Original Article

Assessment of plasma level of D-dimer, platelets, and MPV in myocardial infarction patients

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ABSTRACT

Myocardial infarction disease is a leading cause of morbidity and mortality. D-dimer was previously only utilized as a marker in venous thromboembolism and aortic dissection, and types of research on its significance in MI diagnosis have been undertaken. This study aims to assess D- dimer plasma level &platelets and MPV among myocardial infarction patients. Fifty Sudanese patients with myocardial infarction were enrolled as the case group, and fifty healthy individuals of various ages were included as the control group. D- dimer was measured using an immunodetection technique in both groups, whereas platelet counts and MPV were measured using a cell counter. (automated hematology analyzer Sysmex KX-21N). When patient and control samples were analyzed, it was observed that MPV and D-dimer had a highly significant relationship (P-value 0.001), whereas platelet count has a significant correlation (P-value 0.001). (P-value 0.05). Also, there is a significant association between patient age groups, platelet count, and D dimers. The D-dimer, platelet count, and MPV were considered as risk factors and diagnostic values for MI.

Keywords: D-dimer, Platelets, MPV, Myocardial infarction

Introduction

In the Western world, myocardial infarction (MI) is the major cause of death [1]. Platelets have an important part in the growth of coronary plaques and the thrombotic blockage of coronary arteries, which leads to ischemia and MI [2-4]. Furthermore, microembolization and platelet aggregation within the myocardium's damaged microcirculation during late ischemia and reperfusion (IR) cause additional tissue injury [2]. Because D-dimer is the major breakdown product of cross-linked fibrin, it acts as an effective marker of continuing coagulation with fibrinolysis. D-dimer levels have also been demonstrated to have a strong correlation with later coronary artery occurrences [5-7]. Platelet activation is critical for the onset of acute coronary syndromes. Platelet size has been linked to platelet function. Large platelets are thought to be more metabolically and enzymatically active than smaller ones [8]. High mean platelet volume (MPV) is linked to the degree of sluggish coronary flow [9]. MPV levels are higher in patients with unstable angina pectoris and MI. Higher MPV following acute ischemic cerebrovascular events is related to a poorer result and a higher risk of recurrent stroke. It has also been identified as an independent risk factor for MI, but not for the prevalence of coronary artery disease. MPV has been identified as a robust, independent predictor of poor angiographic reperfusion and 6-month death [8]. Platelet size has also been involved in the development of restenosis following successful coronary angioplasty [8]. As a result, the purpose of this study is to assess the levels of D-dimer, platelets, and MPV in Sudanese patients with myocardial infarction.

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Materials and Methods

Study design

This hospital-based case-control study was undertaken at Ahmed Gasim Hospital in Khartoum, Sudan, between December 2020 and January 2021. One hundred Sudanese volunteers participated in this study, 50 of whom were MI patients while the others appeared to be healthy as controls.

Inclusion criteria

Patients with MI in Khartoum state who were on regular follow-up were included in this study.

Exclusion criteria

Patients with other diseases rather than MI such as Bleeding disorder, malignancy, patients with PE, patients with DVT, patients with chronic liver disease, and patients with recent surgery were excluded

Data collection

The demographic data were acquired from individuals using a pre-prepared structural questionnaire; the questionnaire is an open-ended questionnaire performed by an interviewer.

Sampling

Each individual had 3 mL of venous blood drawn, with 2.7mL collected in 3.8 % tri-sodium citrate (9:1 vol/vol) for D-dimer assay. After centrifuging the samples for 15 minutes at 2500 rpm, the plasma is delivered to the laboratory in ice bags and maintained at 25 °C until evaluated within 24 hours of collection To collect CBC samples, blood was drawn into a tube containing an anticoagulant (usually EDTA) to prevent natural coagulation.

Principle of D dimer

The sandwich immunodetection method is used in the test; the detector antibody in buffer binds to antigens in the sample, generating antigen-antibody complexes that move to the nitrocellulose matrix and are collected by the other immobilized antibody on the test strip. The more antigens in the sample, the more antigen-antibody complexes produced, resulting in a brighter fluorescence signal on the detector antibody, It is processed by a piece of equipment for the Ichroma test to determine D-dimer concentration in a sample [10].

Principle of Sysmex KX-21N for CBC analysis

The Sysmex KX-21N is a quantitative automated hematology analyzer that can determine 17 hematological parameters in vitro. The numerical and/or morphologic findings of CBC can help in the diagnosis of such clinical conditions. The KX-21N uses electrical resistance detection to count and size red blood cells (RBC) and platelets (PLT). Using cumulative pulse height detection, hematocrit (HCT) is calculated as the ratio of total RBC volume to whole blood. HGB is transformed to methemoglobin and photometrically read at 555 nm. White blood cells (WBC) are evaluated using direct current and classified into three groups using Particle Distribution Analysis (PDA). The WBC histogram that results is divided into lymphocyte, neutrophil, and mixed cell populations. Monocytes, basophils, and eosinophils make up the mixed cell population [11].

Statistical analysis

The data were analyzed with SPSS program version 23.0. Initially, all information was gathered through a data master sheet and coded into variables. The results were presented using descriptive and inferential statistics such as the Independent T-test, one sample T-test, One Way ANOVA (Analysis of variances) test, Pearson Correlation test, and ROC Curve. A statistically significant p-value of less than 0.05 was evaluated.

Results and Discussion

This study included fifty patients who had all suffered a myocardial infarction. **Figure 1** shows that the average age of the participants ranged from 40 to 49 years. Males made up 62% of all patients, while females comprised 38% of all participants, as seen in **Figure 2**. **Figure 3** shows that the treatment duration of 7-12 months accounted for the greatest number 27 %.

As patient and control samples were examined, it was observed that MPV and D- dimer had a highly significant (P-value 0.001) relationship, whereas platelet count has a significant (P-value 0.05) relationship, as shown in **Table 1**. As seen in the **Table 2**, there was no significant relationship between treatment time and platelet count, MPV, or D dimer. Furthermore, as shown in the **Table 3**, there was no significant link between patient gender and platelet count, MPV, and D-dimers in the test and control samples. The **Table 4** indicates the substantial link between different age groups, platelet count, and D -dimers in patients.

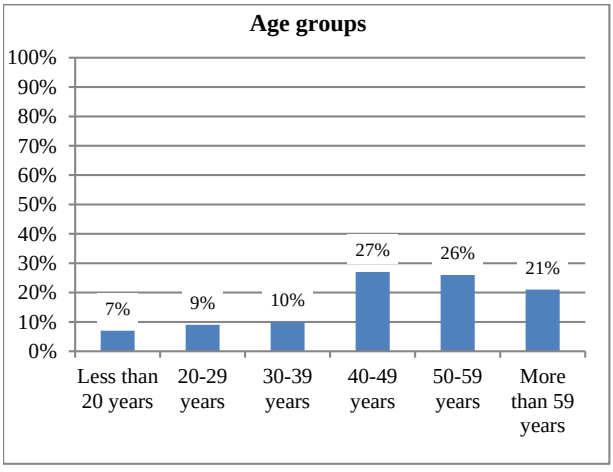

Figure 1. Shows the age distribution

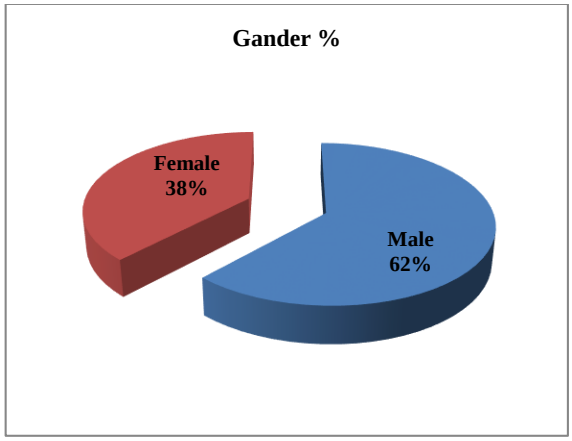

Figure 2. Illustrates the gender distribution

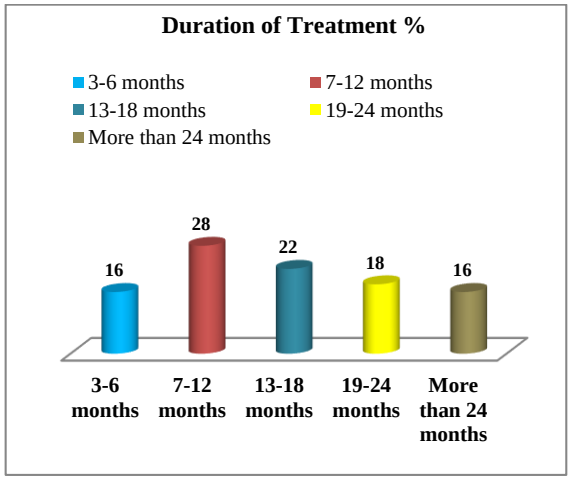

Figure 3. displays the percentage of treatment duration

Table 1. Comparison of D dimer, platelets count, and MPV in case (n=50) and control (n=50) individuals

Variables	Groups	Mean± SD	P-value
D dimer	Case	471±157	0.001**
	Control	160±60	
Platelets count	Case	268±106	0.023*
	Control	324±137	
MPV	Case	8.8± 1.5	0.001**
	Control	8.0± 1.0	

*P≤ 0.05, ** P≤ 0.001

Table 2. Correlation between duration of treatment and D dimer, platelets count, and MPV in the case group.

Variables	Duration of treatment	No	Mean± SD	P-value
D dimer	3-6 months	8	533±152	0.485
	7-12 months	14	473±152	
	13-18 months	11	460±173	
	19-24 months	9	498±109	
	>24 months	8	393±193	
Platelets count	3-6 months	8	329±171	0.502
	7-12 months	14	257±89	
	13-18 months	11	264±111	
	19-24 months	9	260±43	
	> 24 months	8	239±96	
MPV	3-6 months	8	9.2±1.8	0.678
	7-12 months	14	8.6±0.6	
	13-18 months	11	8.4±1.8	
	19-24 months	9	9.2±2.0	
	>24 months	8	9±1.1	

Table 3. Association between Gender and D dimer, platelets count, and MPV in both group case and control

Variables		Gender	No	Mean±	P-value
Case	D dimer	Male	31	482±170	0.531
		Female	19	453±135	
	Platelets count	Male	31	261±81	0.603
		Female	19	278±140	
	MPV	Male	31	8.8±1.4	0.764
		Female	19	8.9±1.6	
Control	D Dimer	Male	31	167±66	0.335
		Female	19	150±49	
	Platelets count	Male	31	308±139	0.276
		Female	19	352±133	
	MPV	Male	31	8±0.9	0.968
		Female	19	8±1.2	

Table 4. Correlation between age groups and D dimer, platelets count, and MPV in case and control.

Variables		Age groups	No	Mean± SD	P value
Control	D dimer	40-49 years	16	428±164	0.398
		50-59 years	20	498±157	
		>59 years	14	483±150	
	Platelets count	40-49 years	16	305±134	0.206
		50-59 years	20	257±85	
		>59 years	14	240±90	
	MPV	40-49 years	16	8.8±1.7	0.731
		50-59 years	20	9±1.6	
		>59 years	14	9±1	
Case	D dimer	< 20 years	7	99±43	0.018*
		20-29 years	9	146±29	
		30-39 years	10	171±36	
		40-49 years	11	196±49	
		50-59 years	6	147±71	
		>59 years	7	179±94	
	Platelets count	< 20 years	7	399±147	0.038*
		20-29 years	9	418±197	
		30-39 years	10	285±85	
		40-49 years	11	273±68	
		50-59 years	6	237±74	

MPV	>59 years	7	214±59	0.860
	< 20 years	7	7.9±1.0	
	20-29 years	9	7.8±0.9	
	30-39 years	10	7.8±1.5	
	40-49 years	11	8±0.8	
	50-59 years	6	8.5±0.9	
	>59 years	7	8±1	

*P≤ 0.05

The major findings of our study show that platelet count, MPV, and D- dimer are strong predictors of clinical course in MI patients. We discovered a link between D dimer concentration, platelet count, and MPV and the risk of MI. According to the findings of this study, the age group with the most common manifestation of the condition is between the ages of 40 and 49. According to the findings of this study, the concentrations of D-dimer and MPV in the serum of patients with MI are significantly higher when compared to control samples, while platelet count appears to be significantly lower in patients.

D-dimer, a thrombotic burden marker that reflects fibrin turnover secondary to plaque rupture at any arterial location, and plasmin-mediated fibrin breakdown, another sensitive marker of continuing thrombosis, may be directly connected to an inflammatory vascular state [12, 13]. The levels of D-dimer, platelets count, and MPV was not altered by the duration or shortness of the treatment time in this study, indicating that the treatment period is a non-influential factor in the criteria used to evaluate MI, as was the patient's gender.

D-dimer has been linked to an increased risk of recurrent thrombotic events, all-cause mortality, and cardiovascular disease risk, especially in patients with vascular disease or coronary heart disease [14]. D-dimer was also linked to the incidence of heart failure and all-cause death in individuals with MI in a previous study [15, 16]. The current study discovered that the concentration of D-dimer in patients with MI grows steadily with age, whereas platelet count declines dramatically with age.

Platelets play an important part in the etiology of atherosclerotic problems, aiding in thrombus formation or apposition following plaque rupture. Platelets hyperactivity and local platelet activation following rupture of arteriosclerotic plaque in coronary arteries have been proposed to play a causative role in prothrombotic events leading to MI [17]. Because large platelets are more active than tiny platelets and have a larger thrombotic potential due to high thromboxane A2 concentrations, platelet size has been believed to indicate platelet degree of activity. Platelets have a critical role in accelerating the creation and spread of intracoronary thrombus, resulting in acute thrombotic episodes [17].

MPV, which is regarded as a key marker of cardiovascular illness, indicates the degree of activation of platelets to some extent [18]. It can also be employed in the risk prediction, diagnosis, and prognosis assessment of cardiovascular illnesses [19, 20]. According to a recent study, MPV increased dramatically in AMI patients, and the rise in MPV was associated with the long-term prognosis of AMI patients to some extent [21]. A recent study found that MPV was considerably higher in individuals with AMI and SCAD. The increase in MPV is most likely related to the strength of the body's inflammatory reaction [18].

Conclusion

We can conclude that our key findings reveal that platelet count, MPV, and D- dimer are all good predictors of clinical course in MI patients. It predicts risk andas traditional risk factors and biomarkers can guide prognosis and management decisions.

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Conflict of interest: None

Financial support: None

Ethics statement: Ethical approval was obtained from the research committee at National University-Sudan for this research, written consent was obtained from participants in this study before sample collection after a thorough explanation of the research purpose, and the results of this research were retained for participants and their health leaders.

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