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Predictive value of white blood cells count to mean platelets volume ratio in patients with ST segment elevation myocardial infarction undergoing primary percutaneous coronary intervention

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Abstract
Background: The SYNTAX score (SS) is a scale utilized in angiography to assess the complexity of lesions in the coronary arteries. A greater SS is indicative of a more complicated situation and a worse prognosis among individuals who are undergoing contemporary revascularization procedures, particularly percutaneous coronary intervention (PCI). The purpose of this work was to evaluate predictive value of white blood cells count to mean platelets volume ratio (WMR) among individuals with ST segment elevation myocardial infarction (STEMI) whom undergone primary PCI and correlate WMR in STEMI patients with its predictive value on SS.
Methods: This prospective work was performed on 100 participants, both genders, with STEMI within 12 hours and managed with primary PCI. The work cases had been split in to three groups according to SS: [Group I (29 patients): Low SS ≤22, Group II (45 patients): Intermediate SS (23-32) and Group III (26 patients): High SS (≥33)].
Results: A statistically significant positive correlation was existed among WBCs/MPV ratio and the SS (r=0.755 and p<0.001). WBCS count, MPV and WBCs/MPV ratio was substantially elevated in group III contrasted to group I and II (P<0.001). WMR >1472.5 can predict a SS ≥ 23 with 71.11% sensitivity and 60.0% specificity. WMR >1537.6 predicted a SS ≥33 with 73.08% sensitivity and 60.81% specificity.
Conclusions: WMR could offer supporting proof for estimating the degree of CAD among individuals with STEMI.

Keywords: White blood cells count to mean platelets volume ratio, st segment elevation percutaneous coronary intervention, myocardial infarction, syntax score

Introduction
It has been hypothesized that atherosclerosis is an inflammatory condition [1]. Previous research has shown that acute coronary syndromes are caused not only by the gradual narrowing of the lumen of the coronary artery, but additionally by other pathophysiological variables that contribute to the occurrence of these occurrences [1].
Inflammatory processes resulting from ruptured atherosclerotic plaques are responsible for the creation of blood clots, that could ultimately lead to an occurrence of acute coronary syndrome (ACS) [2]. Studies have demonstrated that leukocytes have an impact in the inflammatory responses, that might potentially contribute to the occurrence of cardiovascular events [3]. T-cells and macrophages situated inside the lipid core of the atherosclerotic plaques become active following endothelial damage, and they contribute to the development of a blood clot by releasing cytokines and procoagulants. Thus, these mechanisms increase the likelihood of blood clot formation and the progression of ACS [2].
In addition to leukocytes, platelets have been shown to contribute to the occurrence of ACS via inflammatory pathways [4]. Platelets that are activated and deactivated have a role in promoting the adhesion of platelets and leukocytes. This adhesion is facilitated by molecules and cytokines promoting the development of atherosclerosis [5].

The interaction between platelets and leukocytes contributes to the increased recruitment of leukocytes at the site of plaque rupture, which is crucial in the progression and prognosis of ACS [5].

The connections among these cells might serve as a pathogenic mechanism implicated in the blockage of coronary arteries throughout an ACS episode [6]. The mean volume of platelets, a measure of platelet activation [7], and the distribution of various types of white blood cells [8-10] have been shown to be linked to the occurrence of cardiovascular diseases and death [10].

Various evaluation modalities are currently being established to assess the risk and predict the outcome for individuals with CAD who are undergoing therapeutic intervention. This is because of the rising number of individuals with CAD being treated each year and the significance of risk stratification and prognostic assessments. The SYNTAX score (SS) is considered one of the most significant scoring systems developed so far [11].

The SYNTAX score is a diagnostic measure used by interventionists, cardiologists, and surgeons to assess the level of complexity of lesions of coronary artery [12]. A greater SS suggests a more complicated disease and a worse prognosis among individuals performing contemporary revascularization, particularly with PCI [12].

This study aimed to assess the predictive value of white blood cells count to mean platelets volume ratio (WMR) among individuals with STEMI having primary PCI and correlate WMR in STEMI patients with its predictive value on SS [12].

Patients and Methods

This prospective work was performed on 100 individuals, both genders, with STEMI within 12 hours and managed with primary PCI. The work was performed from June 2020 to December 2022 following permission from the Ethics Committee Tanta University Hospitals, Tanta, Egypt. All participants provided a well-informed written consent.

Criteria for exclusion were patients with prior myocardial infarction, history of documented left ventricle (LV) dysfunction or history suggestive of heart failure, significant valvular heart disease, and patients with other co morbidities such as end stage renal disease, liver cirrhosis with ascites, cancer, sepsis, haematological disease, and previous coronary bypass graft surgery (CABG).

The work cases had been split in to three groups according to SS: [Group I (29 patients): Low SS ≤22, Group II (45 patients): Intermediate SS (23-32) and Group III (26 patients): High SS (≥33)].

Each participant had been exposed to taking of history, clinical assessment, laboratory tests [full blood picture (CBC), serum urea and creatinine, cardiac enzymes (serum troponin and CK-MB), twelve leads surface electrocardiogram (ECG) and echocardiography.

Typical criteria for ST-segment elevation in acute myocardial infarction [12]: When measuring at the J point, the following criteria ought to be met: in men less than the age of 40 years, the measurement ought to be ≥0.25 mV in leads V2 and V3; in men above the age of 40 years, the measurement ought to be ≥0.2 mV in leads V2 and V3; in women, the measurement ought to be ≥0.15 mV in leads V2 and V3; in other leads (in the lack of left ventricular hypertrophy or left bundle branch block (LBBB)), the measurement should be ≥0.1 mV.

Echocardiography: was done for evaluation of cardiac valves to exclude any valvular abnormalities and exclude mechanical complication and LV ejection fraction (EF). Normal range of EF = 55-70%

Primary percutaneous intervention for Infarct related artery (IRA)

A loading dose of dual anti platelet (Aspirin 300mg chewable) plus P2Y12 inhibitor (Ticagrelor 180 mg or Clopidogrel 600mg), plus IV unfractionated heparin (UFH) or low molecular weight heparin (LMWH) were used before the procedure. Glycoprotein IIb IIIa inhibitors (Eptifipatide or Tirofiban) were utilised during or after the procedure in selected cases [12, 13]. Both femoral and radial arterial approaches were used.

Coronary angiography and PCI:

The artery IRA has been determined. The interventional cardiologist determined the culprit lesion by analyzing the location of the infarct on the admission ECG and the data from the angiography, including the target vessel and features of the lesion [13]. PCI, either with or without stenting, was promptly conducted using a 6-Fr guiding catheter. Aspiration of thrombus, balloon dilatation before and after the procedure were carried out as necessary. The decision about the kind of stent (drug-eluting or bare metal stent stents) should have been left to the discretion of the operator. The success of reperfusion is assessed using the TIMI blood flow grade. The success of reperfusion was determined based on the TIMI blood flow grade, with a score of 3 indicating successful reperfusion and scores of 0, 1, or 2 indicating faulty reperfusion [13].

Syntax score calculation

The SYNTAX score is measured by adding up the points provided to each specific lesion seen in the coronary tree, where the diameter narrowing is more than 50% in arteries with a diameter larger than 1.5mm. Based on the AHA categorization [14], the coronary tree is split into 16 segments. Each segment is assigned a score of either 1 or 2 depending on the extent of Disease. This score is then adjusted according to a chart, which assigns weights that vary from 3.5 for the proximal left anterior descending artery (LAD) to 5.0 for the left Main and 0.5 for lesser branches.

If there is complete blockage, the following criteria are used to provide extra points: age over 3 months or unknown, bridging collaterals image, a blunt stump, and a side branch with a diameter more than 1.5. Each of these criteria is given one point. Regarding trifurcations, a single affected segment receives three points, 2 affected segments receive four points, three affected segments receive five points, and four affected segments receive six points. In the case of bifurcation lesions, a single point is assigned to types A, B, and C, whereas types D, E, F, and G receives two points. Additionally, an angulation greater than 70 degrees receives one point [14].

Furthermore, an aorto-ostial lesion has a value of one point, while significant tortuosity of the artery receives two points. A lesion length exceeding 20 mm receives one point, extensive calcification receives 2 points, and the presence of

thrombus is worth 1 point. In addition, widespread disease or involvement of tiny vessels is scored at 1 point per segment. If there are several lesions that are fewer than three times the diameter of the reference vessel apart, they are considered as a single lesion. However, when the distance is larger than three times the diameter of the vessel, they are regarded as distinct lesions [15].

Statistical analysis

The data were inputted into the computer and analysed utilizing the IBM SPSS software program, namely version 20.0. (Armonk, NY: IBM Corp). Quantitative data were represented utilizing numerical values and percentages. The normality of the distribution had been evaluated utilising the Kolmogorov-Smirnov test. The quantitative data had been characterized utilizing statistical measures such as range, mean, standard deviation, median, and interquartile range (IQR). The Spearman coefficient has been utilized to establish the correlation among two abnormally distributed quantitative parameters. An assessment of the diagnostic performance is conducted by evaluating the sensitivity, specificity, negative predictive value (NPV), and positive predictive value (PPV). Significance of the obtained results was judged at the 5% level.

Results

No statistically substantial variation was existed among three groups as regard age , gender and risk factors (DM, HTN, smoking, dyslipidemia and family histories). Table 1

Table 1: Comparison among the three groups under the study based on demographic data, risk factors

		SS			p
		Low (n = 29)	Intermediate (n = 45)	High (n = 26)	
Age (years)		52.24±10.21	54.40±7.23	57.0±10.20	0.151
Sex	Male	26(89.7%)	37(82.2%)	23(88.5%)	^{MC}p= 0.710
	Female	3(10.3%)	8(17.8%)	3(11.5%)	
Risk factors	DM	12(41.4%)	25(55.6%)	13(50.0%)	0.492
	HTN	10(34.5%)	22(48.9%)	17(65.4%)	0.073
	Smoking	13(44.8%)	30(66.7%)	15(57.7%)	0.178
	Dyslipidemia	9(31.0%)	0(44.4%)	16(61.5%)	0.076
	Family history	7(24.1%)	16(35.6%)	13(50.0%)	0.136

Data are presented as mean±SD or frequency (%). MC: Monte Carlo, SS: SYNTAX score, DM: diabetes mellitus, HTN: hypertension.

Ejection fraction was substantially reduced in group III contrasted to group II and group I (P = 0.001). WBCS count, MPV and WBCs/MPV ratio was substantially elevated in group III compared to group I and II (*P*<0.001). Table 2

Table 2: Comparison among the two groups under the study based on LVEF and laboratory parameters

	SS			p
	Low (n = 29)	Intermediate (n = 45)	High (n = 26)	
ECHO EF	46.55±2.71	40.11±4.58	36.35±8.55	<0.001*
	p_1<0.001*p_2<0.001*p_3=0.018*			
Laboratory Parameters				
WBCs (cell/mm^3)	9.41±1.69	19.80±2.85	19.02±4.32	<0.001*
	p_1<0.001*p_2<0.001*p_3<0.001*			
MPV	8.33±0.20	9.46±0.46	10.83±1.08	<0.001*
	p_1<0.001*p_2<0.001*p_3<0.001*			
WBCs/MPV	1128.4±190.8	1604.3±236.3	1745.3±304.1	
	p_1<0.001*, p_2<0.001*, p_3=0.040*			<0.001*

Data are presented as mean± SD. *: Statistically significant at p ≤ 0.05, p: p value for comparison between the studied categories, p1: p value for comparison between low and intermediate, p2: p value for comparison between low and high, p3: p value for comparison between intermediate and high, ECHO: echocardiogram, SS: SYNTAX score, LVEF: Left ventricular ejection fraction, EF: ejection fraction, WBCs: white blood cell, MPV: Mean Platelet Volume.

There is a substantial positive correlation among WBCs/MPV ratio and the SS (r=0.755 and *p*<0.001). Table 3. In receiver operating characteristics (ROC) analysis, WMR >1472.5can predict a SS ≥ 23 with 71.11% sensitivity and 60.0% specificity (AUC: 0.632; 9 5% CI: 0.516 – 0.747; p: <0.024). WMR >1537.6 predicted a SS ≥33 with 73.08% sensitivity and 60.81specificity (AUC: 0.796; 95% CI: 0.686 – 0.906; p<0.001). Figure 1.

Table 3: Correlation between WBCs/MPV and SS

	WBCs/MPV (n = 100)	
	r_s	p
SS	0.755*	<0.001*

rs: Spearman coefficient, *: Statistically significant at p ≤ 0.05, SS: SYNTAX score, WBCs: white blood cell, MPV: Mean Platelet Volume.

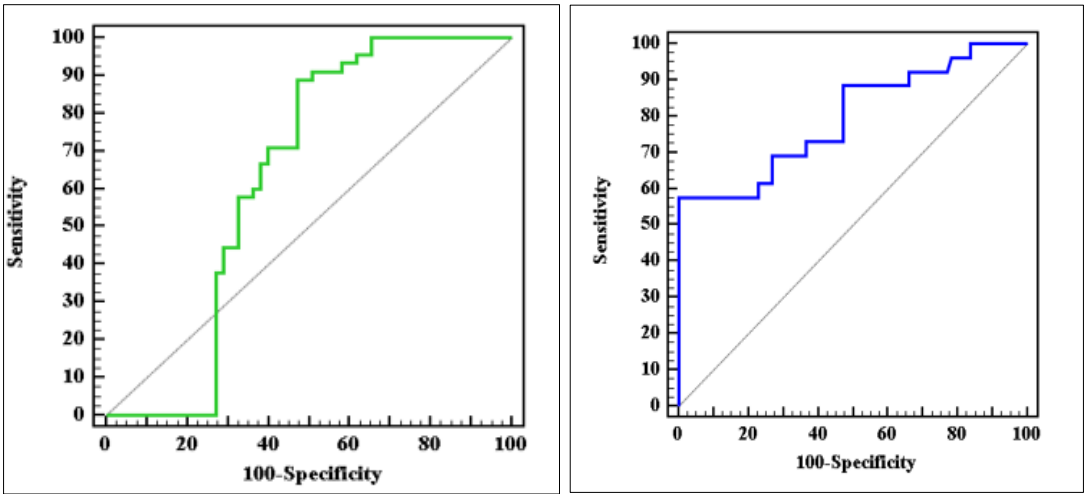

Fig 1: ROC curve for WBCs/MPV to discriminate (A) intermediate SYNTAX score (SS) vs low + high SYNTAX score and (B) high SYNTAX score vs low + intermediate SYNTAX score

Discussion

Ischemic heart disease is the predominant cause of mortality globally and its prevalence is rising [16].

Atherosclerosis and the subsequent rupture of atherosclerotic plaques are the primary factors contributing to the occurrence of STEMI. Inflammation is a significant element in the occurrence of atherosclerosis and may potentially cause the rupture of plaques when combined with certain risk factors [17].

The SYNTAX score is an angiographic scale that is utilized to assess the complexity of CAD. Clinical investigation has demonstrated that SS has significant predictive value in CAD and offers crucial insights into the choice of revascularization approach [18].

In line with the findings of this work, studies were performed by Muammer Karakayali *et al.* [19] on 335 patients , Gang Wang *et al.* [20] on 477 patient , Caner Türkoˇglu *et al.* [21] on 300 patients and Mehmet Kadri Akboga *et al.* [21] on 1229 patients.

In our work, A notable variance occurred amongst the three groups. WBC count had been greater in group III compared to group II and I. In line with the findings of this work, studies were performed by Muammer Karakayali *et al.* [19] on 335 patients and Mehmet Kadri Akboga *et al.* [22] on 1229 patients. Contrary to the findings of our work, the work performed by Gang Wang *et al.* [20] on 477 patient that demonstrated no statistically notable variance among the three group.

In our work, A statistically substantial variation was existed among the three groups. MPV was greater in group III contrasted to group II and I. In accordance with the findings of this work, studies were performed by Muamme Karakayali *et al.* [19] on 335 patients, Sani Namik Murat *et al.* [23] on 520 Patients, Berkay Ekici *et al.* [24] on 435 patients, Ioannis Vogiatzis *et al.* [25] on 104 Patients.

Contrary to the findings of our work, research performed Giuseppe De Luca *et al.* [26] on 1411 patients, which revealed that MPV is not correlated with the severity of CAD.

Regarding the WBCS/MPV ratio, a statistically notable variance was existed amongst the three groups. WMR was greater in group III contrasted to group II and I. In accordance with the results of this work, studies were performed by Muammer Karakayali *et al.* [19] on 335 patients , Altekin Refik Emre *et al.* [27] on 537 patients, Serkan Sivri *et al.* [28] on 335 patients.

Limitations of this study include that the relatively small of sample size. The work was in a single center. Additional inflammatory markers, that includes high sensitivity-C-reactive protein, fibrinogen, or myeloperoxidase weren't included.

Conclusions

There was a significant correlation among the WMR values and SS in STEMI individuals. Within this particular basis, WMR has the capability to provide corroborative information in forecasting the intensity of CAD among individuals experiencing STEMI,

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Conflict of Interest: Nil

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