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The evaluation of red cell distribution width in type 2 diabetic patients with acute ST-segment elevation myocardial infarction in Erbil city: a cross sectional study

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Abstract

Background: The relationship of high red cell distribution width (RDW) with many hematological and angiographic characteristics in type 2 diabetic patients with acute ST-segment elevation myocardial infarction (STEMI) is still a matter of debate.

Objective: To evaluate the relationship of high RDW with multiple hematological and angiographic characteristics in type 2 diabetic patients with acute STEMI.

Patients and Methods: In this cross-sectional study, one hundred patients with acute STEMI who underwent coronary angiography were enrolled. The patients were divided into two groups according to the presence of type 2 diabetes mellitus (T2DM); group I, diabetic patients and group II, non-diabetic patients. Further division was made to group I patients based on how high or low RDW level was; subgroup A patients with high RDW level, and subgroup B patients with low RDW level. The groups were evaluated and compared regarding baseline demographic, laboratory and angiographic characteristics.

Results: The mean RDW was higher (P=0.04) in group I compared to group II. The mean values of white blood cell (WBC) , RDW, CK-MB, Troponin T high sensitive (hs) , and HbA1C levels were significantly higher in subgroup A compared to subgroup B (P=0.007, 0.003, 0.03 and < 0.001, respectively). Subgroup A patients have significantly more extension of coronary diseases than subgroup B (P=0.001). A positive correlation was detected between RDW and WBC, CK-MB, Troponin T hs, HbA1C as well as number of diseased vessels in diabetic patients (0.76, 0.4, 0.98 and 0.79, respectively).

Conclusion: Diabetic patients with acute STEMI had higher levels of RDW than non-diabetics and higher levels were positively correlated with inflammatory and poor outcome cardiovascular markers as well as multiple vessel diseases involvement. It was also correlated with poor glycemic control represented by high HbA1C.

Keywords: Red cell distribution width, Coronary artery disease, Type 2 diabetes mellitus

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Introduction

Acute Myocardial infarction (AMI) is still considered one of the most important types of coronary artery disease (CAD) worldwide [1], and acute STEMI represents up to 40% of the cases [2]. According to novel studies in Iraq, the mortality rate of CAD was 33 % [3], and the prevalence of acute STEMI was 67.4% which considered high compared to the abovementioned rate [4].

It is pivotal to recognize critical patients who will demand instant and robust treatment for AMI. One of these very effective interventions is cardiac catheterization. Primary percutaneous coronary intervention (PPCI) can restores the flow to the culprit epicardial coronary arteries in many patients with acute STEMI [5].

Type 2 diabetes mellitus (T2DM) is one of the most common non-communicable diseases in the world, and in recent years, an increase in its prevalence has been observed leading to enormous problems which affected the quality of human life [6] .While the prevalence of T2DM in Iraq was ranged from 8% to 14 % in some studies [7], it was even higher (19.7%) in other studies like a local study that was done in Basrah city which included 5400 people [8]. Acute Myocardial infarction is one of the most important causes of death in patients with T2DM [9].

Red cell distribution width (RDW) is a test that present in many modern hematology analyzers. It usually measures the differences in the volume and size of red blood cells RDW is usually figured by dividing the standard deviation (SD) of the mean corpuscular volume (MCV) by the MCV and multiplying by 100 to get a percentage value according to this formula: RDW= (standard deviation of red blood cell volume/mean cell volume) × 100 [10]. In humans, the RDW-CV is ranged from 11.5 to 15.4 % [11].

Even though RDW is a parameter used in the differential diagnosis of anemia and hematological disorders, numerous studies have shown that a high RDW value is linked to an increased risk of cardiovascular disease and may also be a sign of poor outcomes in a number of clinical cardiovascular conditions [12, 13].

Several studies have shown elevated RDW values in patients with poor glycemic control [14, 15]. The aim of this study was to find any rule of RDW in type 2 diabetic patients with acute STEMI. To the best of our knowledge, no previous study was done in Erbil city concerning the same subject.

Patients and Methods

In this prospective, cross-sectional study, one hundred patients with acute STEMI (including 40 patients with T2DM) were enrolled. The patients were admitted to the coronary care unit at Rizgary Hospital and underwent coronary angiography followed by Primary percutaneous coronary intervention (PPCI) at the Hawler hospital for surgical specialties. The study was performed between June 2021 and December 2021.

The inclusion criteria were adult patients with acute STEMI and of either gender .In addition; only patients with T2DM were included.

The diagnosis of STEMI required chest pain duration of ≥20 min and ST-segment elevation of ≥1 mm in at least two extremity ECG leads or ≥ 2 mm in at least two contiguous precordial leads or new onset left bundle branch block (LBBB) [16].

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According to the American Diabetes Association (ADA) , T2DM was diagnosed when the fasting plasma glucose level of 126 mg/dL (7.0 mmol/L) or higher, or a random plasma glucose of 200 mg/dL (11.1 mmol/L) or higher in a patient with classic symptoms of hyperglycemia , or when the hemoglobin A1c (HbA1c) level of 6.5% (48 mmol/mol) or higher [17] .Diabetes was recorded if the patient was receiving regular treatment with oral hypoglycemic agents or insulin.

Coronary angiography and PPCI was performed according to ACC/AHA guidelines and criteria [18, 19].

Patients with coronary artery bypass graft (CABG), pacemaker, heart failure, old LBBB, severe arrhythmia (supraventricular/ ventricular tachycardia) , cardiogenic shock, active cancer, anemic patients (hemoglobin <13gm/ dL for males and < 12gm/dL for females)[20], hematological proliferative diseases, active or autoimmune diseases, pregnancy ,history of hemorrhage in the last three months that required hospitalization and history of blood transfusions in the last three months, significant liver disease or hepatic failure, clinical evidence of active infection as well as those currently using anti-inflammatory, steroid, chemotherapeutic or immunosuppressants drugs were excluded. Patients who received tonics for any reason within the past 3 months were not included in the current study.

According to the presence of T2DM, the participants were divided into two groups; group I, 40 patients with T2DM and group II, 60 patients without T2DM. Further division was made to group I diabetic patients based on how high or low their RDW level was; subgroup A include 16 diabetic patients with high RDW level, and subgroup B include 24 diabetic patients with low RDW level. The groups were evaluated and compared regarding baseline demographic, laboratory and angiographic characteristics.

The patients were underwent some basic laboratory investigations like complete blood count which contains Hb level, white blood cells (WBC) count , RDW, platelets (PLT) count, mean platelet volume (MPV), and HbA1C level. Cardiac markers such as Creatinine kinase –Myocardial Brand (CK-MB) and cardiac Troponin-T high sensitive (cTnT hs) levels were also assessed. RDW is estimated on fully automated fluorescence flow cytometry.

RDW-CV value was ranging from 11% to 16% in our laboratory. Normal hemoglobin level was 13gm/ dL for males and 12gm/dL for females according to the World Health Organization (WHO) [20]. According to the reference values of our laboratory, the WBC count was 4.5-10 (103/µl), the platelet count was 150-400 (103/µl), the MPV value was 6.3-13.1(fl), the normal CK-MB level was up to 6.22 ng/ml, and cardiac cTnT hs level was ranging from 0.0-0.014 ng/ml.

On admission to the hospital, antecubital venous blood samples were drawn from all patients and were sent to laboratory analysis before they started any medication. All investigations were performed and analyzed within 12 hours of the onset of symptoms.

A 5-mL blood sample was drawn into a tube containing Tri-potassium ethylenediamine tetra-acetic acid (K3 EDTA) as the anticoagulant. The tube was gently inverted many times to allow mixing at room temperature, and then sent to the lab for testing. The Department of Clinical

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Chemistry analyzed the blood samples. Complete Blood Count (CBC) and other parameters were measured by an automated hematology analyzer (Medonic M- Series M32,Boule Medical ,Domnarvsgatan4,SE-16353, Spanga, Sweden, 2016) ,calibrated daily by skilled technicians.

At least two blood samples for cTn T hs levels were taken at the time of presentation and were assessed using a chemiluminescent immunoenzymatic assay (Nano checker 710, automatic POCT immunoassay analyzer, Nano-Ditech Corporation, CA,USA). To establish or exclude the diagnoses of STEMI, cTnT high sensitive measurement was repeated after 6 hours. Other biochemical markers were evaluated using a Clinical Chemistry Analyzer, Miura 200, ISE, Italy, 2018.

Questionnaire and data collection

The data were collected in a specially designed questionnaire filled by the researcher through a standardized approach. The questionnaire consists of three sections. Section I contains sociodemographic data (age, gender), and whether the patient had T2DM with acute STEMI. Some of the baseline laboratory findings of the study population were also included such as CBC, HbA1C level, cardiac markers such as Creatinine kinase –Myocardial Brand (KC-MB) and cardiac Troponin-T high sensitive (cTnT hs) levels. The second section contains the angiographic characteristics such as the number of affected coronary arteries, which was the dominant occluded coronary artery, the location of AMI, and the number of stents.

Statistical Analysis

The data were collected and entered via Microsoft Excel (Microsoft Corporation, Redmond, Washington). They were analyzed on Statistical Package of Social Science (SPSS) Statistics for Windows, Version 25.0 (IBM SPSS Inc., Chicago, Illinois, USA). Continuous variables were reported as mean ± standard deviation (SD), while the other categorical variables were reported as percentages (no. [%]). To compare means between the parametric variables, independent sample t-test was used. Categorical variables were compared using the Chi-squared test ($\chi 2$) or Fisher exact test when appropriate. In addition to that, correlation analyses were done between RDW and some variables to report the strength of the relationship between them. If the P value was ≤ 0.05, it was considered a statistically significant.

Results

In this prospective, cross-sectional study, one hundred patients with acute STEMI were enrolled and underwent coronary angiography, followed by successful PPCI. As shown in Table (1), the participants were classified into two groups based on the presence of DM; Group I, which include 40 participants with DM and Group II, which contained 60 participants without DM.

In total, there were 72 males and 28 females. The mean age of them was 57.6±11.6 years. In Group I patients, there were 24 males and 16 females and their mean age was 58.5±13.9 years, while in Group II patients there were 48 males and 12 females and their mean age was 57±10.4 years. No statistical difference was found between the

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two groups regarding gender (P= 0.7) or age (P =0.77).

Concerning laboratory findings, RDW levels showed statistically significant differences. The mean level of RDW was greater (P=0.04) in group I participants in contrast to group II. The other laboratory findings (WBC, platelets, mean platelet volume (MPV), CK-MB and cardiac troponin T high sensitive (cTnT hs) show no statistical significant differences.

There were 28 patients (28%) with high RDW levels in this study. Group I had significantly (P=0.001) more patients (16, 40%) with high RDW levels than Group II (12, 20%).

Table (1): Baseline characteristics and laboratory findings of the study groups

characteristics	All patients (n=100)	Group I patients with DM (n=40)	Group II patients without DM (n=60)	P value
Gender: Male/female (n)	72/28	24/16	48/12	0.7
Age (years): mean ±SD	57.6±11.6	58.5±13.9	57±10.4	0.77
WBC (10^3 /µl) :mean ±SD	12.2±4.3	13.6±5.7	11±3.5	0.08
Platelet(10^3 /µl): mean ±SD	260.1±68.3	289.5±51.8	240.6±72.5	0.07
MPV(fl): mean ±SD	10.4±1.4	10.4±1.1	10.5±0.8	0.86
RDW (%) :mean ±SD	14.4±2	15.45±2.7	13.7±1.4	0.04
High RDW Level (n, %)	28 (28%)	16 (40%)	12 (20%)	0.001
CK-MB(ng/ml) :mean ±SD	12.26±9.5	16.7±12.8	9.3±5.1	0.06
Troponin T hs (ng/ml) mean ±SD	0.4±0.5	0.77±0.8	0.15±0.1	0.08

Further division into two subgroups was made to group I patients based on how high or low their RDW level was; subgroup A include 16 diabetic patients with high RDW level, and subgroup B include 24 diabetic patients with low RDW level. Both subgroups were divided according to the RDW levels evaluated and compared regarding laboratory findings as shown in Table (2) and angiographic characteristics as shown in Table (3).

In Table (2), the mean Hb level was significantly lower (P=0.001) , while the mean values of the WBC , the RDW , CK-MB , Troponin T hs, and HbA1C levels were significantly higher in subgroup A compared to subgroup B (P=0.007, 0.003, 0.03 and < 0.001, respectively). No significant differences were found concerning platelets and MPV (P=0.5 and 0.6, respectively).

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Table (2): Comparison regarding some laboratory characteristics between group I subgroups

characteristics	Subgroup A DM patients with high RDW (n=16)	Subgroup B DM patients with low RDW (n=24)	P value
WBC (10^3 /µl) :mean ±SD	18.6±5.2	11.1±0.9	0.007
Platelet(10^3 /µl): mean ±SD	304±40	279.8±59.6	0.5
Hb (gm/dl): mean±SD	12.9±0.5	14.9±1.7	0.001
MPV(fl): mean ±SD	10.7±1.9	10.21±2.1	0.6
RDW (%) :mean ±SD	17.6±6.5	13.9±0.3	0.003
CK-MB(ng/ml) :mean ±SD	22.2±14	13±10	0.03
Troponin T hs (ng/ml) mean ±SD	1.56±0.6	0.24±0.1	<0.001
HbA1C level	11.6±1.5	9.5±0.6	<0.001

Regarding angiographic variables, subgroup A patients have significantly more extension of coronary diseases than subgroup B represented by high percentage of multiple vessel diseases involvement (P=0.001). The left anterior descending (LAD) coronary artery was the dominantly affected artery in subgroup A patients (P=0.04). While the inferior myocardial infarction was the most common pattern in subgroup B patients , double wall infarction was only seen in subgroup A patients (P=0.03). Two or more stents were used more in subgroup A patients than subgroup B (P=0.001), as seen in Table (3).

Table (3): Comparison regarding angiographic variables between group I subgroups according

Variables	Subgroup A Diabetic patients with high RDW (n=16)	Subgroup B Diabetic patients with low RDW (n=24)	P value
Extension of coronary artery disease			
Single vessel disease, n (%)	0 (0%)	8(33.3%)	0.001
Multiple vessel disease, n (%)	16 (100%)	16 (66.7%)	
Dominantly affected vessel			
LAD, n (%)	8 (50%)	7 (29.1%)	0.04
RCA, n (%)	8 (50%)	16 (66.7%)	
LCX, n (%)	0 (0%)	1 (4.2%)	
AMI localization			
Anterior	8 (50%)	12 (50%)	0.03
Inferior	0 (0%)	12 (50%)	
Double wall	8 (50%)	0 (0%)	
Number of stents			
1 stent	0 (0%)	8(33.3%)	0.001
2 or more stents	16 (100%)	16 (66.7%)	

The correlation of RDW with some hematological parameters in group I patients was examined in Table (4). There were positive correlations between RDW and WBC, CK-MB, Troponin T hs, HbA1C as well as Number of diseased vessels (0.76, 0.4, 0.98 0.79, and 0.5, respectively).

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Table (4): Correlation between RDW level and some hematological and angiographic variables in group I patients

Variables	(r)
WBC	0.76
CK-MB	0.4
Troponin T hs	0.98
HbA1C	0.79
Number of diseased vessels	0.5

Discussion

While many studies correlated between high RDW values and coronary artery disease [12, 13], only few studies discussed the rule of RDW in type 2 diabetic patients with acute myocardial infarction. According to the results of the current study, a potent and significant relation was detected between RDW levels and CAD among diabetic patients.

The present study showed that diabetic patients with acute STEMI had more elevated levels of RDW than non-diabetics. The prevalence of high RDW levels was higher (40%) in diabetic patients with acute STEMI than non-diabetic group (20%). The result of this study was in agreement with previous studies. In Celik et al study which was published in 2017, 233 diabetic patients who subjected to coronary angiographies were included in the study. The study group was divided into two, according to angiographic results (CAD negative and CAD positive). The RDW was significantly higher in the CAD –positive diabetic group ($p < 0.001$) [21].

In the current study, diabetic patients with high RDW levels presented with greater WBC counts and lower Hb levels than diabetics with low RDW level. Inflammation, represented by elevated WBC counts, has been established to be a significant risk factor for evolution of cardiovascular events and some studies have also declared a good correlation between high WBC count and intensified risk of short- and long-term mortality in patients with AMI as in Majid et al study. In this study, the researchers showed that there was a growing body of evidence supports the usefulness of the WBC count as a predictor of future coronary events [22].

The effects of high WBC counts and low hemoglobin levels on the survival outcomes in patients with AMI have been well determined .The aim of the Bae et al study, which included 1,332 consecutive patients with AMI, was to estimate the prognostic effects of WBC, Hb, and platelet distribution width (PDW) in patients with AMI. What had been noticed in this study that the patients who had elevated WBC counts, high PDW value and lower Hb levels died during in-hospital admission. They also concluded that, the collection of WBC, Hb, and PDW, was considered a useful simple and inexpensive hematologic marker in early risk stratification of patients with AMI [23].

As has been mentioned in the Stucchi et al. study, low Hb level which is commonly noticed as co-morbidity in patients with AMI, is correlated with high mortality in these patients as has been mentioned in Stucchi et al study. They mentioned that estimated prevalence of anemia on admission in the setting of an acute coronary syndrome (ACS) was between 10% and 43% of the patients,

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and that up to 57% of ACS patients may develop hospital-acquired anemia (HAA). They also declared that both anemia on admission and HAA were associated with worse short- and long-term mortality, even if different mechanisms contribute to their prognostic impact. [24]. The association between low hemoglobin and high mortality in AMI could be demonstrated by reduced oxygen delivery to myocardium. This association has been reported in several studies, like the Padda et al study which was published in 2021. In this study, the literature was analyzed to determine the association between acute anemia and MI based on the pathophysiology, outcomes, and management options. Acute anemia results in decreased blood supply and sudden hypoxia to the heart. Additionally, it exacerbates the preexisting compromised coronary blood supply in patients with MI. Thus, there is a disproportionate oxygen supply and demand ratio to the heart. It was found that anemia increases all-cause mortality in acute MI [25]. In the present study, the CK-MB and the troponin T hs levels were significantly increased in diabetic patients with high RDW levels. This result was in agreement with a study done by Lippi et al. In their study, the researchers revealed that the combined estimation of cardiac troponin and the RDW at admission heightened the sensitivity of cardiac troponin to diagnose ACS from 94% to 99% [26].

The current study revealed that the HbA1C levels were significantly increased in diabetic patients with high RDW level compared to low RDW group. The result of this study was in correspondence to previous studies [15]. In Nada AM study, which was done in 2015, 260 type 2 diabetic patients on treatment and 44 healthy control subjects were enrolled. RDW was substantially greater in diabetic patients than in control subjects (P=0.008). In addition, it was greater in patients with uncontrolled diabetes (HbA1c >7%) than those with acceptable control (HbA1c ≤7%; P=0.035) [14].

According to the Engström et al study, RDW and MCV were estimated in 26 709 non-diabetic participants (their age was ranged from 45 to 73 years). In the same study, HbA1c and fasting blood glucose levels were evaluated in 4845 subjects. The incidence of DM was assessed in 2944 participants over 14 years of follow-up. The study showed that RDW was virtually and positively correlated with HbA1c [15].

Our study demonstrated a robust correlation between elevated RDW levels and the severity of STEMI. Diabetic patients with high RDW level had more extension of CAD than the other subgroup and this was represented by high percentage of multiple vessel disease involvement, the dominantly affected left anterior descending coronary artery (LAD), and double wall infarction that was only seen in this subgroup.

The results of the present study are in consistent with many previous studies. In the abovementioned Celik *et al* study, patients who had CAD and their RDW values were above 13.25 % had greater percentages of obstructive CAD and triple-vessel disease ($p \leq 0.001$ for all) [21]. The correlation between RDW and complexity of CAD had been notified in Isik et al study. In their prospective cross-sectional study which comprised 193 patients who subjected to coronary angiography for stable CAD, the

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researchers found a relation between RDW and complexity of CAD [27]. In Akin *et al* study that was done on 580 patients with AMI, a close relation was detected between elevated RDW level and greater percentage of three vessel lesions in those patients [28].

A positive correlation was detected in the current study between RDW and WBC, CK-MB, Troponin T hs, HbA1C as well as number of diseased vessels among diabetic patients. This correlation has been discussed previously [14, 15, 21, 23, 26, 27, 28].

Conclusions

Diabetic patients with acute STEMI had higher levels of RDW than non-diabetics. The mean values of WBC, CK-MB, Troponin T hs, and HbA1C levels were significantly high while the mean value of Hb was significantly low in acute STEMI diabetic patients with high RDW levels compared to the other subgroup. Acute STEMII diabetic patients with high RDW levels show more extension of coronary artery disease than the other subgroup and this was represented by high percentage of multiple vessel disease involvement, the dominantly affected left anterior descending coronary artery (LAD), and double wall infarction that was only seen in this subgroup.A positive correlation was detected between RDW and WBC, CK-MB, Troponin T hs, HbA1C, as well as number of diseased vessels in diabetic patients with acute STEMI.

Recommendations

1. RDW is a cheap and simple hematologic marker that can be used as an adjuvant to other inflammatory and risk stratification markers in diabetic patients with AMI.
2. RDW can also be used as a marker to assess the glycemic control in diabetic patients regardless of being at risk of coronary artery diseases.
3. RDW can be applied as a marker for predicting the severity of CAD in patients with T2DM as high RDW levels were correlated with more huge lesions in this population.
4. We recommend conducting future studies with larger population to clarify the effect of high RDW values on short- and long outcomes including the mortality rate for diabetic patients with acute myocardial infarction.

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Ethical clearance: A written informed consent was obtained from the patients prior to the study. The study design, protocol and the informed consent was reviewed and approved by the local Research Ethics Committee of the College of Medicine at Hawler Medical University.

Conflict of interest: Nil

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تقييم عرض توزيع الخلايا الحمراء في مرضى السكري من النوع الثاني المصابين باحتشاء حاد في عضلة القلب بارتفاع المقطع ST في مدينة اربيل : دراسة مقطعية

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الملخص

خلفية الدراسة: لا تزال العلاقة بين ارتفاع مستوى عرض التوزيع الخاص بخلايا الدم الحمراء(RDW) والعديد من الخصائص الدموية وتصوير الأوعية في مرضى السكري من النوع الثاني والمصابين باحتشاء حاد في عضلة القلب نوع(STEMI) محل نقاش.

اهداف الدراسة: لتقييم ارتباط ارتفاع RDW بخصائص دموية وتصوير الأوعية الدموية في مرضى السكري الذين يعانون من احتشاء عضلة القلب الحاد.

المرضى والطرائق: في هذه الدراسة المقطعية ، تم تسجيل مائة مريض مصابين باحتشاء حاد في عضلة القلب وخضعوا لتصوير الأوعية التاجية. تم تقسيم المرضى إلى مجموعتين حسب وجودمرض السكري. المجموعة الأولى الذين لديهم مرضى السكري والمجموعة الثانية الغير مصابين بمرضى السكري. تم إجراء مزيد من الانقسام للمرضى من المجموعة الأولى بناءً على مدى ارتفاع أو انخفاض مستوى RDW لديهم ؛ مرضى المجموعة الفرعية A مع مستوى RDW مرتفع ، ومرضى المجموعة الفرعية B بمستوى RDW منخفض. تم تقييم المجموعات ومقارنتها فيما يتعلق بالخصائص الديموغرافية الأساسية والمختبرية وتصوير الأوعية.

النتائج: كان متوسط RDW أعلى (P = 0.04) في المجموعة الأولى مقارنة بالمجموعة الثانية. كانت القيم المتوسطة لمستويات WBC و RDW و CK-MB و Troponin T hs و HbA1C أعلى بشكل ملحوظ في المجموعة الفرعية A مقارنة بالمجموعة الفرعية B (P = 0.007 ، ٠,٠٠٣ ، ٠,٠٣ و <٠,٠٠١ ، على التوالي). مرضى المجموعة الفرعية A لديهم امتداد لأمراض الشريان التاجي أكثر بكثير من المجموعة الفرعية B (P = 0.001). تم الكشف عن ارتباط إيجابي بين RDW و WBC و CK-MB و Troponin T hs و HbA1C وكذلك عدد الأوعية المريضة في مرضى السكري (٠,٧٦ و ٠,٤ و ٠,٩٨ و ٠,٧٩ على التوالي).

الاستنتاجات: كان لدى مرضى السكري الذين يعانون من احتشاء عضلة القلب الحاد (STEMI) مستويات عاليه من RDW مقارنة بغير مرضى السكري وكانت المستويات الأعلى مرتبطة بشكل إيجابي بعلامات الالتهاب والنتائج المستقبلية السيئة للقلب والأوعية الدموية بالإضافة إلى إصابة عدد اكبرمن الأوعية الدموية المتضررة. كما ارتبطت أيضًا بضعف التحكم في نسبة السكر في الدم ممثلة بارتفاع مستوى HbA1C

الكلمات المفتاحية: عرض توزيع الخلايا الحمراء ، مرض الشريان التاجي ، داء السكري من النوع ٢

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