

Association of eosinophil-to-lymphocyte ratio with coronary slow-flow phenomenon in patients undergoing coronary angiography

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Abstract

Introduction: The current investigation intended to evaluate the correlation between eosinophil-to-lymphocyte ratio (ELR) and the coronary slow-flow phenomenon (CSFP) in patients undergoing elective coronary angiography.

Material and methods: A case-control investigation was conducted on 200 individual CSFP patients and another 200 individuals with normal coronary arteries and who were matched for age, gender, and body mass index. ELR was computed by dividing the number of eosinophils by the number of lymphocytes. Thrombolysis in myocardial infarction frame count was used to determine the CSFP.

Results: The ELR in the CSFP group was substantially greater than in the control group [0.38 (0.28–0.50)] and [0.22 (0.17–0.35)], $p < 0.001$, respectively). With the help of multivariable logistic regression analysis, ELR independently predicted the CSFP presence (odds ratio = 1.040, 95% CI: 1.026–1.053), $p < 0.001$). The effective cutoff point of ELR in predicting CSFP presence was > 0.29 with sensitivity of 77% and specificity of 70%. ELR had better diagnostic accuracy to predict CSFP than either lymphocyte or eosinophil count alone [AUC = 0.746 vs. AUC = 0.687 vs. AUC = 0.687, respectively].

Conclusions: To our knowledge, this was the first investigation to determine the connection between ELR and CSFP. We discovered that individuals with CSFP had higher ELR than those with normal coronary arteries in the control group.

Key words: inflammation, eosinophils, lymphocytes.

Introduction

During routine coronary angiography (CAG), slow filling of the epicardial coronary artery is frequently observed with a lack of significant stenosis. This finding is termed the coronary slow-flow phenomenon (CSFP), and it was first documented by Tambe in 1972 in six individuals suffering from angina pectoris [1]. Roughly, one percent of the individuals undergoing elective CAG are diagnosed with CSFP [2]. The precise mechanisms causing CSFP remain obscure. However, the CSFP has been suggested

to be linked to inflammation, oxidative stress, and endothelial dysfunction [3, 4].

Eosinophils and lymphocytes have been implicated in inflammation, atherosclerosis, and endothelial dysfunction in previous investigations [5]. The eosinophil-to-lymphocyte ratio (ELR) is a new inflammatory bioindex that takes into account both eosinophil and lymphocyte levels [6]. In recent studies, the relationship between the ELR and adverse events in patients with malignancy has been demonstrated [6, 7]. Besides that, the predictive value of this index has been investigated for isolated coronary artery ectasia presence and severity [8]. Moreover, a recent study revealed that the ELR, simply derived from the complete blood count (CBC), has greater diagnostic and prognostic power than either lymphocyte or eosinophil alone [9]. With respect to the current knowledge, however, there are no existing data about the relationship between ELR and CSFP. Because an increased ELR was closely related to inflammation and atherosclerosis, we hypothesized that there may be an association between ELR and CSFP. Consequently, we aimed to determine the link between CSFP and ELR in subjects undergoing elective CAG.

Material and methods

Study population

In this retrospective, case-control investigation, a total of 16,000 subjects who underwent elective CAG between June 2014 and July 2020 were identified by scanning their electronic medical reports. Patients who were accepted as having typical angina or with a suspected or positive finding in one of the non-invasive methods that was performed for detection of coronary ischemia underwent elective CAG. Patients who were diagnosed with acute coronary syndrome, who had an acute or chronic infection, who used any glucocorticoid treatments or anti-allergic drugs within 3 months, had a hematologic and auto-immune disease, undergoing chronic peritoneal dialysis or hemodialysis treatment were eliminated from the study. In addition, patients with a history of previous myocardial infarction, liver and gallbladder diseases, severe coronary artery disease, and those who had a decision for coronary artery bypass grafting and stent implantation were excluded from the study. After assessment regarding elimination criteria, 200 (1.2%) individuals were found to have CSFP. The control group consisted of 200 cases with a normal coronary artery that matched with age, gender, and body mass index (BMI). Baseline demographic characteristics along with related clinical information were retrieved from the hospital's electronic database. The local ethics com-

mittee reviewed and approved our study protocol (decision number 448 dated 21/04/2021).

CAG

CAG was performed via either the femoral or radial artery according to Judkins's approach. All of the coronary angiograms were documented in DICOM digital media with a rate of 25 frames/ms. Patients who were diagnosed with CSFP were also reevaluated by two skilled physicians who did not have access to the patient's medical records. The thrombolysis in myocardial infarction frame count (TFC) was used to calculate the CSFP [10]. The cine frames required for the contrast to reach a conventional distal coronary landmark in the left anterior descending (LAD), left circumflex (LCX), and right coronary artery (RCA) at 30 frames/s were calculated. The LAD distal bifurcation, the LCX distal bifurcation with the segment having the longest total distance, and the RCA's first branch of the posterolateral artery were all predefined distal landmarks. Participants with a TFC of more than 2 standard deviations beyond the usual reported range for any of the three coronary arteries (> 40.6 frames for LAD, > 29.8 frames for LCX, and > 27.3 frames for RCA) were considered to have a CSFP.

Laboratory analysis

Prior to the CAG, all blood samples were taken from the ante-cubital vein and delivered to the laboratory for examination within an hour of collection. A hematology analyzer was used to evaluate the hematologic indices. The ELR was calculated from the same blood sample and is defined by dividing the number of eosinophils by the number of lymphocytes.

Statistical analysis

Continuous parameters that were normally distributed were presented as means and standard deviations. In case of a non-normal distribution, continuous parameters were provided as medians [interquartile ranges (IQRs)]. The percentages for categorical variables were used. To compare categorical parameters between the groups, the chi-squared (χ^2) test was utilized. To evaluate whether the variables were normally distributed, the Kolmogorov-Smirnov test was applied. The Mann-Whitney *U* test or Student's *t*-test was applied to evaluate continuous parameters between the groups based on whether or not they were regularly distributed. Parameters that yielded a *p*-value < 0.05 in the univariable logistic regression analysis were entered in the multivariable logistic regression analysis to evaluate the independent predictors of CSFP. The area under the

curve (AUC), which represented the accuracy of each value in discriminating individuals with CSFP from those without it, was calculated to assess the diagnostic accuracy and discriminatory power of the lymphocyte count, eosinophil count, and ELR. If the AUC was more than 0.70, it was rated as 'good,' and if it was less than 0.70, it was labeled as 'inadequate'. The ideal cutoff value was calculated using Youden's index from the point

of maximum sensitivity and specificity. The effect size (Cohen's *d*) and power value ($1 - \beta$) of the study were calculated using G*Power software (version 3.1.9.2) The effect size and power value were 0.74 and 99%, respectively. A *p*-value of < 0.05 was accepted as the statistical significance level. SPSS Statistics, version 24.0, was used to conduct all statistical analyses (IBM Corp., Armonk, NY, USA). By using the MEDCALC software

Table I. Demographic characteristics, laboratory and angiographic data of all cases

Parameter	Coronary slow-flow phenomenon (-) (n = 200)	Coronary slow-flow phenomenon (+) (n = 200)	P-value
Risk factors:			
Male gender, n (%)	125 (62.5)	119 (59.5)	0.539
Age, mean \pm SD	52.9 \pm 6.6	53.4 \pm 6.4	0.362
BMI, mean \pm SD	26.2 \pm 1.1	27.4 \pm 1.3	0.235
Hypertension, n (%)	53 (26.5)	84 (42)	0.001
Diabetes, n (%)	59 (29.5)	64 (32)	0.588
Smoking, n (%)	57 (28.5)	53 (26.5)	0.654
Hyperlipidemia, n (%)	104 (52)	113 (56.5)	0.366
Medications, n (%):			
Acetylsalicylic acid	54 (27)	68 (34)	0.128
Beta-blockers	21 (10.5)	32 (16)	0.105
RAS blockers	40 (20)	52 (26)	0.154
Dihydropyridine CCBs	22 (11)	30 (15)	0.234
Statins	42 (21)	52 (26)	0.238
Laboratory parameters:			
Creatinine [mg/dl] mean \pm SD	0.80 \pm 0.22	0.85 \pm 0.25	0.051
TC [mg/dl] mean \pm SD	207 \pm 48	206 \pm 48	0.928
LDL-C [mg/dl] mean \pm SD	129 \pm 45	131 \pm 46	0.562
HDL-C [mg/dl] mean \pm SD	46 \pm 4	39 \pm 9	< 0.001
Triglyceride [mg/dl] IQR	165 [115–248]	165 [114–245]	0.961
CRP [mg/dl] IQR	0.5 [0.4–0.8]	0.8 [0.5–0.8]	0.003
Hemoglobin [g/dl] mean \pm SD	14 \pm 1.2	14 \pm 1.1	0.716
WBC count [cells/ μ l] IQR	7.6 [6.9–8.3]	8.2 [7.3–8.8]	< 0.001
Neutrophil count [cells/ μ l] IQR	5.1 [4.1–5.9]	5.2 [4.3–6.0]	0.043
Lymphocyte count [cells/ μ l] IQR	1.5 [0.99–1.90]	1.2 [0.70–1.40]	< 0.001
Eosinophil count [cells/ μ l] IQR	0.35 [0.27–0.41]	0.44 [0.33–0.47]	< 0.001
Platelet count [cells/ μ l] mean \pm SD	284 \pm 52	299 \pm 55	0.007
ELR [IQR]	0.22 [0.17–0.35]	0.38 [0.28–0.50]	< 0.001
Angiographic parameters:			
LAD, n (%)	0 (0)	102 (51)	
Cx, n (%)	0 (0)	53 (26.5)	–
RCA, n (%)	0 (0)	45 (22.5)	
LAD TFC, mean \pm SD	24.3 \pm 3.3	45.7 \pm 8.2	< 0.01
CX TFC, mean \pm SD	22.1 \pm 2.2	27.7 \pm 9.4	< 0.01
RCA TFC, mean \pm SD	18.7 \pm 2.3	29.6 \pm 9.9	< 0.01

Continuous variables are presented as mean \pm SD or interquartile ranges (IQRs), nominal variables are presented as frequency (%). BMI – body mass index, RAS – renin-angiotensin-system, CCBs – calcium channel blockers, TC – total cholesterol, LDL-C – low-density lipoprotein cholesterol, HDL-C – high-density lipoprotein cholesterol, CRP – C-reactive protein, ELR – eosinophil/lymphocyte ratio, WBC – white blood cell, RCA – right coronary artery, Cx – circumflex artery, LAD – left anterior descending artery, TFC – thrombolysis in myocardial infarction frame count.

tool, the models' receiver operating characteristic (ROC) curves were compared (Software BVBA 13, Ostend, Belgium).

Results

Basal characteristics and laboratory and angiographic findings of all patients are summarized in Table I. There were no notable differences between the two groups in terms of diabetes, hyperlipidemia, and smoking. In the CSFP, however, hypertension was considerably greater. Additionally, the medications were not different across the groups. In regard to laboratory results, the CSFP group had greater white blood cell and eosinophil counts, while the control group had a higher lymphocyte count. When compared to the non-CSFP group, the ELR and serum C-reactive protein (CRP) levels were considerably higher in the CSFP group, but lymphocyte count and high-density lipoprotein cholesterol (HDL-C) levels were significantly lower in this group. Both groups had equal hemoglobin, neutrophil, and platelet levels. The CSFP group also had considerably higher median TFC values for all epicardial coronary arteries than the non-CSFP group. The CSFP was most commonly detected in the LAD (51%), later CX (25.5%), and with the RCA appearing less frequently (13.3%).

In order to identify potential CSFP predictors, multivariable logistic regression examination with two models was performed. In univariable analysis, hypertension, ELR, neutrophil count, eosinophil count, lymphocyte count, platelet count, and HDL-C were predictors of CSFP (Table II). To prevent multi-collinearity between eosinophil count and lymphocyte count and ELR, model 2 was implemented to identify the independent predictors of CSFP. According to this analysis, hypertension, HDL-C, platelet count, and ELR were independent predictors of CSFP.

We performed ROC analysis in order to test the diagnostic accuracy and discrimination power of lymphocyte count, eosinophil count, and ELR. In a ROC curve analysis, ELR > 0.29 was established as an appropriate cutoff point for the presence or absence of CSFP with 77% sensitivity and 70% specificity (AUC = 0.746, 95% CI: 0.697–0.796, $p < 0.001$). The AUC of the ELR value was ≥ 0.70 , and it had better diagnostic accuracy and discrimination power than the other two parameters (AUC = 0.687 for lymphocyte count and AUC = 0.687 for eosinophil count) (Figure 1).

Discussion

To our knowledge, this was the first investigation to determine the connection between ELR and CSFP. We discovered that individuals with CSFP had higher ELR than those with normal coronary arteries in the control group.

Based on the previous data, CSFP existed in 1% of patients undergoing CAG studies [2]. We found a comparable 1.2% incidence of CSFP among individuals who had CAG for chest discomfort or had objective indications of ischemia in this research. The pathophysiological mechanisms underlying the CSFP condition have not been clearly defined yet. CSFP has been hypothesized as a variant form of early atherosclerosis and microvascular dysfunction, among other theories. Besides that, inflammation has been shown to be involved in the development of CSFP [11]. Thus, inflammatory biomarkers have been extensively employed to investigate CSF [12–14]. Moreover, Li *et al.* discovered that plasma CRP and interleukin 6 levels were considerably elevated in individuals with CSFP in a recent study [15]. Elevated hs-CRP levels might reveal that the inflammation and microvascular abnormalities may be linked to the etiology of CSFP, and that it might be a sign of poor en-

Table II. Two different adjusted multivariable logistic regression analysis models to determine the predictors of coronary slow-flow phenomenon

Parameter	Model 1* Multivariable		Model 2* Multivariable	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Hypertension	2.428 (1.404–4.197)	< 0.001	2.438 (1.435–4.142)	0.001
HDL	0.876 (0.843–0.910)	< 0.001	0.866 (0.833–0.900)	< 0.001
CRP	1.530 (0.809–2.893)	0.280	1.649 (0.854–3.183)	0.136
Neutrophil	1.134 (0.919–1.400)	0.240	1.041 (0.850–1.275)	0.699
Platelet	1.008 (1.003–1.013)	0.003	1.008 (1.002–1.013)	0.004
Eosinophil	1.077 (1.047–1.107)	< 0.001	–	–
Lymphocyte	0.235 (0.148–0.371)	< 0.001	–	–
ELR	–	–	1.040 (1.026–1.053)	< 0.001

*Logistic regression analyses using the backward LR method were used for multivariable analysis of independent variables that were included if they were significantly different in univariable analyses ($p < 0.05$). OR – odds ratio, CI – confidence interval, HT – hypertension, HDL-C – high-density lipoprotein cholesterol, CRP – C-reactive protein, ELR – eosinophil/lymphocyte ratio.

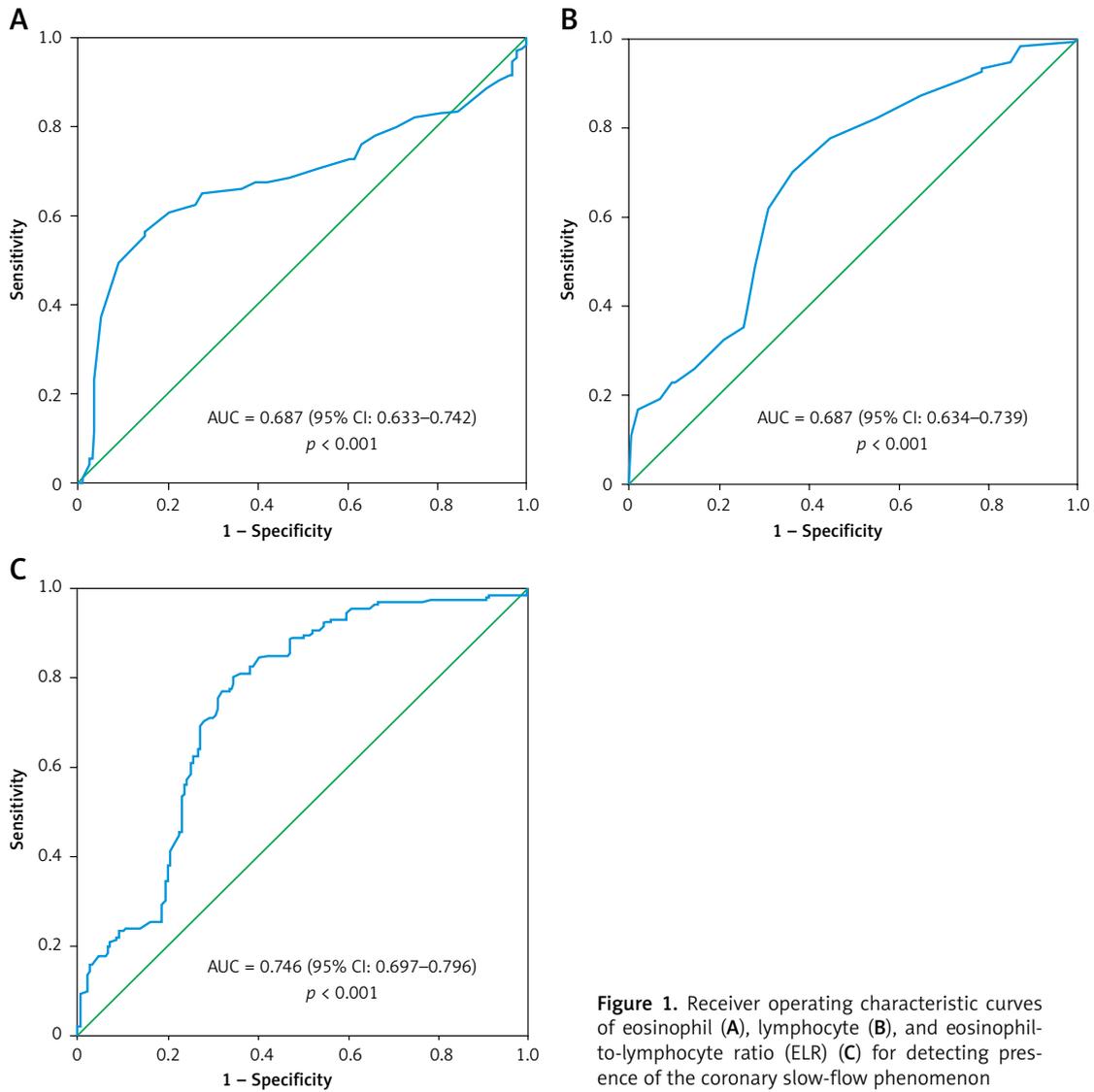


Figure 1. Receiver operating characteristic curves of eosinophil (A), lymphocyte (B), and eosinophil-to-lymphocyte ratio (ELR) (C) for detecting presence of the coronary slow-flow phenomenon

dothelial function in these individuals [16]. Also, Turhan *et al.* discovered that individuals with CSFP had higher levels of E-selectin, the vascular cellular adhesion molecule, and the intercellular adhesion molecule 1 [17]. In our investigation, even though some inflammatory markers, such as CRP levels and white blood cell counts, were considerably higher in the CSFP group than the non-CSFP group, these parameters were not independently associated with CSFP.

Eosinophils can trigger activation of the coagulation system and platelets and they can also lead to inflammation and aneurysm. Additionally, eosinophils also play an important role in vascular damage and they can enhance the risk of thrombosis by stimulating leukocytes and platelets, as well as releasing tissue factor [18–20]. Coronary artery ectasia is most likely an extreme type of expansive vascular remodeling in response to the development of atherosclerotic plaques [21].

In a prior study, Demir *et al.* observed significant differences in eosinophil count between the coronary artery ectasia (CAE) and control groups [22]. Their findings may help to explain the etiopathogenesis of CAE by linking higher eosinophil concentrations to vascular damage, endothelial dysfunction, and thrombosis in CAE cases.

It has been discovered that leukopenia is linked to cardiovascular complications [23]. Additionally, increased eosinophil count and decreased lymphocyte count can indicate systemic inflammation and physiologic stress, which can both contribute to cardiovascular disease development [24]. Consequently, ELR has been considered as a systemic inflammatory indicator. Prior studies reported that there was a significant relationship between ELR and adverse events in patients with malignancy [6, 7]. Moreover, Yılmaz *et al.* recently found that subjects with angiographic isolated CAE had significantly greater ELR values [8]. However, the pre-

dictive value of ELR in patients with CSFP has not been evaluated yet. According to our data, the ELR values were significantly higher in individuals with CSFP, and ELR was also independently associated with CSFP. In a ROC curve analysis, we found that the optimal cutoff point of ELR for the presence or absence of CSFP was > 0.29 with 77% sensitivity and 70% specificity (AUC = 0.746). The AUC value of ELR value was ≥ 0.70 , and it had better diagnostic accuracy and discrimination power than its components, including lymphocyte and eosinophil counts (AUC = 0.687 for lymphocyte and AUC = 0.687 for eosinophil count). Based on our data, it is possible to conclude that elevated ELR may play a role in CSFP pathogenesis. In other words, higher ELR in CSFP patients may be a sign of an elevated inflammatory state. Nonetheless, further research is needed to determine the precise involvement of ELR in CSFP.

In addition to its protective effect against low-density lipoprotein cholesterol (LDL-C) oxidation, HDL-C inhibits monocyte activation and transmigration to the subendothelium [25]. It has been suggested that circulating HDL-C levels are important for the development, progression, and severity of atherosclerotic disease [26]. In our investigation, low HDL-C levels were also independent predictor of CSFP. This finding might suggest that HDL-C levels might have an important role in the pathogenesis of CSFP. In the present study, systemic hypertension and platelet count also predicted CSFP. Microvascular alterations in hypertensive individuals may lead to CSFP, and Aksit *et al.* found a link between non-dipper hypertension and CSFP in hypertensive patients who had normal coronary angiograms [27]. Besides that, Seyyed Mohammadzad *et al.* found that men, smokers, hypertensive individuals, and those with a high BMI had considerably higher rates of CSFP. Furthermore, the platelet count of these individuals was substantially higher [28].

There were several limitations regarding this research. First, the research was a retrospective investigation that did not include the prognostic data in terms of ELR with cardiac complications. Second, we simply looked at a single ELR value, not its temporal values. Third, we unfortunately did not have data regarding intravascular ultrasound, which might provide a good tomographic image of the lumen area and composition. Fourth, despite the use of multivariable analysis to determine independent predictors of CSFP, some unmeasured confounders might be present, which might affect the results of the study. Finally, additional prospective studies with a larger sample size are needed to confirm the relationship between CSFP and ELR.

In conclusion, the current investigation clearly demonstrated that the ELR was elevated in cases

of CSFP and that it was associated with this phenomenon independently.

Conflict of interest

The authors declare no conflict of interest.

References

1. Tambe AA, Demany MA, Zimmerman HA, et al. Angina pectoris and slow flow velocity of dye in coronary arteries – a new angiographic finding. *Am Heart J* 1972; 84: 66-71.
2. Goel PK, Gupta SK, Agarwal A, et al. Slow coronary flow: a distinct angiographic subgroup in syndrome X. *Angiology* 2001; 52: 507-14.
3. Mosseri M, Yarom R, Gotsman MS, Hasin Y. Histologic evidence for small vessel coronary artery disease in patients with angina pectoris and patent large coronary arteries. *Circulation* 1986; 74: 964-72.
4. Sezgin AT, Sigirci A, Barutcu I, et al. Vascular endothelial function in patients with slow coronary flow. *Coron Artery Dis* 2003; 14: 155-61.
5. Ferro M, Musi G, Serino A, et al. Neutrophil, platelets, and eosinophil to lymphocyte ratios predict gleason score upgrading in low-risk prostate cancer patients. *Urol Int* 2019; 102: 43-50.
6. Holub K, Biete A. New pre-treatment eosinophil-related ratios as prognostic biomarkers for survival outcomes in endometrial cancer. *BMC Cancer* 2018; 18: 1280.
7. Ohkuma R, Kubota Y, Horiike A, et al. The prognostic impact of eosinophils and the eosinophil-to-lymphocyte ratio on survival outcomes in stage II resectable pancreatic cancer. *Pancreas* 2021; 50: 167-75.
8. Yılmaz M, Kayanççek H, Korkmaz H, et al. A new inflammatory marker: elevated eosinophil-to-lymphocyte ratio associated with presence and severity of isolated coronary artery ectasia. *Cardiovasc J Afr* 2020; 31: 227-35.
9. Branicka O, Rogala B, Glück J. Eosinophil/neutrophil/platelet-to-lymphocyte ratios in various types of immediate hypersensitivity to NSAIDs: a preliminary study. *Int Arch Allergy Immunol* 2020; 181: 774-82.
10. Gibson CM, Cannon CP, Daley WL, et al. TIMI frame count: a quantitative method of assessing coronary artery flow. *Circulation* 1996; 93: 879-88.
11. Gokce M, Kaplan S, Tekelioglu Y, et al. Platelet function disorder in patients with coronary slow flow. *Clin Cardiol* 2005; 28: 145-8.
12. Varol E, Gülcan M, Aylak F, et al. Increased neopterin levels and its association with angiographic variables in patients with slow coronary flow: an observational study. *Anadolu Kardiyol Derg* 2011; 11: 692-7.
13. Yuçel H, Ozaydin M, Dogan A, et al. Plasma concentrations of asymmetric dimethylarginine, nitric oxide and homocysteine in patients with slow coronary flow. *Scand J Clin Lab Invest* 2012; 72: 495-500.
14. Koç F, Erdem S, Altunkaş F, et al. Ischemia-modified albumin and total antioxidant status in patients with slow coronary flow: a pilot observational study. *Anadolu Kardiyol Derg* 2011; 11: 582-7.
15. Li JJ, Qin XW, Li ZC, et al. Increased plasma C-reactive protein and interleukin-6 concentrations in patients with slow coronary flow. *Clin Chim Acta* 2007; 385: 43-7.
16. Barutcu I, Sezgin AT, Sezgin N, et al. Increased high sensitive CRP level and its significance in pathogenesis of slow coronary flow. *Angiology* 2007; 58: 401-7.

17. Turhan H, Saydam GS, Erbay AR, et al. Increased plasma soluble adhesion molecules; ICAM-1, VCAM-1, and E-selectin levels in patients with slow coronary flow. *Int J Cardiol* 2006; 108: 224-30.
18. Yavuz H, Chee R. A review on the vascular features of the hyperimmunoglobulin E syndrome. *Clin Exp Immunol* 2010; 159: 238-44.
19. Moosbauer C, Morgenstern E, Cuvelier SL, et al. Eosinophils are a major intravascular location for tissue factor storage and exposure. *Blood* 2007; 109: 995-1002.
20. Rohrbach MS, Wheatley CL, Slifman NR, et al. Activation of platelets by eosinophil granule proteins. *J Exp Med* 1990; 172: 1271-4.
21. Antoniadis AP, Chatzizisis YS, Giannoglou GD. Pathogenetic mechanisms of coronary ectasia. *Int J Cardiol* 2008; 130: 335-43.
22. Demir M, Keceoglu S, Melek M. The relationship between plasma eosinophil count and coronary artery ectasia. *Cardiol Rev* 2013; 4: 159-64.
23. Horne BD, Anderson JL, John JM, et al. Which white blood cell subtypes predict increased cardiovascular risk? *J Am Coll Cardiol* 2005; 45: 1638-43.
24. Altas Y, Kurtoglu E, Yaylak B, et al. The relationship between eosinophilia and slow coronary flow. *Ther Clin Risk Manag* 2015; 11: 1187-91.
25. Balta S, Celik T, Ozturk C, et al. The relation between monocyte to HDL ratio and no-reflow phenomenon in the patients with acute ST-segment elevation myocardial infarction. *Am J Emerg Med* 2016; 34: 1542-7.
26. Granger CB, Goldberg RJ, Dabbous O, et al.; Global Registry of Acute Coronary Events Investigators. Predictors of hospital mortality in the global registry of acute coronary events. *Arch Intern Med* 2003; 163: 2345-53.
27. Aksit E, Gursul E, Aydin F, Samsa M, Ozcelik F. Non-dipper hypertension is associated with slow coronary flow among hypertensives with normal coronary angiogram. *Cardiovasc J Afr* 2017; 28: 14-8.
28. Seyyed Mohammadzad MH, Khademvatani K, Gardeshkhah S, Sedokani A. Echocardiographic and laboratory findings in coronary slow flow phenomenon: cross-sectional study and review. *BMC Cardiovasc Disord* 2021; 21: 230.