the present study was designed to assess MPV, PWD in Type 2 diabetic obese individuals in comparison to Type 2 diabetic non-obese individuals.

2. Materials and Methods

2.1 Data collection

This was a cross-sectional study carried out during the period of December 2016 to December 2017 at Yastabshiron hospital, Khartoum State, Sudan. An interviewer-administrated questionnaire was used to collect

the characteristics of the patients [Age and gender] and clinical data. A sample of 190 subjects was selected. This sample included 90 Type 2 diabetic patients without known cardiovascular diseases out of which 60 obese with BMI ≥30 kg/m2 [[32 F/28 M], and 30 [16 F/14 M] non-obese] and 100 non-diabetic subjects [50F/50M]. The average age of the diabetic group was 55± 4.53 years, while in the non-diabetic group was 56± 3.61 years.

2.2 Inclusion criteria

All Type 2 diabetic patients were included.

2.3 Exclusion criteria

Type 2 diabetic patients already diagnosed with (hemoglobinopathy, renal failure, leukemia, anemia, thrombotic disease, malaria and rheumatoid arthritis) were excluded.

2.4 Blood sample collection and analysis

Venous blood samples were collected in EDTA and tested within 1 hour following collection. MPV, MDW and platelet counts were performed using the Sysmex KN-21N. Reference values were as follows: MPV 7-11 fl, PDW 9-14 fl, and platelets count 150-450×109/L[32, 33].

2.5 Statistical analysis

Results obtained were analyzed using the statistical package of social science for Windows 7.0 software (SPSS version 20). Numerical variables were summarized as a mean and standard deviation. Statistical significance between groups was tested with the Student's t-test.

1.6 Ethical considerations

The protocol was approved by SUMASRI International Review Board (SIRB) at the University of Medical Sciences and Technology (UMST). The purpose and objectives of the study were explained to the patients. Written informed consent was obtained from the patients at the time of enrollment.

3. Results

The mean platelet counts in the diabetic group were higher than in the non-diabetic group, but the difference was not statistically significant (275.7±70 vs. 261.9±59 × 10^9/L; $P > 0.05$). The mean of MPV was significantly higher in the diabetic group as compared to the non-diabetic group (9.7 ± 0.4 fl vs 7.4 ± 0.1 fl; $P < 0.05$). The mean of PDW was significantly higher in the diabetic group compared to the non-diabetic group (11.7± 0.4 fl vs. 9.3± 0.1 fl; $P < 0.05$) Table 1.

Table 2 revealed that, in the diabetic obese group, the mean MPV was significantly higher compared to the diabetic non- obese group (9.8± 0.5fl vs. 8.4± 0.2fl; $P < 0.05$). The mean PDW was also significantly higher in the diabetic obese group than in diabetic non-obese subjects (11.8±0.4 vs 10.4±0.3 fl; $P < 0.05$).

Regarding the gender, there were no statistically significant differences in the means of MPV, PDW and PLT count between males and females ($P > 0.05$) Table 3.

Table 1 Platelet parameters among the study groups

Study group	PLT count 10^9/L	MPV (fl)	PDW(fl)
Diabetic (n=90)	275.7 ± 70	9.7 ± 0.4	11.7±0.4
Non diabetic (n=100)	261.9 ± 59	7.4 ± 0.1	9.3 ± 0.1
P-value	0.625	0.000*	0.000*

*Statistically significant

Table 2 Platelet parameters in obese and non-obese diabetic individuals

Study group	PLT count 10^9/L	MPV (fl)	PDW(fl)
Diabetic obese (n=60)	279.7 ± 69	9.8 ± 0.5	11.8 ± 0.4
Diabetic non obese (n=30)	274.9 ± 56	8.4 ± 0.2	10.4 ± 0.3
P-value	0.832	0.000*	0.000*

*Statistically significant

Table 3 Platelet parameters in diabetic obese individuals rendering the gender

Gender	PLT count 10^9/L	MPV (fl)	PDW(fl)
Male n (n=28)	277.8 ± 50	9.7 ± 0.4	11.6 ± 0.7
Female (n=32)	280.2 ± 42	9.6 ± 0.5	11.8 ± 0.6
P-value	0.851	0.975	0.816

4. Discussion

Regarding platelets count, we observed higher mean platelet count in the diabetic group than in the non-diabetic group, although the difference was not statistically significant. Inconsistent platelet count results have been reported in diabetic patients. Several studies reported no statistically significant difference in platelet count between the diabetic group and non-diabetic group [34-36], some reported a significantly increased [26, 27], while others reported a significantly decreased [25]. These discordant results can be explained by the presence of other factors that may have influenced the platelet count, such as the mean platelet survival, and the platelet production and turnover rate in T2DM.

In the current study, we observed a significant increase MPV and PWD in Type 2 diabetic group than in the non-diabetic group, which was in accordance with findings reported elsewhere in the literature [17, 25-28]. Moreover, our results observed that T2DM obese group presented higher MPV and PDW in comparison with type 2 diabetic non-obese group.

In diabetic patients, hyperglycemia has been clearly established as a causal factor for in vivo platelet activation and platelet hyperactivity [37, 38]. Elevated MPV values indicate the presence of large platelets which are more active hemostatically in comparison to smaller platelets [20, 39]. Thus, higher MPV increase the possibility of vascular complications. Accumulating evidence indicates that platelet hyperactivity is a contributing factor to the cardiovascular complications in Type 2 diabetes [15-18]. An increased PDW is an indicator for the heterogeneity of platelet size [21]. The activated platelets vary in size from inactive ones due to an alteration in shape from a biconcave disc to a spherical and formation of pseudopodia, resulting in PDW change [19]. Numerous studies have demonstrated that MPV and PDW were significantly higher in diabetic T2DM with vascular complications compared to those without [17, 28, 34-36, 38]. Rechcinski et al. [40] found that PDW is an independent risk factor for recurrent myocardial infarction and cardiac

mortality. Therefore, increased PDW may be a useful biomarker to predict the cardiovascular diseases predictor in obese individuals and diabetic and may help in the early detection of individuals at risk for cardiovascular diseases.

Recent studies have stated that obesity is associated with systemic inflammation [31, 36], and there are reports that some inflammatory conditions play a role in platelet activation and result in the production of larger platelets [41-43]. Coban et al. [44, 45] demonstrated that MPV is higher in obese individuals than in non-obese individuals. Kutlucan et al.[46] investigated the relationship between MPV with metabolic syndrome in obese individuals. They found that MPV levels are more affected by obesity than a metabolic syndrome. PDW was also found to have a statistically significant positive linear correlation with BMI [47].

In conclusion, this study indicated that Sudanese Type 2 diabetic obese individuals manifest evidence of increased platelet reactivity which may subsequently increase the risk of cardiovascular complications. Therefore, regular assessment of platelet activation in Type 2 Diabetes mellitus may lead to early identification of patients who are at high risk of developing vascular complications. These appeals for appropriate medical management.

Abbreviations

MPV: Mean Platelet Volume

NCD-RisC: Non-Communicable Disease Risk Factor Collaboration

PDW: Platelet Distribution Width

PLT: Platelet counts

T2DM: Type 2 Diabetes Mellitus

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