ARCHIVES OF THE TURKISH SOCIETY OF CARDIOLOGY

Official journal of the TURKISH SOCIETY OF CARDIOLOGY

Pan-Immune-Inflammation Value as an Independent Indicator of Isolated Coronary Artery Ectasia

İzole Koroner Arter Ektazisinin Bağımsız Bir Göstergesi Olarak Pan-İmmün-İnflamasyon Değeri

ORIGINAL ARTICLE
KLİNİK ÇALIŞMA

ABSTRACT

Objective: Coronary artery ectasia (CAE) is increasingly recognized as an active inflammatory vascular disorder rather than a benign anatomical variant. The pan-immune-inflammation value (PIV) is a novel biomarker integrating neutrophil, monocyte, platelet, and lymphocyte counts, providing a comprehensive measure of systemic inflammation. This study aimed to evaluate the association between PIV and CAE and to compare their diagnostic performance with that of conventional inflammatory indices.

Method: In this retrospective case-control study, 17,538 patients who underwent elective coronary angiography between 2018 and 2024 were screened. A total of 228 patients with isolated CAE and 296 age-, sex-, and Body Mass Index (BMI)-matched controls with normal coronary arteries were included. Hematologic and biochemical parameters were analyzed, and inflammatory indices were calculated. Logistic regression and receiver operating characteristic (ROC) analyses were performed to identify independent predictors and assess diagnostic performance.

Results: Patients with CAE had significantly higher PIV levels compared to controls (801.6 [504.4–1301.8] vs. 491.8 [302.4–872.7], P < 0.001). In multivariable logistic regression, log-transformed PIV remained independently associated with CAE (odds ratio [OR]: 1.987, 95% confidence interval [CI]: 1.057–3.737, P = 0.033), along with hypertension, triglycerides, high-density lipoprotein (HDL) cholesterol, and serum creatinine. PIV demonstrated the highest discriminative ability among all inflammatory indices (area under the curve [AUC]: 0.674, 95% CI: 0.623–0.722), and correlated strongly with the Systemic Immune-Inflammation Index (SII), neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and Systemic Inflammation Response Index (SIRI) (P = 0.75–0.94).

Conclusion: Elevated PIV levels are independently associated with CAE, reflecting the pivotal role of systemic inflammation in its pathogenesis. Given its simplicity and availability, PIV may serve as a practical adjunctive marker for identifying patients at risk of CAE, warranting validation in larger prospective studies.

Keywords: Atherosclerosis, coronary artery ectasia, inflammatory biomarkers, pan-immune-inflammation value, systemic inflammation

ÖZET

Amaç: Koroner arter ektazisi (KAE), giderek artan şekilde iyi huylu bir anatomik varyanttan ziyade aktif bir inflamatuvar damar hastalığı olarak kabul edilmektedir. Pan-immün-inflamasyon değeri (PIV), nötrofil, monosit, trombosit ve lenfosit sayılarının birleşimiyle oluşturulan ve sistemik inflamasyonun bütüncül bir göstergesini sağlayan yeni bir biyobelirteçtir. Bu çalışmanın amacı, PIV ile KAE arasındaki ilişkiyi değerlendirmek ve tanısal performansını geleneksel inflamatuvar indekslerle karşılaştırmaktır.

Yöntem: Bu retrospektif olgu-kontrol çalışmasında, 2018–2024 yılları arasında elektif koroner anjiyografi uygulanan 17,538 hasta tarandı. İzole KAE'si olan 228 hasta ve yaş, cinsiyet ve BKİ açısından eşleştirilmiş normal koroner anatomili 296 kontrol çalışmaya dahil edildi. Hematolojik ve biyokimyasal parametreler analiz edildi, inflamatuvar indeksler hesaplandı. Bağımsız prediktörleri belirlemek ve tanısal performansı değerlendirmek amacıyla lojistik regresyon ve ROC analizleri yapıldı.

Bulgular: KAE'li hastalarda PIV düzeyleri kontrol grubuna göre anlamlı olarak daha yüksekti (801.6 [504.4–1301.8] vs. 491.8 [302.4–872.7], P < 0.001). Çok değişkenli lojistik regresyon analizinde, log-dönüştürülmüş PIV düzeyi hipertansiyon, trigliserid, HDL-kolesterol ve serum kreatinin ile birlikte KAE ile bağımsız olarak ilişkili kalmıştır (OR: 1.987, %95 GA: 1.057–3.737, P =

Çağatay Tunca[1]
Mehmet Taha Özkan[2]
Berin Nur Ergin[1]
Saner Bahadır Gök[1]
Alperen Taş[3]
Hacı Ali Kürklü[1]
Kürşat Akbuğa[1]
Veysel Ozan Tanık[1]
Bülent Özlek[4]

[1]Department of Cardiology, Ankara Etlik City Hospital, Ankara, Türkiye
[2]Department of Cardiology, Gümüşhane State Hospital, Gümüşhane, Türkiye
[3]Department of Cardiology, Kırşehir Training and Research Hospital, Kırşehir, Türkiye
[4]Department of Cardiology, Muğla Sıtkı Koçman University, Faculty of Medicine, Muğla, Türkiye

Corresponding author:
Çağatay Tunca
✉ md.tunca@gmail.com

Received: August 16, 2025
Accepted: November 25, 2025

Cite this article as: Tunca Ç, Özkan MT, Ergin BN, et al. Pan-Immune-Inflammation Value as an Independent Indicator of Isolated Coronary Artery Ectasia. *Turk Kardiyol Dern Ars.* 2026;54(1):41–50.

DOI: 10.5543/tkda.2025.51336

0.033). PIV, tüm inflamatuvar indeksler arasında en yüksek ayırt edici güce sahipti (AUC: 0.674, %95 GA: 0.623–0.722) ve SII, NLR, PLR ve SIRI ile güçlü korelasyon göstermiştir (P = 0.75–0.94).

Sonuç: Yükselmiş PIV düzeyleri KAE varlığıyla bağımsız olarak ilişkilidir ve bu durum hastalığın patogenezinde sistemik inflamasyonun temel rolünü yansıtmaktadır. Basit, ulaşılabilir ve düşük maliyetli bir belirteç olarak PIV, KAE riski altındaki hastaların belirlenmesinde pratik bir tamamlayıcı araç olabilir. Bulgularımızın, daha geniş ve prospektif çalışmalarda doğrulanması gerekmektedir.

Anahtar Kelimeler: Ateroskleroz, koroner arter ektazisi, inflamatuvar biyobelirteçler, panoimmün-inflamasyon değeri, sistemik inflamasyon

Coronary artery ectasia (CAE) refers to a localized or diffuse dilatation of an epicardial coronary artery, where the vessel diameter is at least 1.5-fold greater than that of the normal adjacent segment.[1] The prevalence of CAE ranges from 1.2% to 4.9%, with males affected three times more often than females.[2] CAE may manifest across a wide clinical spectrum, ranging from incidental detection in asymptomatic individuals to symptoms such as exertional angina, exertional ischemia, and acute coronary syndrome (ACS).[3] While atherosclerosis is considered the primary etiopathogenetic mechanism of CAE, other contributing factors include chronic inflammation, matrix metalloproteinase (MMP) hyperactivity, connective tissue diseases, genetic conditions, infections, and iatrogenic injury following percutaneous coronary interventions.[4,5]

Several previous investigations have explored the link between inflammation and CAE, reporting significant associations with parameters such as the neutrophil-to-lymphocyte ratio (NLR), eosinophil-to-lymphocyte ratio (ELR), Systemic Immune-Inflammation Index (SII), red cell distribution width (RDW), tumor necrosis factor-alpha (TNF-α), C-reactive protein (CRP), and high-sensitivity CRP (hs-CRP).[6–8] Recent research has emphasized the importance of the pan-immune inflammation value (PIV) as a marker of systemic inflammatory status.[9-12] This biomarker incorporates the counts of four key immune cell types in peripheral blood: neutrophils, monocytes, platelets, and lymphocytes.[9-12] Recent studies have demonstrated the prognostic value of PIV in individuals with ST-elevation myocardial infarction (STEMI), non-STEMI, contrast-induced nephropathy, acute decompensated heart failure, coronary slow flow, and hypertrophic cardiomyopathy.[10,13-17]

Although PIV has demonstrated prognostic importance in multiple cardiovascular diseases, its association with CAE remains unexamined. This study represents the first investigation of PIV specifically in patients with CAE.

ABBREVIATIONS

ACE	Angiotensin-converting enzyme
ACS	Acute coronary syndrome
AF	Atrial fibrillation
BMI	Body Mass Index
CAD	Coronary artery disease
CAE	Coronary artery ectasia
CAG	Coronary angiography
CRP	C-reactive protein
DM	Diabetes mellitus
ELR	Eosinophil-to-lymphocyte ratio
HDL	High-density lipoprotein
ICD	International Classification of Diseases
IL-6	Interleukin-6
LAD	Left anterior descending
MMP	Matrix metalloproteinase
NLR	Neutrophil-to-lymphocyte ratio
PIV	Pan-immune inflammation value
PLR	Platelet-to-lymphocyte ratio
RCA	Right coronary artery
RCS	Restricted cubic spline
RDW	Red cell distribution width
ROC	Receiver operating characteristic
SII	Systemic Immune-Inflammation Index
SIRI	Systemic Inflammation Response Index
STEMI	ST-elevation myocardial infarction
TNF-α	Tumor necrosis factor-alpha

Materials and Methods

Study Population

This retrospective case-control study screened 22,843 individuals undergoing elective coronary angiography (CAG) between January 2018 and December 2024. Of these, 17,538 patients remained after applying the exclusion criteria, among whom 228 patients (1.3%) had isolated CAE, as shown in Figure 1. Exclusion criteria included ACS, obstructive coronary artery disease (CAD), history of percutaneous coronary intervention or coronary artery bypass grafting, any acute or chronic infection, systemic inflammatory or autoimmune disorders, heart failure with reduced or mildly reduced ejection fraction, liver disease (defined as liver function tests > 3× the upper normal limit), significant endocrine, hematologic, respiratory, or metabolic conditions, malignancy, pregnancy, inadequate CAG imaging, and missing laboratory data.

The control group included 296 subjects with angiographically normal coronary arteries, matched to the CAE group by age, sex, and Body Mass Index (BMI). Baseline demographic and relevant clinical data were obtained from electronic medical records. The study protocol received approval from the Ankara Etlik City Hospital Scientific Research Ethics Committee (Approval Number: AEŞH-BADEK2-2025-136, Date: 27.05.2025), and was conducted in accordance with the Declaration of Helsinki. Given the retrospective design, informed consent was waived.

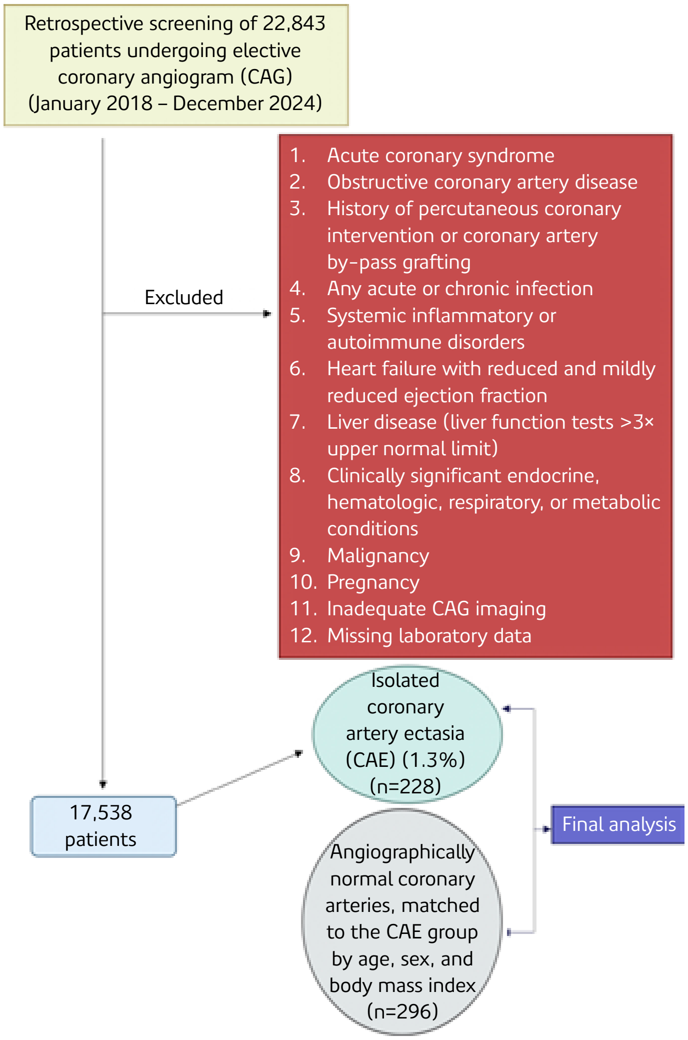


Figure 1. Flowchart of the study population.

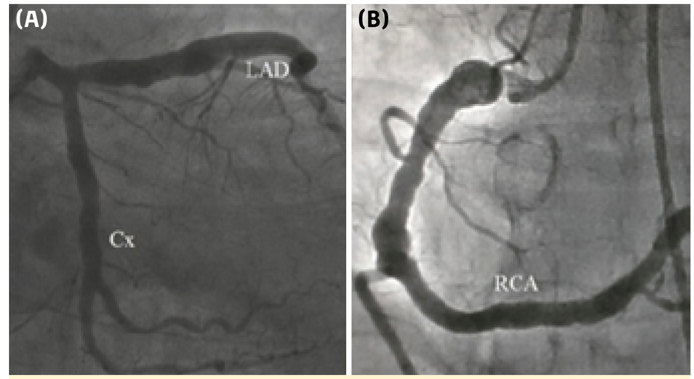


Figure 2. Coronary angiographic images demonstrating coronary artery ectasia (CAE), with (A) showing diffuse ectasia involving the left anterior descending (LAD) and circumflex (Cx) arteries, and (B) depicting marked segmental ectasia of the right coronary artery (RCA), characterized by localized dilatation.

Coronary Angiography and Measurements

All participants underwent coronary angiography using the General Electric Healthcare (GE) Innova™ IGS 530 system, equipped with AutoRight™ CAG devices (Chicago, Illinois, USA). Both normal and ectatic vessels were measured using specialized software (InnovaSpinTM, one-touch analysis, GE Healthcare). CAE is defined as an abnormal enlargement of the coronary artery lumen, occurring either locally or diffusely. This condition is characterized by a vessel diameter that exceeds 1.5 times that of the adjacent healthy segments or the maximal coronary artery.[18] CAE is further classified into three categories based on luminal diameter: small (< 5 mm), medium (5–8 mm), and large (> 8 mm).[19] A representative CAG image of CAE is presented in Figure 2.

Biochemical Analysis

At our institution, blood samples were obtained from the antecubital vein via atraumatic puncture before coronary angiography and delivered to the laboratory for analysis within one hour. For all participants undergoing CAG, blood was drawn into K3 EDTA-containing (ethylenediaminetetraacetic acid-containing) tubes to measure hematological indices. Hematological indices were assessed using a complete blood count analysis conducted with a Coulter LH 780 Hematology Analyzer (Beckman Coulter Ireland Inc., Mervue, Galway, Ireland). Biochemical parameters were measured using a Hitachi Modular P800 autoanalyzer (Roche Diagnostics Corp., Indianapolis, IN, USA).

Definitions

Hypertension was considered present in participants who were receiving antihypertensive therapy. Patients were classified as having diabetes mellitus (DM) if they had a fasting serum glucose level greater than 126 mg/dL, a hemoglobin A1c level of 6.5% or higher, or were taking antidiabetic medications. Atrial fibrillation (AF) was identified based on electrocardiogram recordings and/or the use of anticoagulants. The diagnosis of peripheral arterial disease, cerebrovascular events, chronic obstructive pulmonary disease, and malignancy were established using ICD (International Classification of Diseases) codes and medical records.

Inflammatory Indices

We calculated the NLR by dividing the absolute neutrophil count by the absolute lymphocyte count; the platelet-to-lymphocyte ratio (PLR) by dividing the platelet count by the lymphocyte count; the SII using the formula (neutrophil count × platelet count) / lymphocyte count; the Systemic Inflammatory Response Index as (neutrophil count × monocyte count) / lymphocyte count; and the PIV using the formula: (neutrophil count × platelet count × monocyte count) / lymphocyte count.

Statistical Analysis

We performed all statistical analyses using SPSS software (version 27.0, IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages. In contrast, continuous variables were presented as mean ± standard deviation or median with interquartile range, depending on the data distribution, which was assessed using the Kolmogorov–Smirnov test. We compared groups using the Student's t-test or the Mann–Whitney U test for continuous variables and the chi-square test for categorical variables. Logistic regression was performed to identify independent predictors of CAE, using only variables with P-values < 0.05 in the univariable analysis, after checking for multicollinearity and excluding highly collinear covariates to ensure robustness. In the multivariable logistic regression model, individual hematological parameters (white blood cell count [WBC], platelet, neutrophil, lymphocyte, monocyte) and their derived inflammatory indices (NLR, SII, PLR, SIRI) were not included simultaneously with the PIV to avoid multicollinearity, as these variables constitute components of the PIV formula. Thus, the PIV was considered a representative composite marker integrating the overall inflammatory burden. To evaluate potential non-linear relationships between PIV and CAE, a restricted cubic spline (RCS) was fitted within a multivariable logistic regression framework. The model was adjusted for hypertension, high-density lipoprotein (HDL) cholesterol, triglycerides, and serum creatinine, which were identified as significant covariates in the multivariable analysis. Knots were placed at the 5th, 25th, 50th, 75th, and 95th percentiles of the PIV distribution. The overall association and nonlinearity of PIV with CAE were assessed using Wald and likelihood-ratio tests, respectively. Predicted probabilities with 95% confidence intervals (CI) were visualized to illustrate the adjusted association between PIV and CAE. We assessed the PIV's predictive capability for CAE via receiver operating characteristic (ROC) curve analysis and computed the area under the curve (AUC) to determine its discriminative power. Comparative predictive performances of inflammatory indices (PIV, SII, NLR, PLR, and SIRI) were assessed using ROC curve analysis. Differences between AUCs were evaluated by bootstrap resampling. Correlations among these indices were analyzed using Spearman's rank correlation test, and results were visualized as a correlation heatmap. A two-tailed P-value < 0.05 was deemed statistically significant in all analyses.

Results

Table 1 shows the baseline demographic, clinical, and laboratory features of the study population. No significant differences were found between the CAE and control groups for age, sex, BMI, smoking status, DM, hemoglobin, low-density lipoprotein cholesterol, glucose, or thyroid-stimulating hormone levels. However, hypertension was significantly more prevalent in the CAE group (74.6 vs. 53.0%, P < 0.001), as were cerebrovascular events (4.4 vs. 1.0%, P < 0.001) and AF (9.7 vs. 1.0%, P < 0.001). Baseline medications did not differ significantly between groups, except for angiotensin-converting enzyme (ACE) inhibitor and anticoagulant use, which were significantly more common among CAE patients (both P < 0.001). Statin, acetylsalicylic acid, clopidogrel, and beta-blocker use did not differ significantly between groups. Laboratory analyses revealed significantly greater white blood cell, platelet, neutrophil, and monocyte counts, along with lower lymphocyte counts in the CAE group. The erythrocyte sedimentation rate and CRP levels were similar between the groups. In contrast, CAE patients had higher serum creatinine and uric acid levels, lower high-density lipoprotein cholesterol, and higher triglyceride concentrations compared with controls. Inflammatory indices, including NLR, PIV, SII, PLR, and SIRI, were also significantly elevated in CAE patients. Regarding anatomical distribution, ectatic involvement was most commonly observed in the right coronary artery (RCA) (51.8%), followed by the circumflex (LCx) artery (24.6%) and the left anterior descending (LAD) artery (23.7%). Additionally, 37.7% of patients had small, 52.6% medium-sized, and 9.6% giant ectasia.

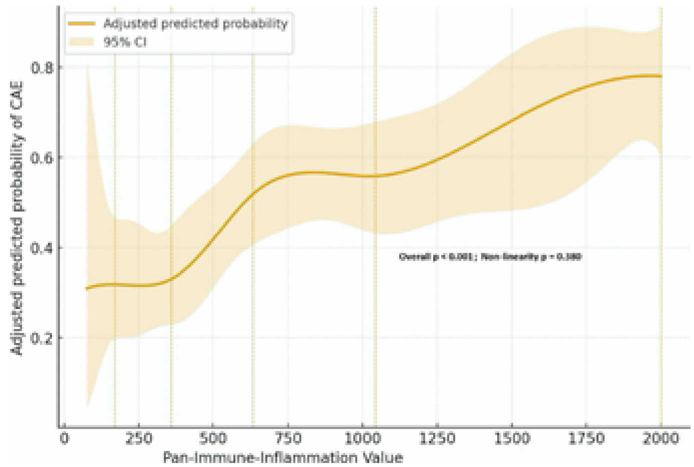


Figure 3. Adjusted restricted cubic spline illustrating the association between the pan-immune-inflammation value (PIV) and the probability of coronary artery ectasia (CAE), adjusted for hypertension, high-density lipoprotein (HDL) cholesterol, triglycerides, and creatinine. The overall association of PIV with CAE was significant (Wald test, P < 0.001), whereas evidence for deviation from linearity was not (likelihood-ratio test vs. linear term, P = 0.380). The shaded area denotes the 95% confidence interval (CI); vertical dashed lines indicate knot locations.

Table 2 summarizes the findings of the univariable and multivariable logistic regression analyses, which identified factors independently associated with CAE. In univariable analysis, multiple clinical and laboratory parameters—including hypertension, AF, ACE-inhibitor and anticoagulant use, triglycerides, HDL-cholesterol, WBC, platelet, neutrophil, lymphocyte, and monocyte counts, serum creatinine, serum uric acid, and inflammatory indices (log-transformed PIV, SII, and PLR, as well as non-transformed NLR and SIRI)—showed significant associations with CAE (all P < 0.05). However, in the multivariable model, only hypertension (odds ratio [OR]: 2.310, 95% CI: 1.463–3.647; P < 0.001), serum creatinine (OR: 4.441, 95% CI: 1.587–12.431; P = 0.005), triglycerides (OR: 1.008, 95% CI: 1.004–1.013; P < 0.001), HDL-cholesterol (OR: 0.953, 95% CI: 0.928–0.978; P < 0.001), and log PIV (OR: 1.987, 95% CI: 1.057–3.737; P = 0.033) remained independently associated with CAE.

In a multivariable logistic regression model adjusted for hypertension, HDL-cholesterol, triglycerides, and serum creatinine, restricted cubic spline analysis demonstrated a significant overall association between the PIV and the probability of CAE (P < 0.001 for overall association). The relationship appeared approximately linear, with no strong evidence of non-linearity (P = 0.380). As illustrated in Figure 3, higher PIV values were associated with a higher adjusted probability of CAE, and this trend persisted after controlling for potential confounders.

Figure 4 illustrates the predictive performance of the clinical and laboratory parameters identified as significant in the multivariable analysis for detecting CAE. Hypertension demonstrated an AUC of 0.608 (95% CI: 0.566–0.651, P < 0.001), with a sensitivity of 77.4% and specificity of 44.1%. HDL cholesterol showed an

Table 1. Baseline demographic, clinical, and laboratory characteristics of the groups

	Control group (n = 296)	CAE group (n = 228)	P
Demographic characteristics			
Age, years	60.8 ± 10.4	60.3 ± 10.2	0.452
Female sex, n (%)	80 (27.0)	65 (28.5)	0.755
Body Mass Index (kg/m²)	27.5 ± 4.2	27.8 ± 4.1	0.637
Smoker, n (%)	58 (19.6)	62 (20.9)	0.658
Medical history, n (%)			
Hypertension	157 (53.0)	170 (74.6)	<0.001
Diabetes mellitus	143 (48.3)	113 (49.6)	0.552
Cerebrovascular event	3 (1.0)	10 (4.4)	<0.001
Atrial fibrillation	3 (1.0)	22 (9.7)	<0.001
Baseline medications, n (%)			
ACE inhibitor	139 (47.0)	154 (67.5)	<0.001
Anticoagulant	3 (1.0)	25 (11.0)	<0.001
Statin	57 (19.3)	52 (22.8)	0.318
Acetylsalicylic acid	75 (25.3)	69 (30.3)	0.184
Clopidogrel	3 (1.0)	6 (2.6)	0.168
Beta-blocker	76 (25.7)	70 (30.7)	0.204
Laboratory findings			
Hemoglobin (g/dl)	13.89 ± 1.43	13.90 ± 2.11	0.951
White blood cells (10^3/μL)	8.15 ± 2.09	8.72 ± 2.61	0.005
Platelets (10^3/μL)	272.1 ± 67.4	289.1 ± 70.1	0.005
Neutrophils (10^9/L)	5.10 ± 2.19	6.31 ± 2.99	<0.001
Lymphocytes (10^9/L)	1.83 ± 0.83	1.56 ± 0.71	<0.001
Monocytes (10^9/L)	0.69 ± 0.21	0.75 ± 0.19	0.008
HDL-cholesterol (mg/dl)	45.6 ± 8.9	41.7 ± 11.5	<0.001
LDL-cholesterol (mg/dl)	117.4 ± 37.1	114.2 ± 38.8	0.335
Triglycerides (mg/dl)	140.3 ± 44.5	169.3 ± 75.9	<0.001
Blood glucose (mg/dl)	96 (88–104)	100 (89–109)	0.658
Erythrocyte sedimentation rate (mm/hr)	5.2 (4.0–10.0)	6.0 (3.1–12.0)	0.447
C-reactive protein (mg/L)	4.7 (3.0–7.2)	5.0 (2.6–10.3)	0.255
Serum creatinine (mg/dl)	0.8 (0.7–0.9)	0.9 (0.8–1.0)	<0.001
Serum uric acid (mg/dl)	5.0 (4.2–5.5)	5.5 (4.8–6.5)	<0.001
TSH (μIU/ml)	1.8 (1.2–2.1)	1.6 (1.0–2.2)	0.108
Inflammatory indices			
Neutrophil-to-lymphocyte ratio	2.8 (1.9–4.3)	4.1 (2.5–5.8)	<0.001
Pan-immune inflammation value	491.8 (302.4–872.7)	801.6 (504.4–1301.8)	<0.001
Systemic immune-inflammation index	727.2 (471.3–1217.1)	1125.3 (698.4–1746.8)	<0.001
Platelet-to-lymphocyte ratio	152 (105–228)	196.8 (131.0–294.1)	<0.001
Systemic inflammation response index	1.8 (1.2–2.9)	2.9 (1.7–4.7)	<0.001
Ectasia artery, (n, %)			
LAD	–	54 (23.7)	N/A
LCx	-	56 (24.6)	N/A
RCA	-	118 (51.8)	N/A
Ectasia size, (n, %)			
Small	-	86 (37.7)	N/A
Medium	-	120 (52.6)	N/A
Giant	-	22 (9.6)	N/A

ACE, Angiotensin-converting enzyme; CAE, Coronary artery ectasia, HDL, High-density lipoprotein; LAD, Left anterior descending artery; LCx, Circumflex artery; LDL, Low-density lipoprotein; N/A, Not applicable; RCA, Right coronary artery; TSH, Thyroid-stimulating hormone.

Table 2. Univariable and multivariable logistic regression analyses of inflammatory and clinical parameters associated with coronary artery ectasia

	Univariable regression analysis		Multivariable regression analysis	
	OR (95% CI)	P	OR (95% CI)	P
Hypertension	2.592 (1.781-3.774)	<0.001	2.310 (1.463-3.647)	<0.001
Atrial fibrillation	10.433 (3.081-35.324)	<0.001	3.055 (0.324-28.809)	0.329
ACE inhibitor	2.352 (1.640-3.362)	<0.001	1.834 (0.750-4.487)	0.184
Anticoagulant	12.021 (3.581-40.373)	<0.001	8.823 (0.934-83.324)	0.057
Triglycerides	1.012 (1.010-1.022)	<0.001	1.008 (1.004-1.013)	<0.001
HDL-cholesterol	0.961 (0.943-0.982)	<0.001	0.953 (0.928-0.978)	<0.001
White blood cells	1.114 (1.031-1.190)	0.006	–	–
Platelets	1.004 (1.001-1.006)	0.005	–	–
Neutrophils	1.201 (1.114-1.303)	<0.001	–	–
Lymphocytes	1.381 (1.132-1.542)	<0.001	–	–
Monocytes	3.512 (1.372-8.963)	0.008	–	–
Serum creatinine	9.630 (4.142-22.361)	<0.001	4.441 (1.587-12.431)	0.005
Serum uric acid	1.530 (1.312-1.781)	<0.001	1.179 (0.966-1.439)	0.105
Neutrophil-to-lymphocyte ratio	1.125 (1.052-1.204)	<0.001	–	–
Log PIV*	1.903 (1.412-2.552)	<0.001	1.987 (1.057-3.737)	0.033
Log SII*	1.614 (1.280-2.031)	<0.001	–	–
Log PLR*	2.981 (1.122-7.901)	<0.001	–	–
Systemic Inflammation Response Index	1.170 (1.071-1.272)	<0.001	–	–

ACE, Angiotensin-converting enzyme; CI, Confidence interval; HDL, High-density lipoprotein; OR, Odds ratio; PIV, Pan-immune inflammation value; PLR, Platelet-to-lymphocyte ratio; SII, Systemic Immune-Inflammation Index. *Log PIV, Log SII, and Log PLR correspond to the logarithmically transformed values of PIV, SII, and PLR, respectively. A logarithmic transformation was applied to achieve normality prior to regression analysis.

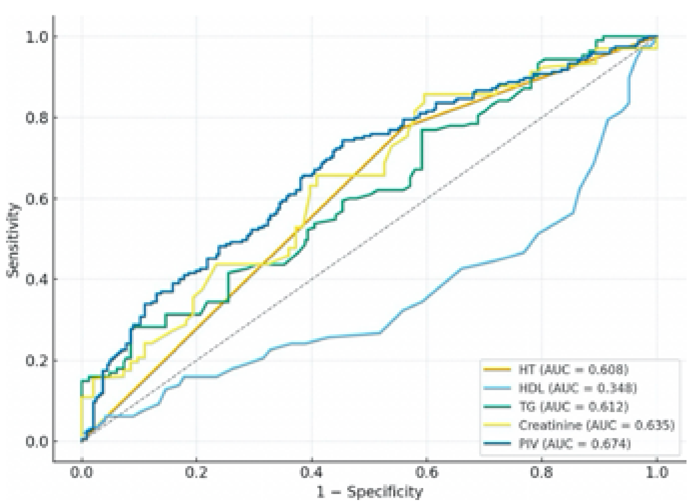


Figure 4. Receiver operating characteristic curves demonstrating the predictive performance of hypertension (HT), high-density lipoprotein (HDL) cholesterol, triglyceride (TG), creatinine, and the pan-immune-inflammation value (PIV) for identifying coronary artery ectasia. PIV exhibited the highest discriminative ability (AUC = 0.674, 95% CI: 0.623–0.722), while all parameters showed statistically significant AUC values (P < 0.001). AUC, Area Under the Curve.

inverse association with CAE, yielding an AUC of 0.348 (95% CI: 0.297–0.403, P < 0.001) and demonstrating high specificity (96.0%) but low sensitivity (6.2%) at the optimal cut-off value of 63 mg/dL. Triglyceride levels yielded an AUC of 0.612 (95% CI: 0.556–0.661, P < 0.001), with a sensitivity of 27.7% and specificity of 91.5% at a threshold of 187 mg/dL. Serum creatinine yielded an AUC of 0.635 (95% CI: 0.584–0.686, P < 0.001), with a sensitivity of 85.6% and specificity of 40.5% at an optimal cut-off value of 0.71 mg/dL. Among the evaluated variables, the PIV demonstrated the highest discriminative performance, with an AUC of 0.674 (95% CI: 0.623–0.722, P < 0.001), sensitivity of 74.4%, and specificity of 54.7%, using an optimal threshold of 533.8. Although PIV outperformed conventional biochemical and clinical markers, its diagnostic power remained moderate.

Comparative ROC analysis of PIV and conventional inflammatory indices (SII, NLR, PLR, and SIRI) revealed that PIV had the highest discriminative ability for predicting CAE (Figure 5A). Although PIV outperformed SII, NLR, and SIRI, the differences were not statistically significant (P = 0.260, P = 0.142, and P = 0.549, respectively). However, PIV showed a significantly higher predictive value than PLR (P = 0.001). Spearman correlation analysis demonstrated strong positive correlations between PIV and other indices (P = 0.75–0.94), indicating that these inflammatory markers share common biological pathways and reflect overlapping immune–inflammatory activity. The correlation heatmap (Figure 5B) visually illustrates these strong associations, supporting the conceptual interrelatedness among the inflammatory indices.

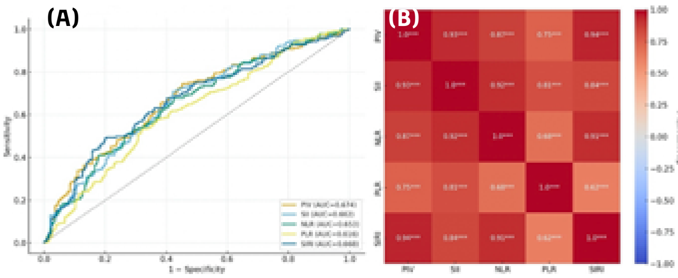


Figure 5. (A) Receiver operating characteristic curves of the pan-immune inflammation value (PIV) and other inflammatory indices for predicting coronary artery ectasia. PIV demonstrated the highest discriminative performance among the indices. (B) Spearman correlation matrix between PIV and other inflammatory indices. Strong positive correlations were observed among all indices, indicating shared inflammatory activity. SII, Systemic Immune-Inflammation Index; NLR, Neutrophil-to-Lymphocyte Ratio; PLR, Platelet-to-Lymphocyte Ratio; SIRI, Systemic Inflammation Response Index.

Discussion

This research is the first to examine the relationship between PIV and CAE. The analysis found that patients with CAE had significantly higher PIV levels compared to those with normal coronary anatomy, and PIV remained an independent predictor of CAE even after accounting for traditional cardiovascular risk factors and other inflammatory markers. While these findings underscore the potential importance of PIV in the pathophysiological assessment of CAE, its diagnostic accuracy was moderate, as shown by an ROC analysis indicating only fair discriminative ability. This suggests that although PIV may be a useful marker of systemic inflammation, it should be viewed as a supplementary parameter within a broader clinical and laboratory context rather than a standalone diagnostic tool.

Inflammation plays a key role in CAE development, triggering both local vascular changes and systemic immune activation. Levels of adhesion molecules, such as E-selectin, intercellular adhesion molecule-1, and vascular cell adhesion molecule-1, are significantly higher in patients with isolated CAE than in those with obstructive CAD or normal coronary arteries on angiography, and they positively correlate with the extent of ectatic involvement.[20] These molecules facilitate monocyte adhesion and migration across the endothelium, thereby worsening local inflammation and endothelial dysfunction.[20] Vascular endothelial growth factor, a major regulator of inflammation and new blood vessel formation, is elevated in diffuse CAE cases, aligning with pathological neovascularization and its role in activating MMPs and breaking down the extracellular matrix.[21,22] Additionally, leukotrienes, proinflammatory lipids commonly found in atherosclerotic plaques, have been linked to the development of increased atherosclerosis and aneurysms.[23,24] Experimental studies show that overexpression of the 5-lipoxygenase gene increases the risk of aortic aneurysms and is associated with MMP secretion by macrophages in the vessel wall.[24,25] Overall, these findings emphasize the complex inflammatory processes underlying CAE and suggest that targeted anti-inflammatory treatments could benefit patients with this condition.

These findings align with an expanding body of literature that emphasizes the role of systemic inflammation in the development of CAE. Vrachatis et al.[8] conducted a comprehensive meta-analysis showing that inflammatory markers, including NLR, hs-CRP, interleukin-6 (IL-6), TNF-α, and RDW, were significantly higher in CAE patients compared to controls, indicating an inflammatory imbalance underlying the condition. Similarly, Tosu et al.[7] reported that SII was notably higher in patients with isolated CAE and had better diagnostic value than NLR. Yılmaz et al.[26] introduced the ELR as a new marker elevated in CAE patients and correlated with disease severity, supporting its usefulness in assessing diffuse or high-grade ectasia. Argan et al.[6] further demonstrated that CRP and serum uric acid levels were independently associated with CAE in patients with concomitant CAD, suggesting that CAE may be a manifestation of increased vascular inflammation beyond atherosclerosis. The current study found that PIV, a broader index including neutrophils, monocytes, lymphocytes, and platelets, was independently associated with CAE and showed moderate discriminative ability. Furthermore, our analysis revealed that PIV was strongly correlated with other inflammatory indices, including SII, NLR, PLR, and SIRI, further supporting the interrelated inflammatory mechanisms observed in previous studies. Collectively, these findings reinforce the notion that CAE is an active inflammatory vascular disorder rather than a passive anatomic variant, and that composite inflammatory indices such as PIV, SII, and ELR may serve as valuable tools in the diagnosis, risk stratification, and possibly future therapeutic targeting of CAE.

Fucà et al.[11] introduced the PIV in 2020 as a systemic inflammation-related predictive biomarker for metastatic colorectal cancer. PIV differs from other systemic inflammatory indices by providing a more comprehensive assessment of the inflammatory response, as it simultaneously incorporates neutrophils, monocytes, and platelets into its numerator. While indices such as the NLR, PLR, and SII include lymphocyte count in the denominator to reflect immune competence, PIV's unique strength lies in integrating three key pro-inflammatory cell types, thereby amplifying the overall inflammatory burden. Including monocytes enhances its clinical relevance, given their central role in vascular inflammation, endothelial dysfunction, and arterial remodeling, making PIV especially promising for inflammation-related cardiovascular conditions such as CAE.[27] The PIV has been shown to outperform other inflammatory indices in various clinical settings, including multiple types of cancer, ACS, acute heart failure, the coronary slow-flow phenomenon, and contrast-induced nephropathy.[10,11,13,16,28,29] Elevated PIV levels, indicative of increased inflammatory burden, may contribute to microvascular dysfunction and thus play a role in the pathogenesis of CAE. From a clinical perspective, PIV's practicality and affordability, especially in resource-limited settings, highlight its potential utility for cardiovascular risk stratification. Incorporating PIV into diagnostic algorithms may improve the detection of CAE, particularly in patients undergoing CAG for atypical chest pain or with non-obstructive lesions. However, despite its independent predictive value, PIV should not be used alone. Accurate diagnosis and risk stratification of CAE require a comprehensive approach that integrates clinical, angiographic, and laboratory findings.

Consistent with previous literature, most patients in our cohort were male (about 72%), aligning with the commonly cited male-to-female ratio of 3:1 in CAE[2] Regarding coronary artery involvement, the RCA was the most frequently affected vessel, involved in 51.8% of cases. This finding matches earlier studies that identify the RCA as the primary site of ectatic changes.[30] The LCx and LAD arteries were affected in 24.6% and 23.7% of cases, respectively. Additionally, single-vessel ectasia was observed in 41% of our patients, which agrees with previous reports indicating that CAE usually presents as a localized vascular abnormality rather than a diffuse process.[31] Overall, these findings demonstrate that the demographic and angiographic characteristics of our study population are consistent with established patterns of CAE, supporting the external validity of our results.

Hypertension was the most common comorbidity among patients with CAE in our study, affecting 74.6% of the CAE group. This rate is notably higher than those reported in previous studies by Harikrishnan (45.4%), Gunes (47.5%), Lam (58%), and Almansori (64%).[32-35] Moreover, hypertension independently predicted CAE in the multivariable logistic regression analysis, suggesting a potential pathogenic role beyond mere coexistence. These findings support the hypothesis that elevated blood pressure may contribute to vascular remodeling processes underlying ectasia formation.[36] In contrast to previous findings,[37] although serum uric acid levels were significantly higher in the CAE group and showed moderate discriminatory power in ROC analysis, they did not reach statistical significance in the multivariable model. This indicates that while uric acid may reflect systemic inflammation or endothelial dysfunction, it may not be a strong independent marker of CAE. Interestingly, in our cohort, traditional cardiovascular risk factors such as smoking and DM were not significantly associated with CAE. This aligns with recent studies reporting a weak or even inverse association between these factors and ectatic coronary changes, despite earlier evidence linking them to vascular dysfunction.[36,38] Although statins and ACE inhibitors are known to exert anti-inflammatory and endothelial-protective effects,[39,40] their specific influence on CAE remains a matter of controversy. In our study, statin use was not significantly different between the CAE and control groups. Additionally, ACE inhibitor therapy, although significant in univariable analysis, did not retain independent predictive value in the multivariable analysis. Prior evidence suggests that both drug classes may attenuate vascular inflammation and enhance endothelial function by reducing circulating inflammatory mediators, including hs-CRP and adhesion molecules. Özbay et al.[41] demonstrated that combined statin and ACE inhibitor therapy reduced hs-CRP levels in CAE patients after three months of treatment, suggesting a potential modulatory effect on vascular inflammation. Similarly, recent reviews have proposed that statins and ACE inhibitors may have favorable effects in CAE by improving endothelial stability and suppressing chronic inflammation, although large-scale prospective trials are lacking.[42] Our findings did not demonstrate any independent or protective association between the use of statins or ACE inhibitors and the presence of CAE. These results suggest that although these medications may exert systemic anti-inflammatory effects, as reported in prior studies, their influence on CAE itself appears limited in our study population. Collectively, these observations underscore the complex, multifaceted nature of CAE and highlight the potential utility of incorporating new inflammatory and metabolic markers into risk assessment models.

Study Limitations

This research presents certain limitations. This was a single-center study with a relatively small sample size, which may limit the generalizability of the findings; therefore, validation in larger, multicenter prospective studies is warranted. Given the retrospective and cross-sectional design of our study, causal relationships between PIV and CAE cannot be established. Although rigorous exclusion criteria were applied to minimize confounding, unrecognized subclinical inflammatory or immune conditions, dietary factors, and medication effects (particularly anti-inflammatory or lipid-lowering agents) could still have influenced the results. Additionally, a proportion of patients were on statin therapy, which exerts anti-inflammatory and endothelial-protective effects that may influence inflammatory indices such as the PIV; this potential confounding factor was not specifically addressed in our analysis. Inflammatory indices were derived from a single blood sample collected before angiography. Therefore, potential temporal fluctuations in inflammatory status could not be assessed. Serial measurements might provide a more robust evaluation in future prospective studies. Furthermore, advanced biomarkers, including cytokines (e.g., IL-6, TNF-α), oxidative stress markers, and genetic markers, were unavailable in this retrospective dataset. Despite employing automated software, the diagnosis of CAE based on CAG measurements may still be subject to interobserver variability. The control group consisted of individuals with angiographically normal coronary arteries. Inclusion of an additional comparison group with atherosclerotic but non-ectatic coronary arteries might have provided deeper insight into the inflammatory differences between CAE and atherosclerotic CAD. Additionally, the potential impact of medical therapy on PIV levels or CAE progression was not evaluated, as treatment data were limited to baseline use at the time of CAG. Finally, although PIV was identified as an independent predictor of CAE, its moderate sensitivity and specificity may limit its diagnostic utility as a standalone biomarker.

Conclusion

The study revealed that PIV levels are significantly higher in patients with CAE and are independently associated with its occurrence. This emphasizes the possible role of systemic inflammation in the development of CAE. Due to its simplicity and ease of use, PIV could serve as a helpful additional marker in the diagnostic process for patients suspected of having CAE. Further prospective studies are needed to determine its prognostic significance and to explore how it can be effectively incorporated into clinical decision-making.

Ethics Committee Approval: Ethics committee approval was obtained from Ankara Etlik City Hospital Scientific Research Ethics Committee (Approval Number: AEŞH-BADEK2-2025-136, Date: 27.05.2025).

Informed Consent: Informed consent was waived due to the study's retrospective nature.

Conflict of Interest: The authors have no conflicts of interest to declare.

Funding: The authors declared that this study received no financial support.

Use of AI for Writing Assistance: The authors acknowledge that artificial intelligence–assisted technologies (such as ChatGPT, OpenAI, San Francisco, CA, USA) were used solely for language editing and translation during the preparation of this manuscript. No artificial intelligence (AI) tool was used for data analysis, result generation, or interpretation. All content was reviewed and approved by the authors.

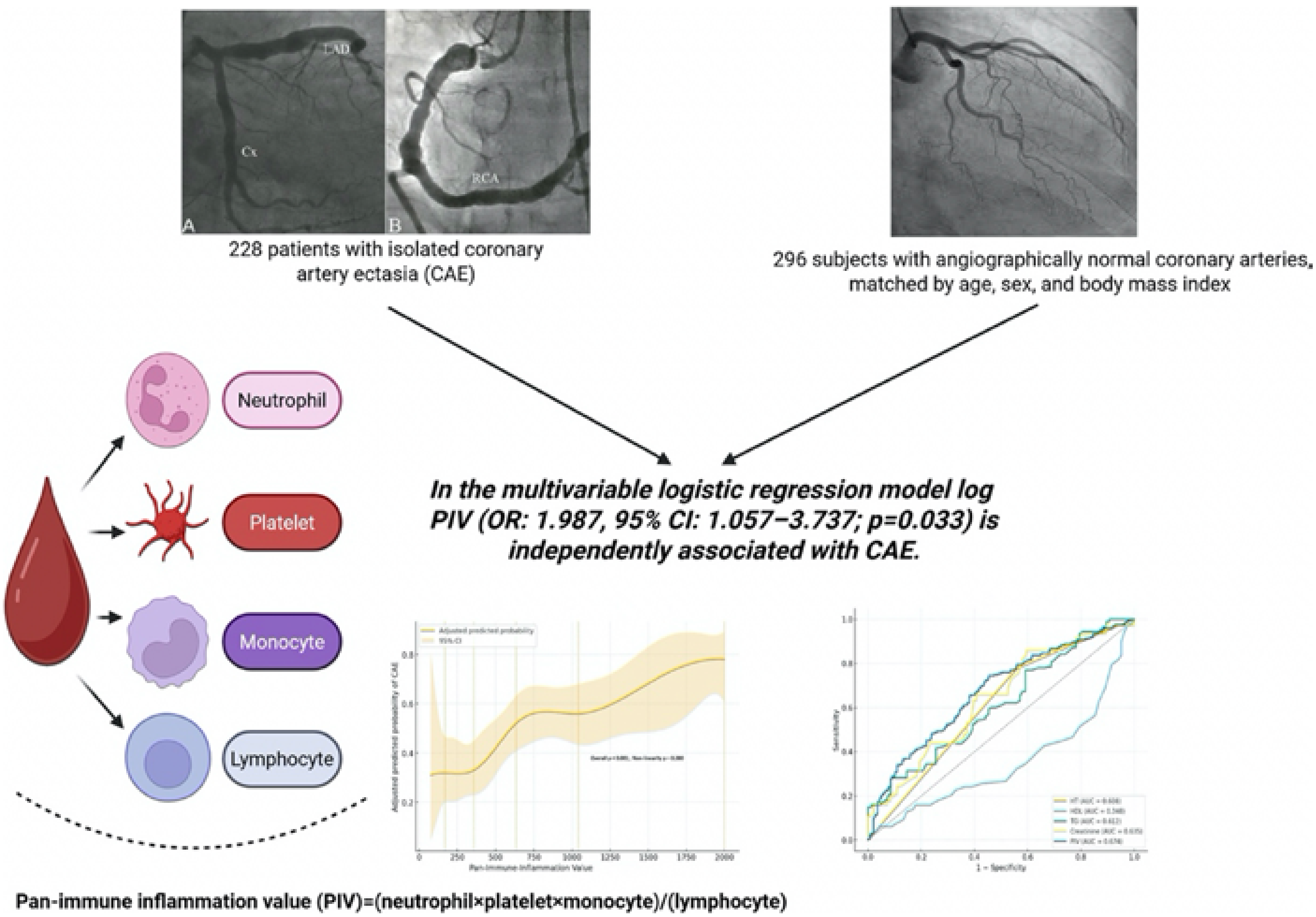
Author Contributions: Concept – Ç.T., M.T.Ö., B.N.E., S.B.G., A.T., H.A.K., K.A., V.O.T., B.Ö.; Design – Ç.T., M.T.Ö., B.N.E., S.B.G., A.T., H.A.K., K.A., V.O.T., B.Ö.; Supervision – Ç.T., M.T.Ö., B.N.E., S.B.G., A.T., H.A.K., K.A., V.O.T., B.Ö.; Resource – Ç.T., M.T.Ö., B.N.E., S.B.G., A.T., H.A.K., K.A., V.O.T., B.Ö.; Materials – Ç.T., M.T.Ö., B.N.E., S.B.G., A.T., H.A.K., K.A., V.O.T., B.Ö.; Data Collection and/or Processing - Ç.T., M.T.Ö., B.N.E., S.B.G., A.T., H.A.K., K.A., V.O.T., B.Ö.; Analysis and/or Interpretation – Ç.T., M.T.Ö., B.N.E., S.B.G., A.T., H.A.K., K.A., V.O.T., B.Ö.; Literature Review – Ç.T., M.T.Ö., B.N.E., S.B.G., A.T., H.A.K., K.A., V.O.T., B.Ö.; Writing – Ç.T., M.T.Ö., B.N.E., S.B.G., A.T., H.A.K., K.A., V.O.T., B.Ö.; Critical Review – Ç.T., M.T.Ö., B.N.E., S.B.G., A.T., H.A.K., K.A., V.O.T., B.Ö.

Peer-review: Externally peer-reviewed.

References

1. Liu R, Zhao H, Gao X, Liang S. Is Coronary Artery Ectasia a Progressive Disease? A Self-Controlled Retrospective Cohort Study. *Front Cardiovasc Med*. 2021;8:774597. [CrossRef]
2. Devabhaktuni S, Mercedes A, Diep J, Ahsan C. Coronary Artery Ectasia-A Review of Current Literature. *Curr Cardiol Rev*. 2016;12(4):318-323. [CrossRef]
3. Woźniak P, Iwańczyk S, Błaszyk M, et al. Coronary Artery Aneurysm or Ectasia as a Form of Coronary Artery Remodeling: Etiology, Pathogenesis, Diagnostics, Complications, and Treatment. *Biomedicines*. 2024;12(9):1984. [CrossRef]
4. Núñez-Gil IJ, Cerrato E, Bollati M, et al.; CAAR investigators. Coronary artery aneurysms, insights from the international coronary artery aneurysm registry (CAAR). *Int J Cardiol*. 2020;299:49-55. [CrossRef]
5. Ozturk S, Yetkin E, Waltenberger J. Molecular and cellular insights into the pathogenesis of coronary artery ectasia. *Cardiovasc Pathol*. 2018;35:37-47. [CrossRef]
6. Argan O, Bozyel S. C-Reactive Protein, Uric Acid, and Coronary Artery Ectasia in Patients with Coronary Artery Disease. *Med Sci Monit*. 2025;31:e947158. [CrossRef]
7. Tosu AR, Biter Hİ. Association of systemic immune-inflammation index (SII) with presence of isolated coronary artery ectasia. *Arch Med Sci Atheroscler Dis*. 2021;6:e152-e157. [CrossRef]
8. Vrachatis DA, Papathanasiou KA, Kazantzis D, et al. Inflammatory Biomarkers in Coronary Artery Ectasia: A Systematic Review and Meta-Analysis. *Diagnostics (Basel)*. 2022;12(5):1026. [CrossRef]
9. Liu Y, Liu J, Liu L, et al. Association of Systemic Inflammatory Response Index and Pan-Immune-Inflammation-Value with Long-Term Adverse Cardiovascular Events in ST-Segment Elevation Myocardial Infarction Patients After Primary Percutaneous Coronary Intervention. *J Inflamm Res*. 2023;16:3437-3454. [CrossRef]
10. Murat B, Murat S, Ozgeyik M, Bilgin M. Comparison of pan-immune-inflammation value with other inflammation markers of long-term survival after ST-segment elevation myocardial infarction. *Eur J Clin Invest*. 2023;53(1):e13872. [CrossRef]
11. Fucà G, Guarini V, Antoniotti C, et al. The Pan-Immune-Inflammation Value is a new prognostic biomarker in metastatic colorectal cancer: results from a pooled-analysis of the Valentino and TRIBE first-line trials. *Br J Cancer*. 2020;123(3):403-409. [CrossRef]
12. Yang XC, Liu H, Liu DC, Tong C, Liang XW, Chen RH. Prognostic value of pan-immune-inflammation value in colorectal cancer patients: A systematic review and meta-analysis. *Front Oncol*. 2022;12:1036890. [CrossRef]
13. Kaplangoray M, Toprak K, Deveci E, Caglayan C, Şahin E. Could Pan-Immune-Inflammation Value be a Marker for the Diagnosis of Coronary Slow Flow Phenomenon? *Cardiovasc Toxicol*. 2024;24(5):519-526. [CrossRef]
14. Pay L, Yumurtas AC, Dereli S, et al. Clinical Implications of Pan-Immune-inflammatory Values in Patients with Hypertrophic Cardiomyopathy. *Medeni Med J*. 2024;39(4):254-260. [CrossRef]
15. Cetinkaya Z, Kelesoglu S. The Role of Pan-Immune-Inflammation Value in Predicting Contrast-Induced Nephropathy Development in Patients Undergoing Percutaneous Coronary Intervention Due to NSTEMI. *Angiology*. 2025;76(3):281-288. [CrossRef]
16. Bayramoğlu A, Hidayet Ş. Association between pan-immune-inflammation value and no-reflow in patients with ST elevation myocardial infarction undergoing percutaneous coronary intervention. *Scand J Clin Lab Invest*. 2023;83(6):384-389. [CrossRef]
17. Ömür SE, Koyun E, Zorlu Ç, Genç Tapar G, Cabri G. The Association of SYNTAX and Mehran Scores with Inflammation in Patients with Contrast-Induced Nephropathy Secondary to Acute Coronary Syndrome. *Turk Kardiyol Dern Ars*. 2024;52(8):543-552. [CrossRef]
18. Wang X, Montero-Cabezas JM, Mandurino-Mirizzi A, et al. Prevalence and Long-term Outcomes of Patients with Coronary Artery Ectasia Presenting with Acute Myocardial Infarction. *Am J Cardiol*. 2021;156:9-15. [CrossRef]
19. ElGuindy MS, ElGuindy AM. Aneurysmal coronary artery disease: An overview. *Glob Cardiol Sci Pract*. 2017;2017(3):e201726. [CrossRef]
20. Turhan H, Erbay AR, Yasar AS, et al. Plasma soluble adhesion molecules; intercellular adhesion molecule-1, vascular cell adhesion molecule-1 and E-selectin levels in patients with isolated coronary artery ectasia. *Coron Artery Dis*. 2005;16(1):45-50. [CrossRef]
21. Jiang L, Wei W, Kang S, Li XL, Luo Y. Insights into lipid metabolism and immune-inflammatory responses in the pathogenesis of coronary artery ectasia. *Front Physiol*. 2023;14:1096991. [CrossRef]
22. Savino M, Parisi Q, Biondi-Zoccai GG, Pristipino C, Cianflone D, Crea F. New insights into molecular mechanisms of diffuse coronary ectasiae: a possible role for VEGF. *Int J Cardiol*. 2006;106(3):307-312. [CrossRef]
23. Erdoğan A, Özkan E, Sonsöz MR, et al. Gender-Dependent Comparison of Coronary Computed Tomography Angiographic Characteristics among Patients with Suspected Atherosclerosis: A Single-Center Experience. *Turk Kardiyol Dern Ars*. 2023;51(1):22-31. [CrossRef]
24. Zhao L, Moos MP, Gräbner R, et al. The 5-lipoxygenase pathway promotes pathogenesis of hyperlipidemia-dependent aortic aneurysm. *Nat Med*. 2004;10(9):966-973. [CrossRef]
25. Dwyer JH, Allayee H, Dwyer KM, et al. Arachidonate 5-lipoxygenase promoter genotype, dietary arachidonic acid, and atherosclerosis. *N Engl J Med*. 2004;350(1):29-37. [CrossRef]
26. Yilmaz M, Kayançiçek H, Korkmaz H, et al. A new inflammatory marker: elevated eosinophil-tolymphocyte ratio associated with presence and severity of isolated coronary artery ectasia. *Cardiovasc J Afr*. 2020;31(5):227-235. [CrossRef]
27. Medrano-Bosch M, Simón-Codina B, Jiménez W, Edelman ER, Melgar-Lesmes P. Monocyte-endothelial cell interactions in vascular and tissue remodeling. *Front Immunol*. 2023;14:1196033. [CrossRef]
28. Akkaya S, Cakmak U. Association between Pan-Immune-Inflammation Value and Contrast-Induced Nephropathy with Coronary Angiography. *Medicina (Kaunas)*. 2024;60(6):1012. [CrossRef]
29. Grünewaldt A, Peiffer KH, Bojunga J, Rohde GGU. Characteristics, clinical course and outcome of ventilated patients at a non-surgical intensive care unit in Germany: a single-centre, retrospective observational cohort analysis. *BMJ Open*. 2023;13(7):e069834. [CrossRef]
30. Yu H, Dai J, Tang H, et al. Characteristics of coronary artery ectasia and accompanying plaques: an optical coherence tomography study. *Int J Cardiovasc Imaging*. 2023;39(7):1357-1366. [CrossRef]

31. Willner NA, Ehrenberg S, Musallam A, Roguin A. Coronary artery ectasia: prevalence, angiographic characteristics and clinical outcome. *Open Heart*. 2020;7(1):e001096. [CrossRef]
32. Almansori MA, Elsayed HA. Coronary artery ectasia - A sample from Saudi Arabia. *J Saudi Heart Assoc*. 2015;27(3):160-163. [CrossRef]
33. Lam CS, Ho KT. Coronary artery ectasia: a ten-year experience in a tertiary hospital in Singapore. *Ann Acad Med Singap*. 2004;33(4):419-422. [CrossRef]
34. Gunes Y, Boztosun B, Yildiz A, et al. Clinical profile and outcome of coronary artery ectasia. *Heart*. 2006;92(8):1159-1160. [CrossRef]
35. Harikrishnan S, Sunder KR, Tharakan J, et al. Coronary artery ectasia: angiographic, clinical profile and follow-up. *Indian Heart J*. 2000;52(5):547-553.
36. Esposito L, Di Maio M, Silverio A, et al. Treatment and Outcome of Patients With Coronary Artery Ectasia: Current Evidence and Novel Opportunities for an Old Dilemma. *Front Cardiovasc Med*. 2022;8:805727. [CrossRef]
37. Sen N, Ozcan F, Uygur B, et al. Elevated serum uric acid levels in patients with isolated coronary artery ectasia. *Turk Kardiyol Dern Ars*. 2009;37(7):467-472.
38. Richards GHC, Hong KL, Henein MY, Hanratty C, Boles U. Coronary Artery Ectasia: Review of the Non-Atherosclerotic Molecular and Pathophysiologic Concepts. *Int J Mol Sci*. 2022;23(9):5195. [CrossRef]
39. Khan S, Huda B, Bhurka F, Patnaik R, Banerjee Y. Molecular and Immunomodulatory Mechanisms of Statins in Inflammation and Cancer Therapeutics with Emphasis on the NF-κB, NLRP3 Inflammasome, and Cytokine Regulatory Axes. *Int J Mol Sci*. 2025;26(17):8429. [CrossRef]
40. Awad K, Zaki MM, Mohammed M, Lewek J, Lavie CJ, Banach M; Lipid and Blood Pressure Meta-analysis Collaboration Group. Effect of the Renin-Angiotensin System Inhibitors on Inflammatory Markers: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Mayo Clin Proc*. 2022;97(10):1808-1823. [CrossRef]
41. Özbay Y, Akbulut M, Balin M, Kayançiçek H, Baydaş A, Korkmaz H. The level of hs-CRP in coronary artery ectasia and its response to statin and angiotensin-converting enzyme inhibitor treatment. *Mediators Inflamm*. 2007;2007:89649. [CrossRef]
42. Khedr A, Neupane B, Proskuriakova E, Jada K, Kakieu Djossi S, Mostafa JA. Pharmacologic Management of Coronary Artery Ectasia. *Cureus*. 2021;13(9):e17832. [CrossRef]



Graphical Abstract. Schematic summary of the study design and main findings. Among 17,538 patients undergoing elective coronary angiography, 228 patients with isolated coronary artery ectasia (CAE) and 296 controls with normal coronary anatomy were compared. The pan-immune-inflammation value (PIV), calculated as (neutrophil × platelet × monocyte) / lymphocyte, was significantly higher in CAE patients. In multivariable logistic regression, log-transformed PIV was independently associated with CAE (OR: 1.987, 95% CI: 1.057–3.737, P = 0.033).