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RELATIONSHIP BETWEEN ROUTINE INFLAMMATORY MARKERS AND EJECTION FRACTION IN ELDERLY MEN WITH STABLE CORONARY ARTERY DISEASE

KARARLI KORONER ARTER HASTALIĞI OLAN YAŞLI ERKEKLERDE RUTİN İNFLAMATUAR BELİRTEÇLER VE EJEKSİYON FRAKSİYONU ARASINDAKİ İLİŞKİ

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ABSTRACT

AIM: Routine inflammatory markers have recently been proposed for chronic inflammatory diseases. Inflammation plays an important role in the pathogenesis of stable coronary artery disease. Our study aimed to evaluate routine hematological and biochemical parameters in elderly male patients with stable coronary artery disease.

MATERIALS AND METHODS: Between March 2015 and August 2019, the patients over 65 years of age who had exertional angina for more than 3 months, three-vessel disease on coronary angiography, and an ejection fraction of less than 55% on transthoracic echocardiogram were included in Group 1. The patients over 65 years of age who had exertional angina for more than 3 months, three-vessel disease on coronary angiography, and an ejection fraction of ≥55% on transthoracic echocardiogram were included in Group 2. Data of the elderly male patients were recorded from the patient files of the institution and the data of two study groups were compared.

RESULTS: In group 1, there were 131 male patients and in group 2, there were 117 male patients. In Group 1, values of red cell distribution width, mean platelet volume/platelet count, and red cell distribution width/platelet count were significantly higher than in Group 2 ($p<0.01$).

CONCLUSION: Routine inflammatory markers were higher in elderly men with stable coronary artery disease and low ejection fraction than in those with normal ejection fraction.

Keywords: *Stable coronary artery disease, inflammation, aged men, ejection fraction*

ÖZET

AMAÇ: Son zamanlarda kronik inflamatuar hastalıklar için bazı inflamatuar belirteçler önerilmiştir. İnflamasyon, stabil koroner arter hastalığının (SKAH) patogenezinde önemli bir rol oynar. Çalışmamızın amacı, SKAH olan yaşlı erkek hastalarda hematolojik ve biyokimyasal inflamatuar parametreleri değerlendirmektir.

GEREÇ VE YÖNTEM: Mart 2015 ve Ağustos 2019 tarihleri arasında, 3 ay boyunca efor anjinası olan, koroner anjiyografide 3 damar hastalığı olan ve transtorasik ekokardiyogramda kasılma oranı %55'den az olan 65 yaş üstü erkek hastalar birinci çalışma grubuna dahil edildi. En az 3 aydan fazla efor ağrısı olan, koroner anjiyografide 3 damar hastalığı tespit edilen ve transtorasik ekokardiyogramda kasılma oranı %55 ve üzerinde olan, 65 yaş üstü erkek hastalar ikinci çalışma grubuna dahil edildi. Yaşlı erkek hastaların verileri, kurumun hasta dosyalarından kaydedildi. İki çalışma grubunun verileri karşılaştırıldı.

BULGULAR: Grup 1'de 131 erkek hasta var iken, grup 2'de 117 erkek hasta vardı. Grup 1'de, Kırmızı hücre dağılım genişliği, Ortalama trombosit hacmi / trombosit ve Kırmızı hücre dağılım genişliği / trombosit değerleri grup 2'den anlamlı olarak yüksekti ($p<0,01$).

SONUÇ: Rutin inflamatuar belirteçler düşük ejeksiyon fraksiyonu olan kararlı koroner arter hastalığı olan yaşlı erkeklerde normal ejeksiyon fraksiyonu olanlardan daha yüksekti.

Anahtar kelimeler: *stabil koroner arter hastalığı, inflamasyon, yaşlı erkekler, ejeksiyon fraksiyonu*

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Ethics committee approval was obtained from the University of Health Sciences, Dr. Abdurrahman Yurtaslan Oncology Health Practice and Research Center, Clinical Research Ethics Committee (Ethical Code:2020-06/675).

INTRODUCTION

Detection of a left ventricular ejection fraction (LVEF) below 55% by echocardiography is defined as a decrease in ejection fraction (EF) (1). Although no correlation was found between EF measured on transthoracic echocardiogram and symptomatology, EF has always had prognostic value and is closely related to the severity of coronary artery disease and long-term mortality and morbidity (2).

The relationship between increased systemic inflammatory predictors and increased cardiovascular mortality and morbidity has been demonstrated (3). White blood cell (WBC) count is one of the simple and important markers that can show systemic inflammation levels, and the neutrophil/lymphocyte ratio is another of the widely used predictors that can show systemic inflammation (4). There is a statistically significant correlation between the degree of increase of the neutrophil/lymphocyte ratio and the severity of coronary artery disease (5). The neutrophil/lymphocyte ratio is one of the easily accessible inflammatory predictors used to identify risk of death, risk of myocardial infarction, and high-risk coronary artery patients (6). Recently, some indices obtained from simple routine complete blood count testing have been suggested as predictors of the inflammatory process and the course of chronic inflammatory disease. These markers include red cell distribution width (RDW), mean platelet volume (MPV), neutrophil/lymphocyte ratio (N/L), platelet count/lymphocyte count ratio (P/L), MPV/lymphocyte count ratio (MPV/L), MPV/platelet count ratio (MPV/P), and RDW/platelet count ratio (RDW/P). These markers have been tested for diabetes mellitus, rheumatoid arthritis, Hashimoto thyroiditis, diabetic nephropathy, lumbar disc herniation, thyroid cancer, and hepatocellular carcinoma recurrence after liver transplantation (7-13).

Although various inflammatory markers have been studied in various forms of coronary artery disease (14,15), the relationship between EF and these indices obtained from simple routine complete blood counts have not yet been studied in male patients older than 65 years with three-vessel stable coronary artery disease (SCAD). The EF and these markers obtained from routine blood samples are easily accessed and applied. With these simple methods, high-risk patients can be easily identified. Our study aimed to investigate the association of these inflammatory markers with EF in men older than 65 years with SCAD.

MATERIAL AND METHOD

Study Population

This retrospective study was performed in the Cardiology department of Sincan State Hospital. Ethics committee approval was obtained from the University of Health Sciences, Dr. Abdurrahman Yurtaslan Oncology Health Practice and Research Center, Clinical Research Ethics Committee (Ethical Code: 2020-06/675). Between March 2015 and October 2019, the patients over 65 years of age with SCAD attending the Cardiology outpatient clinic were included in the study. Enrolled patients had more than 3 months of exertional angina, indication for coronary angiography in an exercise test, and coronary angiography showing three-vessel disease (at least 70% or more stenosis in three epicardial coronary arteries was accepted three-vessel coronary artery disease).

The enrolled patients were divided into two groups according to their EFs. In group 1 the patients had with LVEF below 55%. In group 2 the patients had LVEF of 55% or more. The study group assignments were made based on the patient files of the institution.

The patients included in the study had undergone transthoracic echocardiograms and full routine blood tests, and they did not meet any of the exclusion criteria listed below. Age, weight, height, routine biochemistry results, and complete blood count findings of the patients were examined and recorded.

Exclusion Criteria

Presence of active infectious disease; angina with exertion that started less than 3 months previously; signs or history of myocardial infarction by routine ECG; history of coronary angiography; having previously been diagnosed with cancer and having received or receiving treatment for this reason; impaired liver or kidney function tests by routine biochemistry; having been diagnosed with hyperthyroidism and having received or receiving any relevant treatment; any significant electrolyte disturbance by routine biochemistry tests; any hematological disease, such as anemia or polycythemia, or treatment; important valvular disease by transthoracic echocardiogram; detection of the right chambers being wider than normal; having already been diagnosed with chronic obstructive pulmonary disease and therefore having received or receiving treatment; pacemaker presence; any chronic or acute inflammatory disease; diagnosis of or treatment for any collagen tissue disease.

Coronary Angiography

Coronary angiography recordings were determined primarily for three-vessel disease. Patients with obstruction of 70% or more in all three epicardial coronary arteries were considered as having three-vessel disease and were included in the study.

Blood Examination

Blood samples were taken from the subjects at the first application and recorded. Blood urea nitrogen, creatinine, total cholesterol, LDL cholesterol, HDL cholesterol, triglyceride, fasting blood glucose, sodium, potassium, magnesium, calcium, thyroid-stimulating hormone, C-reactive protein (CRP), and fibrinogen were analyzed retrospectively and recorded.

The WBC, neutrophil, lymphocyte, and platelet counts and the hemoglobin, MPV, and RDW values were obtained from the patient registry and recorded. From

these values, the relevant ratios were calculated. The N/L ratio was obtained by dividing the neutrophil count by the lymphocyte count. The P/L ratio was obtained by dividing the platelet count by lymphocyte count, the MPV/L ratio by dividing the MPV value by lymphocyte count, the MPV/P ratio by dividing the MPV value by platelet count, and the RDW/P ratio by dividing the RDW value by platelet count.

Transthoracic Echocardiography

Data recorded from the routine transthoracic echocardiograms of the patients were used. Transthoracic echocardiograms were performed with a Philips HD11X Echocardiography device (Philips Healthcare, the Netherlands). The LVEF was calculated by the single-plane method and recorded.

Ethical Approval

All procedures performed in studies involving human participants followed the ethical standards of the National Health and Medical Research Council of Turkey and the 1964 Declaration of Helsinki and later comparable ethical standards. Ethics committee approval was obtained from the University of Health Sciences, Dr. Abdurrahman Yurtaslan Oncology Health Practice and Research Center, Clinical Research Ethics Committee (Ethical Code:2020-06/675).

Statistical Analysis

Continuous variables were expressed as mean±standard deviation. Categorical variables were expressed as percentages. The Student t-test and chi-square test were used for the comparison of continuous and categorical variables. To compare the values of the two different groups, t-tests for two independent means were used. To compare the proportions, Z-tests for two population proportions were used. The Pearson correlation test was used to examine the correlation between variables. Values of $p<0.05$ were considered to be significant. Statistical analysis was performed using the commercially available SPSS 20.0 statistical package (IBM Co., Armonk, NY, USA).

RESULTS

In Group 1, there were 131 male patients over the age of 65, with an average age of 69.83±3.52 years, with SCAD and an ejection fraction below 55%. In Group 1, 51.6% of the patients had essential hypertension, 33.51% had diabetes mellitus, and 28.5% had hyperlipidemia, and 41.5% of the patients in Group 1 were smokers or patients who had quit smoking. In Group 2, there were 117 male patients over the age of 65, with an average age of 69.61±3.93 years, with SCAD and an ejection fraction of ≥55%. In Group 2, 52.1% of the patients had essential hypertension, 32.89% had diabetes mellitus, and 27.9% had hyperlipidemia, and 42.1% of the patients in Group 2 were smokers or patients who had quit smoking. There were no significant differences between Groups 1 and 2 in terms of hypertension, diabetes mellitus, hyperlipidemia, or smoking habits ($p>0.05$).

In Group 1, the systolic pulmonary arterial pressure was significantly higher than in Group 2. Furthermore, stroke volume and EF values were significantly lower in Group 1 than in Group 2. In Group 1, all other sociodemographic and baseline clinical findings were similar to those of Group 2 **(Table 1).**

Table 1. Sociodemographic and baseline clinical findings of the two groups

Variables	Group 1	Group 2	T-value	P-value
Age, years	69.83±3.52	69.61±3.93	0.46	0.64
BMI, kg/m²	26.34±3.51	25.95±3.44	0.88	0.37
LV EDD, cm	4.63±0.53	4.51±0.45	1.91	.057
LV ESD, cm	2.91±0.35	2.83±0.39	1.70	0.09
Stroke volume, mL	56.31±11.52	68.32±7.43	-9.62	<0.01
sPAP, mmHg	21.56±3.82	16.83±3.01	10.74	<0.01
Ejection fraction, %	43.78±2.72	64.38±3.99	47.92	<0.01
SBP, mmHg	124.85±10.42	123.91±11.3	0.68	0.49
DBP, mmHg	74.35±9.56	72.63±7.37	1.57	0.11
LV mass, g	175.12±21.59	169.79±26.82	1.73	0.08
FBG, mg/dL	101.47±12.52	99.71±10.48	1.19	0.23
BUN, mg/dL	19.42±2.17	19.91±1.85	-1.90	.059
Creatinine, mg/dL	0.98±0.09	0.96±0.12	1.49	0.13
TC, mg/dL	194.72±34.82	189.36±29.24	1.30	0.19
LDL, mg/dL	139.63±17.32	134.49±19.38	1.77	0.07
HDL, mg/dL	33.56±4.23	34.46±5.83	-1.40	0.16
Triglyceride, mg/dL	171.82±31.61	167.12±27.93	1.23	0.21
Calcium, mg/dL	9.06±0.57	9.16±0.66	1.28	0.20
Sodium, mEq/L	139.82±3.51	140.38±2.91	-1.37	0.17
Magnesium, mg/dL	1.92±0.23	1.98±0.31	1.74	0.08
TSH, mIU/L	3.36±1.25	3.21±1.12	0.99	0.32

Abbreviations: BMI, Body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; LV, left ventricle; TC, total cholesterol; LDL, low-density lipoprotein; TSH, thyroid-stimulating hormone; EDD, end diastolic diameter; ESD, end systolic diameter; sPAP, systolic pulmonary arterial pressure; HDL, high-density lipoprotein; dL, deciliter; mEq, milli-equivalent; mg, milligram; mmHg, millimeter of mercury; mL, milliliter; BUN, blood urea nitrogen; FBG, fasting blood glucose

In Group 1, the WBC count, neutrophil count, RDW value, MPV value, N/L ratio, P/L ratio, MPV/L ratio, MPV/P ratio, and RDW/P ratio were significantly higher than in Group 2. There was no difference between Groups 1 and 2 in terms of platelet counts or hemoglobin values. Furthermore, in Group 1, the lymphocyte count was significantly lower than in Group 2 **(Table 2).**

In Group 1, there were significant weak negative correlations between LVEF and CRP, fibrinogen, RDW, MPV, N/L ratio, P/L ratio, MPV/L ratio, MPV/P ratio, and RDW/P ratio. Furthermore, in Group 2, while there were significant weak negative correlations between LVEF and CRP, fibrinogen, RDW, MPV, and N/L ratio, there were no correlations between LVEF and P/L ratio, MPV/L ratio, MPV/P ratio, or RDW/P ratio **(Table 3).**

Table 2. Comparison of the inflammatory markers of the two groups obtained from complete blood count indices and routine biochemical examinations

Variables	Group 1	Group 2	T-value	P-value
WBC	$8.64\times10^3\pm1.21\times10^3$	$7.71\times10^3\pm1.97\times10^3$	4.53	<0.01
Neutrophil	$6.87\times10^3\pm0.51\times10^3$	$4.62\times10^3\pm0.44\times10^3$	36.98	<0.01
Lymphocyte	$1.96\times10^3\pm1.70\times10^3$	$2.76\times10^3\pm0.50\times10^3$	-4.90	<0.01
RDW	17.43±1.27	15.74±1.37	10.08	<0.01
Hemoglobin, g/dL	14.82±2.84	14.63±2.58	0.54	0.59
Platelet	$181.34\times10^3\pm19.16\times10^3$	$185.21\times10^3\pm39.91\times10^3$	-0.86	0.38
MPV	9.38±0.71	7.38±0.90	15.51	<0.01
N/L	3.88±086	1.70±0.32	25.86	<0.01
P/L	96.96±25.49	68.61±17.72	10.05	<0.01
MPV/L	$5.23\times10^{-3}\pm1.11\times10^{-3}$	$2.88\pm0.46\times10^{-3}$	21.32	<0.01
MPV/P	$0.056\pm0.01\times10^{-3}$	$0.044\times10^{-3}\pm0.01\times10^{-3}$	8.85	<0.01
RDW/P	$0.104\pm0.02\times10^{-3}$	$0.089\times10^{-3}\pm0.02\times10^{-3}$	5.41	<0.01
CRP	6.97±0.71	4.01±0.45	38.68	<0.01
Fibrinogen	477.79±96.1	313.62±62.41	15.74	<0.01

Abbreviations: WBC, White blood cell; RDW, red cell distribution width; MPV, mean platelet volume; N, neutrophil; L, lymphocyte; P, platelet; CRP,C-reactive protein

Table 3. The correlations between inflammatory markers and left ventricular ejection fraction in the two groups

Group 1 (n=131)				
Variable 1	**Variable 2**	**R-value**	**P-value**	**Correlation**
CRP	LV EF	-0.44	<0.01	Weak negative
Fibrinogen	LV EF	-0.31	<0.01	Weak negative
RDW	LV EF	-0.34	<0.01	Weak negative
MPV	LV EF	-0.32	<0.01	Weak negative
N/L ratio	LV EF	-0.33	<0.01	Weak negative
P/L ratio	LV EF	-0.22	0.011	Weak negative
MPV/L ratio	LV EF	-0.19	0.029	Weak negative
MPV/P ratio	LV EF	-0.18	0.039	Weak negative
RDW/P ratio	LV EF	-0.18	0.039	Weak negative
Group 2 (n=117)				
CRP	LV EF	-0.26	<0.01	Weak negative
Fibrinogen	LV EF	-0.26	<0.01	Weak negative
RDW	LV EF	-0.24	<0.01	Weak negative
MPV	LV EF	-0.21	0.023	Weak negative
N/L ratio	LV EF	-0.23	0.012	Weak negative
P/L ratio	LV EF	-0.11	0.23	No correlation
MPV/L ratio	LV EF	-0.08	0.39	No correlation
MPV/P ratio	LV EF	-0.08	0.39	No correlation
RDW/P ratio	LV EF	-0.07	0.45	No correlation

Abbreviations: RDW, Red cell distribution width; MPV, mean platelet volume; N, neutrophil; L, lymphocyte; P, platelet; CRP,C-reactive protein; LV EF, left ventricular ejection fraction

DISCUSSION

In our study, all parameters showing inflammation in the group of elderly men with three-vessel SCAD and LVEF of less than 55% were significantly higher compared with a group of elderly men with three-vessel SCAD and LVEF of ≥55%. We also found that multiple inflammation markers had a statistically significant negative correlation with LVEF.

In a study conducted on patients with preserved LVEF, N/L ratio has been proven to be an important marker that can be used when performing risk stratification (16).

In a study conducted in 2014, it was found that the N / L ratio in patients with stable coronary artery disease is directly proportional to the severity of coronary artery disease (17). In addition, LVEF in coronary artery disease correlates with the extent of ischemia and the size of myocardial infarction. When the subject is considered to have SCAD, the measured EF reflects the degree of ischemia and the severity of coronary artery disease. In our study, we examined whether there was a difference between the recently identified hematological and biochemical markers of inflammation in patients with three-vessel SCAD between those with LVEF above 55% and those with LVEF below 55%.

With or without significant risk factors such as diabetes mellitus, smoking, hypertension, and hyperlipidemia, the loss of endothelial cell function accelerates the passage of inflammatory cells into the sub-endothelial regions, thus initiating atherosclerosis in the background of the inflammatory process (18).

Several forms of complex cellular and molecular inflammatory processes in various forms of coronary artery disease have been examined and it has been emphasized that some inflammatory markers may be independent predictors for all-cause and cardiovascular-related mortality. In one study, it was demonstrated that increased WBC count was associated with cardiovascular events in patients of middle and advanced age and with hyperuricemia. Therefore, it has been emphasized that WBC count may indicate cardiovascular risks in patients of middle and advanced aged with hyperuricemia (19). In our study, the WBC count was found significantly higher in the group with EF below 55% compared to the group with EF above 55%.

Various markers of inflammation have been studied in various forms of coronary artery disease. One of the most emphasized of these is MPV. In a review study, when coronary artery disease was considered in general, it was found that higher MPV is closely related to the severity of coronary artery disease (20). Increased cardiovascular mortality and morbidity in follow-up has also been argued to be associated with lower MPV (21).

Another examined hematological maker is mean RDW. In one study, it was shown that high RDW and MPV values in patients with SCAD showed a negative correlation with collateral development (22). In our study, we found that RDW and MPV values were significantly higher in the group 1 than in the group 2. In another study, the N/L ratio was found to be closely related to SYNTAX scoring, which showed coronary artery disease severity in patients with SCAD (23). In one study, the N/L and P/L ratios were closely correlated with the severity of coronary artery disease (24). In a review of 38 studies and 76,002 cases, it was emphasized that the N/L ratio was closely related to all clinical forms of coronary artery disease, acute coronary syndromes, cerebrovascular events, and mixed cardiovascular events and could be a predictor of these events (25).

In another review, 149 studies were examined and it was stated that inflammatory markers such as fibrinogen and CRP are associated with coronary artery disease and can be used in risk scoring (26). In one study, the MPV/L ratio was correlated with poor angiographic findings in acute myocardial infarction and a high MPV/L ratio was closely associated with both early and late mortality (27). Elevated MPV/P ratio has also been observed as an independent predictor of mortality and acute myocardial infarction at the 4-year follow-up in hemodialysis patients with vascular access failure (28). Additionally, in a study, N / L ratio and ejection fraction were found to be significant predictors of mortality and morbidity in patients with stable coronary artery disease (29). In addition to all these, N/L ratio and ejection fraction were found to be closely related in patients with stable coronary artery disease with 3-vessel disease (30).

Although many studies have investigated the relationship between RDW elevation and poor prognosis in coronary artery disease, no studies have investigated the relationship between RDW/P ratio and coronary artery disease. In our study, we found that RDW/P ratio values were higher in Group 1 than in Group 2.

Our study has certain limitations. First, the number of cases in our study is small. Second, we could not track the short-term or long-term follow-up and examine the relationship between cardiovascular events. Third, high-sensitivity CRP was not routinely tested and we could not include it in our study.

CONCLUSION

In elderly male patients with three-vessel SCAD, the most recently used markers in Group 1 patients, who had LVEF below 55%, were significantly higher than in Group 2 patients, who had LVEF above 55%. In addition, most of them showed a significant correlation with LVEF. The EF and these markers obtained from routine complete blood counts are easily accessed and applied.

REFERENCES

1.)Lang RM, Bierig M, Devereux RB et al. Chamber Quantification Writing Group; American Society of Echocardiography's Guidelines

and Standards Committee; European Association of Echocardiography. Recommendations for chamber quantification: a report from the American Society of Echocardiography's Guidelines and Standards Committee and the Chamber Quantification Writing Group, developed in conjunction with the European Association of Echocardiography, a branch of the European Society of Cardiology. J Am Soc Echocardiogr 2005; 18: 1440–63.
2.)Yancy CW, Jessup M, Bozkurt B et al. American College of Cardiology Foundation. American Heart Association Task Force on Practice Guidelines 2013 ACCF/AHA guideline for the management of heart failure: A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2013; 62: e147–e239.
3.)Balta I, Balta S, Demirkol S et al. Aortic arterial stiffness is a moderate predictor of cardiovascular disease in patients with psoriasis vulgaris. Angiology. 2014; 65: 74-8.
4.)Balta S, Demirkol S, Unlu M et al. Neutrophil to lymphocyte ratio may be predict of mortality in all conditions. Br J Cancer. 2013; 109: 3125-6.
5.)Arbel Y, Finkelstein A, Halkin A et al. Neutrophil/lymphocyte ratio is related to the severity of coronary artery disease and clinical outcome in patients undergoing angiography. Atherosclerosis. 2012; 225: 456-60.
6.)Papa A, Emdin M, Passino C et al. Predictive value of elevated neutrophil-lymphocyte ratio on cardiac mortality in patients with stable coronary artery disease. Clin Chim Acta. 2008; 395: 27-31.
7.)Bilgin S, Aktas G, Kocak MZ et al. Association between novel inflammatory markers derived from hemogram indices and metabolic parameters in type 2 diabetic men, The Aging Male, 2019 Jun 28;1-5. doi: 10.1080/13685538.2019.1632283
8.)Motomura T, Shirabe K, Mano Y et al. Neutrophil lymphocyte ratio reflects hepatocellular carcinoma recurrence after liver transplantation via inflammatory microenvironment. J Hepatol. 2013; 58: 58–64.
9.)Fu H, Qin B, Hu Z et al. Neutrophil- and platelet-to lymphocyte ratios are correlated with disease activity in rheumatoid arthritis. Clin Lab. 2015; 61: 269–73.
10.)Kocak MZ, Aktas G, Erkus E et al. Mean platelet volume to lymphocyte ratio as a novel marker for diabetic nephropathy. J Coll Physicians Surg Pak. 2018; 28: 844–7.
11.)Gasparyan AY, Sandoo A, Stavropoulos-Kalinoglou A et al. Mean platelet volume in patients with rheumatoid arthritis: the effect of anti-TNF-alpha therapy. Rheumatol Int. 2010; 30: 1125–9.
12.)Dagistan Y, Dagistan E, Gezici AR et al. Could red cell distribution width and mean platelet volume be a predictor for lumbar disc hernias? Ideggyogy Szemle. 2016; 69: 411–4.
13.)Aktas G, Sit M, Karagoz I et al. Could red cell distribution width be marker of thyroid cancer? J Coll Physicians Surg Pak. 2017; 27: 556–8.
14.)Sonmez O, Ertas G, Bacaksiz A et al. Relation of neutrophil -to-lymphocyte ratio with the presence and complexity of coronary artery disease: an observational study. Anadolu Kardiyol Derg. 2013; 13: 662-7.
15.)Weimin L, Xiaoting L, Maofeng W et al. Association between red cell distribution width and the risk of heart events in patients with coronary artery disease. Exp Ther Med. 2015; 9: 1508-14. doi: 10.3892/etm.2015.2244.
16.)Boralkar KA, Kobayashi Y, Amsallem M et al. Value of Neutrophil to Lymphocyte Ratio and Its Trajectory in Patients Hospitalized With Acute Heart Failure and Preserved Ejection Fraction. Am J Cardiol. 2020; 125: 229-35.
17.)Kaya A , Kurt M, Tanboga IH et al. Relation of neutrophil to lymphocyte ratio with the presence and severity of stable coronary artery disease. Clin Appl Thromb Hemost. 2014; 20: 473-7.
18.)Kinlay S, Ganz P. Role of endothelial dysfunction in coronary artery disease and implications for therapy. Am J Cardiol. 1997; 80: 11I-16I.1
19.)Chen H, Ding X, Li J et al. White blood cell count: an independent predictor of coronary heart disease risk in middle-aged and elderly population with hyperuricemia. Medicine (Baltimore). 2018; 97: e13729.
20.)Sansanayudh N, Anothaisintawee T, Muntham D et al. Mean platelet volume and coronary artery disease: a systematic review and meta-analysis. Int J Cardiol. 2014 20; 175: 433-40.
21.)Wada H, Dohi T, Miyauchi K et al. Mean platelet volume and long-term cardiovascular outcomes in patients with stable coronary artery disease. Atherosclerosis. 2018; 277: 108-12.
22.)Sincer I, Gunes Y, Mansiroglu AK et al. Association of mean platelet volume and red blood cell distribution width with coronary collateral development in stable coronary artery disease. Postepy Kardiol Interwencyjnej. 2018; 14: 263-9.
23.)Sönmez O, Ertaş G, Bacaksız A et al. Relation of neutrophil-to-lymphocyte ratio with the presence and complexity of coronary artery disease: an observational study. Anadolu Kardiyol Derg. 2013; 13: 662-7.
24.)Sari I, Sunbul M, Mammadov C et al. Relation of neutrophil-to-lymphocyte and platelet-to- lymphocyte ratio with coronary artery disease severity in patients undergoing coronary angiography. Kardiol Pol. 2015; 73: 1310-6.
25.)Angkananard T, Anothaisintawee T, McEvoy M et al. Neutrophil Lymphocyte Ratio and Cardiovascular Disease Risk: A Systematic Review and Meta-Analysis. Biomed Res Int. 2018 11; 2703518.
26.)Rusnak J, Fastner C, Behnes M et al. Biomarkers in Stable Coronary Artery Disease. Curr Pharm Biotechnol. 2017; 18: 456-71.
27.)Hudzik B, Szkodziński J, Lekston A et al. Mean platelet volume-to-lymphocyte ratio: a novel marker of poor short- and long-term prognosis in patients with diabetes mellitus and acute myocardial infarction. J Diabetes Complications. 2016; 30: 1097-102.
28.)Shin DH, Rhee SY, Jeon HJ et al. An Increase in Mean Platelet Volume/Platelet Count Ratio Is Associated with Vascular Access Failure in Hemodialysis Patients. PLoS One. 2017; 12: e0170357.
29.)Papa A , Emdin M, Passino C et al. Predictive value of elevated neutrophil-lymphocyte ratio on cardiac mortality in patients with stable coronary artery disease. Clin Chim Acta. 2008; 395: 27-31.
30.)Dogdu O , Akpek M, Yarlıoğlueş M et al. Relationship between hematologic parameters and left ventricular systolic dysfunction in stable patients with multi-vessel coronary artery disease. Turk Kardiyol Dern Ars. 2012; 40: 706-13.

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