THE ANATOLIAN JOURNAL OF CARDIOLOGY

Official journal of the TURKISH SOCIETY OF CARDIOLOGY

The Role of Osaka Prognostic Score in Assessing Infrapopliteal Lesion Complexity and Predicting Procedural Technical Success After Endovascular Intervention: A Retrospective Study

ABSTRACT

Background: Peripheral artery disease (PAD) is a progressive atherosclerotic disorder affecting lower extremities. While anatomical classification systems like Trans-Atlantic Inter-Society Consensus (TASC) aid procedural planning, they lack systemic prognostic components. The Osaka Prognostic Score (OPS), incorporating C-reactive protein, albumin, and lymphocyte count, is an emerging biomarker-based index that may aid in stratifying PAD severity. This study aimed to evaluate whether OPS is associated with infrapopliteal lesion complexity and to determine its predictive value for procedural technical success in patients undergoing endovascular intervention.

Methods: This retrospective study included 154 patients undergoing lower extremity percutaneous transluminal angioplasty. Procedures were performed using standard femoral access under fluoroscopic guidance. Technical success was defined as <30% residual stenosis without impairment. The OPS was calculated preoperatively, and outcomes were analyzed.

Results: Higher OPS and low-density lipoprotein (LDL) levels were significantly associated with TASC C–D lesions. Technical success was significantly lower in advanced lesions. The OPS was independently associated with advanced lesion category and procedural technical failure, outperforming LDL in receiver operating characteristic analysis.

Conclusion: The OPS was independently associated with infrapopliteal lesion complexity and procedural technical success in patients undergoing endovascular intervention for PAD. These findings suggest that OPS may serve as a useful adjunct to anatomical classification for preprocedural risk stratification. Further prospective studies with long-term clinical follow-up are needed to validate these findings.

Keywords: Endovascular treatment, lesion complexity, Osaka Prognostic Score, peripheral artery disease, TASC classification

ORIGINAL INVESTIGATION

INTRODUCTION

Peripheral artery disease (PAD) is a prevalent manifestation of systemic atherosclerosis characterized by the obstruction or narrowing of peripheral arteries, most commonly affecting the lower extremities.[1] It is associated with increased cardiovascular morbidity and mortality, posing a significant public health burden worldwide.[2] The clinical presentation of PAD can vary from asymptomatic cases to intermittent claudication and critical limb ischemia, with disease severity largely influencing prognosis and treatment decisions.[3]

Accurate assessment of PAD severity is critical in guiding therapeutic strategies, determining prognosis, and identifying patients who may benefit from revascularization procedures. The Trans-Atlantic Inter-Society Consensus (TASC) classification system is widely used to categorize PAD based on the anatomical complexity of arterial lesions and serves as a practical tool in clinical decision-making.[4] However, anatomical classification alone may not sufficiently reflect the underlying systemic disease burden and inflammatory state of patients.

Alperen Taş[1]
Çağatay Tunca[2]
Emine Cansu Yücel[2]
Muhammed Erzurum[3]
Ayşenur Özkaya İbiş[2]
Mehmet Taha Özkan[2]

[1]*Department of Cardiology, Ahi Evran University Training and Research Hospital, Kırşehir, Türkiye*
[2]*Department of Cardiology, Ankara Etlik City Hospital, Ankara, Türkiye*
[3]*Department of Cardiology, Karabük Training and Research Hospital, Karabük, Türkiye*

Corresponding author:
Alperen Taş
✉ alperentas555@hotmail.com

Received: April 27, 2026
Accepted: July 24, 2026
Available Online Date: August 21, 2026

Cite this article as: Taş A, Tunca Ç, Yücel EC, Erzurum M, İbiş AÖ, Özkan MT. The role of Osaka Prognostic Score in assessing infrapopliteal lesion complexity and predicting procedural technical success after endovascular intervention: a retrospective study. *Anatol J Cardiol.* 2026;XX(X):X-X.

DOI: 10.14744/AnatolJCardiol.2026.6610

In recent years, systemic inflammation and nutritional status have gained attention as important contributors to PAD progression and outcomes. Biomarkers such as C-reactive protein (CRP) and serum albumin have been investigated for their roles in vascular inflammation, endothelial dysfunction, and tissue repair.[5,6] Building upon these components, the Osaka Prognostic Score (OPS)—originally developed as a prognostic tool in oncology—integrates CRP and albumin levels into a single composite score.[7] In this context, inflammatory biomarkers such as high-sensitivity C-reactive protein (hs-CRP) have also been shown to be associated with the severity of atherosclerotic diseases, including coronary artery disease (CAD), suggesting a similar prognostic role in PAD.[8] Since OPS incorporates CRP as a key component, it directly reflects systemic inflammation and nutritional status,[9,10] thereby supporting its potential utility in assessing disease severity and outcomes in patients with PAD.

Inflammatory biomarkers such as hs-CRP have been shown to be associated with the severity of atherosclerotic diseases, including CAD, suggesting a similar prognostic role in PAD. Since the OPS incorporates CRP as a key component, it directly reflects systemic inflammation, further supporting its potential value in assessing disease severity and outcomes in PAD.

Despite its potential, limited evidence exists regarding the role of OPS in patients with PAD. It remains unclear whether this score can serve as a marker for disease severity or predict procedural outcomes such as revascularization success. As PAD is often associated with comorbid conditions such as diabetes mellitus (DM), hypertension (HT), and CAD,[11-13] identifying reliable and accessible predictors beyond anatomical classification could enhance clinical evaluation and optimize management strategies.

The present study aims to evaluate the association between the OPS and both the severity of PAD as defined by TASC classification and the procedural technical success of peripheral endovascular interventions. By investigating the predictive value of OPS alongside conventional clinical, demographic, and laboratory parameters, this study seeks to determine whether OPS can serve as an independent marker for disease burden and procedural technical success in patients undergoing peripheral angiography for PAD.

HIGHLIGHTS

- Osaka Prognostic Score (OPS) is significantly associated with infrapopliteal peripheral artery disease (PAD) lesion complexity.
- Higher OPS values are associated with advanced Trans-Atlantic Inter-Society Consensus C–D lesions.
- The OPS is independently associated with procedural technical failure.
- Reflects systemic inflammation and nutritional status in PAD.
- Serves as a simple and practical tool for risk stratification.

METHODS

Study Population

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of Ankara Etlik City Hospital (Approval No.: 2025-279, Approval Date: September 2, 2025). Since this was not a prospective interventional study, trial registration was not required. Written informed consent was waived due to the retrospective nature of the study. This retrospective observational study included 154 patients diagnosed with PAD who underwent peripheral angiography between September 2024 and September 2025 at the tertiary cardiovascular center. Patients with any condition that could interfere with systemic inflammatory markers or confound the interpretation of laboratory data were excluded from the study. Specifically, individuals with acute or chronic infections, active malignancy or a history of cancer within the last 5 years, chronic liver disease including cirrhosis or active hepatitis, or end-stage renal disease requiring dialysis were not eligible for inclusion. Additionally, patients with autoimmune or systemic inflammatory diseases (such as rheumatoid arthritis or systemic lupus erythematosus), recent major surgery or trauma within the preceding 3 months, hematological disorders, or known immunodeficiency were excluded. The use of systemic corticosteroids or immunosuppressive therapy within the previous 30 days also constituted a criterion for exclusion. Figure 1 presents the study flow diagram.

Patients were categorized based on the complexity of their arterial lesions according to the TASC II classification into 4 groups (A–D). For analysis, they were grouped as:

- Group 1: TASC A–B lesions.
- Group 2: TASC C–D lesions.

Trans-Atlantic Inter-Society Consensus II Classification

The TASC II classification system is a widely accepted anatomical grading system used to stratify the severity and complexity of atherosclerotic lesions in the lower extremity arteries. It is based on lesion length, location, and degree of occlusion. The classification is as follows:[14]

Infrapopliteal Lesions

- TASC A: Single focal stenosis, ≤5 cm in length, in the target tibial artery with occlusion or stenosis of similar or worse severity in the other tibial arteries.
- TASC B: Multiple stenoses, each ≤5 cm in length, or total length ≤10 cm, or single occlusion ≤3 cm in the target tibial artery with occlusion or stenosis of similar or worse severity in the other tibial arteries.
- TASC C: Multiple stenoses in the target tibial artery and/or single occlusion with total lesion length >10 cm with occlusion or stenosis of similar or worse severity in the other tibial arteries.
- TASC D: Multiple occlusions involving the target tibial artery with total lesion length >10 cm or dense lesion calcification or non-visualization of collaterals.
- The other tibial arteries are also occluded or densely calcified.

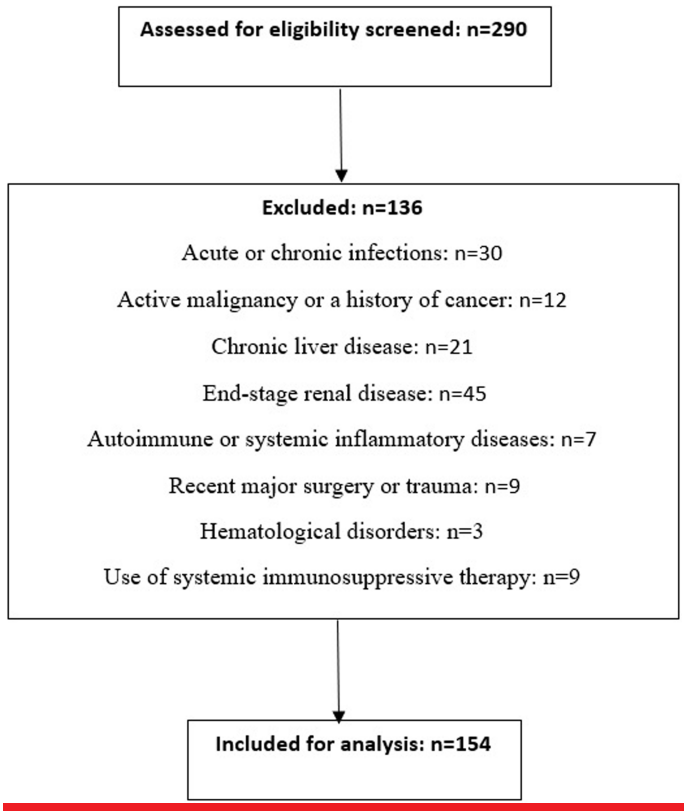

Figure 1. Flow diagram of patient selection and inclusion criteria.

- Patients were classified into these categories based on angiographic evaluation by experienced clinicians who were blinded to the clinical and laboratory data.

Definitions and Diagnostic Criteria

- Hypertension: Defined as a history of HT or a measured systolic blood pressure ≥140 mmHg and/or diastolic pressure ≥90 mmHg on at least 2 separate occasions, or current use of antihypertensive therapy.[15]
- Diabetes mellitus: Defined as a prior diagnosis of DM, ongoing antidiabetic treatment, or laboratory evidence including fasting plasma glucose ≥126 mg/dL, glycated hemoglobin (HbA1c) ≥6.5%, or random glucose ≥200 mg/dL with symptoms of hyperglycemia.[16]
- Smoking: Defined as current smoking or cessation within the last 12 months, as documented in medical records.

Peripheral Angiography Procedure

All infrapopliteal percutaneous transluminal angioplasty procedures were conducted in either a dedicated angiography suite or cardiac catheterization lab by vascular surgeons meeting the Society for Vascular Surgery standards for endovascular interventions.

Under local anesthesia, selective angiography was performed via either contralateral retrograde or ipsilateral antegrade femoral access using 5F or 6F sheaths. Following diagnostic angiography, systemic anticoagulation was achieved using weight-based heparin, and activated clotting times were monitored to guide dosing.

Lesions were crossed using 0.014-0.035-inch platinum-tipped or hydrophilic guidewires. Angioplasty was performed under full anticoagulation without routine use of subintimal techniques. Balloon diameters were selected based on the adjacent normal artery. Balloon inflation pressures ranged between 4 and 12 atm and were maintained for a minimum of 60 seconds.

Post-procedure, all patients received a 300 mg clopidogrel loading dose, followed by 75 mg daily for 6-12 weeks. Aspirin (325 mg) was administered on the day of the intervention and continued indefinitely unless contraindicated. Arterial sheaths were removed with manual compression.

Technical success was considered achieved when the residual stenosis was less than 30% and there was no evidence of impaired distal blood flow. This definition reflects procedural technical success rather than long-term clinical outcomes.

Calculation of the Osaka Prognostic Score

The OPS was calculated using 3 laboratory values obtained before the angiographic procedure:[7]

- C-reactive protein >10 mg/L → 1 point.
- Serum albumin <3.5 g/dL → 1 point.
- Absolute lymphocyte count <1600 cells/μL → 1 point.

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics (version 22). The distribution of continuous variables was assessed using the Kolmogorov–Smirnov test. Variables with a normal distribution were expressed as mean ± SD, while those without a normal distribution were presented as median (minimum–maximum). Categorical variables were reported as numbers and percentages (%).

For comparisons between groups, the independent samples *t*-test was used for normally distributed continuous variables, and the Mann–Whitney *U*-test was applied for non-normally distributed variables. The chi-square test was employed for the comparison of categorical variables.

To identify the predictors of peripheral arterial disease severity and procedural technical success, univariate logistic regression analysis was first conducted, followed by multiple logistic regression analysis including the variables found to be significant. The results were presented as odds ratios (OR) with 95% CIs.

The diagnostic accuracy of certain variables was evaluated using receiver operating characteristic (ROC) curve analysis. In ROC analyses, the area under the curve (AUC), cut-off value, sensitivity, and specificity were calculated. A *P* value of <.05 was considered statistically significant for all analyses.

RESULTS

A total of 154 patients with PAD were included in the study and categorized into 2 groups based on the TASC classification: Group 1 (TASC A–B, n = 89) and Group 2 (TASC C–D, n = 65). Endovascular intervention was performed on the target vessels, including 56 anterior tibial arteries, 41 posterior

tibial arteries (PTAs), 37 peroneal arteries, and 20 tibioperoneal trunks.

As shown in Table 1, patients in Group 2 were significantly older and had a higher prevalence of DM, CAD, and smoking compared to Group 1 ($P = .018$, $P = .004$, $P = .008$, and $P = .010$, respectively). Group 2 also demonstrated significantly higher levels of CRP (13 [5-32] vs. 7 [3-20] mg/L, $P < .001$), and significantly lower albumin levels (35.51 ± 5.39 vs. 38.51 ± 4.78 g/dL, $P < .001$). In terms of lipid profile, total cholesterol and low-density lipoprotein (LDL) were higher, while high-density lipoprotein was lower in Group 2 ($P < .05$ for all).

Table 1. Clinical and Demographic Comparison of Peripheral Artery Disease Patients According to Disease Severity

	Grup 1 (TASC A, B), n = 89	Group 2 (TASC C, D), n = 65	*P*
Male, n (%)	70 (78.7)	51 (78.5)	.977
Age, years	64.25 ± 10.90	68.27 ± 9.30	.018
HT, n (%)	57 (64)	42 (64.6)	.942
DM, n (%)	50 (56.2)	51 (78.5)	.004
CAD, n (%)	44 (49.4)	46 (70.8)	.008
Smoking, n (%)	36 (40.4)	40 (61.5)	.010
EF (%)	54.58 ± 11.23	52.76 ± 10.91	.496
Statin use, n (%)	41 (46.1)	32 (49.2)	.698
β-blocker use, n (%)	33 (37.1)	22 (33.8)	.679
ACEI/ARB use, n (%)	36 (40.4)	25 (38.5)	.803
Glucose (mg/dL)	120 (74-432)	124 (47-401)	.858
Hb (g/dL)	13.32 ± 3.01	13.25 ± 2.29	.781
WBC (cell/μL)	8.80 (4.5-25.3)	8.90 (2.7-23.6)	.973
Lymphocyte (cell/μL)	1.70 (0.50-4.0)	1.90 (0.40-5.50)	.577
Neutrophil (cell/μL)	5.70 (2.60-21.40)	6.20 (1.40-19.60)	.334
CRP (mg/L)	7 (3-20)	13 (5-32)	<.001
PLT 1000 (cell/μL)	264 (59-643)	267 (69-753)	.271
Creatinine (mg /dL)	0.98 (0.58-2.92)	1.04 (0.52-2.97)	.057
Albumin (g/dL)	38.51 ± 4.78	35.51 ± 5.39	<.001
Total protein (mg/dL)	70.15 ± 9.95	64.74 ± 16.03	.033
Total cholesterol (mg/dL)	165 (86-285)	197 (69-347)	.022
LDL (mg/dL)	117 (48-207)	141 (41-296)	.003
HDL (mg/dL)	39 (20-67)	33 (15-173)	<.001
TG (mg/dL)	150 (24-648)	162 (47-566)	.321
Sodium (mmol/L)	137.52 ± 3.04	137.0 ± 4.02	.389
Potassium (mmol/L)	4.39 ± 0.51	4.37 ± 0.49	.766
OPS	0.86 ± 0.91	1.56 ± 0.86	<.001
Treated vessels, n (%)	ATA, 32 (36) PTA, 23 (25.8) PA, 22 (24.7) TPT, 12 (7.8)	ATA, 24 (36.9) PTA, 18 (27.7) PA, 15 (23.1) TPT, 8 (5.2)	.987
CTO, n (%)	18 (20.2)	45 (69.2)	<.001
Lesion length, mm	6 (3-9)	17 (10-30)	<.001
Technical success, n (%)	74 (83)	39 (60)	.001

ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ATA, anterior tibial artery; CAD, coronary artery disease; CRP, C-reactive protein; CTO, chronic total occlusion; DM, diabetes mellitus; EF, ejection fraction; Hb, hemoglobin; HDL, high-density lipoprotein; HT, hypertension; LDL, low-density lipoprotein; OPS, Osaka Prognostic Score; PA, peroneal artery; PLT, platelet; PTA, posterior tibial artery; TASC, Trans-Atlantic Inter-Society Consensus; TG, triglyceride; TPT, tibioperoneal trunk; WBC, white blood cell.

The prevalence of chronic total occlusion (CTO) was significantly higher in Group 2 than in Group 1 (69.2% vs. 20.2%, $P < .001$). In addition, lesion length was significantly greater in Group 2 (17 [10-30] mm vs. 6 [3-9] mm, $P < .001$).

The OPS was significantly elevated in Group 2 (1.56 ± 0.86 vs. 0.86 ± 0.91, $P < .001$). Moreover, technical success rates were significantly lower in Group 2 (60% vs. 83%, $P = .001$).

Multiple logistic regression analysis (Table 2) identified OPS (OR = 2.153, $P = .001$, 95% CI: 1.395-3.323) and LDL (OR = 1.011, $P = .007$, 95% CI: 1.003-1.020) as independent predictors of TASC C–D classification. Technical success was not independently associated with disease severity after adjusting for other factors ($P = .258$).

Out of 154 interventions, 113 were classified as successful and 41 as unsuccessful. Table 3 shows that unsuccessful interventions were associated with a higher frequency of DM and CAD ($P = .006$ and $P = .025$, respectively), lower albumin levels ($P = .024$), higher CRP and LDL levels ($P = .004$ and $P = .006$, respectively), and significantly elevated OPS scores (1.68 ± 1.03 vs. 0.97 ± 0.86, $P < .001$). Patients with procedural technical failure had a significantly higher prevalence of CTO than those with successful procedures (65.9% vs. 31.9%, $P < .001$). Furthermore, lesion length was significantly greater in the unsuccessful intervention group (14 [3-20] mm vs. 7 [3-30] mm, $P < .001$).

According to multiple regression (Table 4), TASC classification (OR = 1.646, $P = .039$, 95% CI: 1.427-1.978) and OPS (OR = 1.507, $P = .004$, 95% CI: 1.320-1.804) remained independently associated with procedural technical failure.

Receiver operating characteristic analysis showed that OPS had the highest discriminatory ability for predicting severe disease (TASC C–D) with an AUC of 0.711, followed by LDL with an AUC of 0.642 (Figure 2A).

In ROC analysis (Figure 2B), OPS showed strong performance in predicting procedural technical success, with an AUC of

Table 2. Logistic Regression Analysis for Predicting the Severity of Peripheral Artery Disease

	Univarite Regression		Multiple Regression	
Variables	**OR (95% CI)**	***P***	**OR (95% CI)**	***P***
Age (years)	1.040 (1.006-1.075)	.039	1.029 (0.991-1.069)	.141
DM	1.352 (1.171-1.726)	.005	0.468 (0.203-1.078)	.074
CAD	1.404 (1.205-1.795)	.009	0.781 (0.301-2.025)	.611
Smoking	2.356 (1.224-4.534)	.010	0.568 (0.223-1.448)	.236
LDL	1.013 (1.006-1.020)	<.001	1.011 (1.003-1.020)	.007
OPS	2.310 (1.573-3.391)	<.001	2.153 (1.395-3.323)	.001
Technical success	3.289 (1.562-6.924)	.002	1.323 (0.536-3.267)	.543

CAD, coronary artery disease; DM, diabetes mellitus; LDL, low-density lipoprotein; OPS, Osaka Prognostic Score.

Table 3. Clinical and Demographic Comparison of Peripheral Artery Disease Patients According to Procedural Technical Success

Variables	Successful Intervention, n = 113	Unsuccessful Intervention, n = 41	*P*
Male, n (%)	89 (78.8)	32 (78)	.924
Age, years	65.16 ± 11.15	68.12 ± 7.80	.120
HT, n (%)	76 (67.3)	23 (56.1)	.201
DM, n (%)	67 (59.3)	34 (82.9)	.006
CAD, n (%)	60 (53.1)	30 (73.2)	.025
Smoking, n (%)	54 (47.8)	22 (53.7)	.520
EF (%)	54.55 ± 10.44	51.91 ± 12.27	.358
Statin use, n (%)	55 (48.7)	18 (43.9)	.600
β-blocker use n (%)	44 (38.9)	11 (26.8)	.166
ACEI/ARB use, n (%)	47 (41.6)	14 (34.1)	.404
Glucose (mg/dL)	139 (64-432)	112 (47-341)	.086
Hb (g/dL)	12.63 ± 2.20	13.59 ± 3.95	.081
WBC (cell/μL)	8.90 (2.7-25.3)	8.70 (4.7-20.7)	.597
Lymphocyte (cell/μL)	1.90 (0.40-4.0)	1.50 (0.50-5.50)	.036
Neutrophil (cell/μL)	5.75 (1.40-21.40)	6.05 (2.60-18.60)	.943
CRP (mg/L)	8 (3-32)	12.0 (5-23)	.004
PLT 1000 (cell/μL)	264 (69-753)	268 (76-643)	.477
Creatinine (mg/dL)	1.0 (0.52-2.92)	1.10 (0.67-2.97)	.255
Albumin (g/dL)	37.81 ± 5.01	35.67 ± 5.60	.024
Total protein (mg/dL)	68.00 ± 13.16	66.70 ± 13.89	.665
Total cholesterol (mg/dL)	167 (69-347)	210 (98-311)	.002
LDL (mg/dL)	120 (41-276)	137 (54-296)	.006
HDL (mg/dL)	37 (15-173)	33(23-61)	.100
TG (mg/dL)	155 (47-648)	158 (24-566)	.687
Sodium (mmol/L)	137.52 ± 3.66	136.60 ± 2.79	.187
Potassium (mmol/L)	4.35 ± 0.48	4.48 ± 0.54	.186
CTO, n (%)	36 (31.9)	27 (65.9)	<.001
Lesion length (mm)	7 (3-20)	14 (3-30)	<.001
TASC	A 36 (31.9) B 38 (33.6) C 22 (19.5) D 17 (15.0)	A 2 (4.9) B 13 (31.7) C 6 (14.6) D 20 (48.8)	<.001
OPS	0.97 ± 0.86	1.68 ± 1.03	<.001

ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ATA, anterior tibial artery; CAD, coronary artery disease; CRP, C-reactive protein; CTO, chronic total occlusion; DM, diabetes mellitus; EF, ejection fraction; Hb, hemoglobin; HDL, high-density lipoprotein; HT, hypertension; LDL, low-density lipoprotein; OPS, Osaka Prognostic Score; PA, peroneal artery; PLT, platelet; PTA, posterior tibial artery; TASC, Trans-Atlantic Inter-Society Consensus; TG, triglyceride; TPT, tibioperoneal trunk; WBC, white blood cell.

Table 4. Logistic Regression Analysis for Predicting Procedural Technical Success in Peripheral Artery Disease

	Univariate Regression		Multiple Regression	
Variables	OR (95% CI)	*P*	OR (95% CI)	*P*
DM	3.335 (1.361-8.168)	.008	2.428 (0.911-6.473)	.076
CAD	2.409 (1.101-4.273)	.028	1.517 (0.624-3.690)	.358
LDL	1.010 (1.002-1.018)	.001	0.992 (0.984-1.000)	.061
TASC	1.454 (1.314-1.655)	<.001	1.646 (1.427-1.978)	.039
OPS	1.448 (1.298-1.673)	<.001	1.507 (1.320-1.804)	.004

CAD, coronary artery disease; DM, diabetes mellitus; LDL, low-density lipoprotein; OPS, Osaka Prognostic Score; TASC, Trans-Atlantic Inter-Society Consensus.

0.695. The optimal OPS cutoff was 1.5, yielding 61% sensitivity and 76% specificity.

DISCUSSION

Peripheral artery disease is a chronic, progressive manifestation of systemic atherosclerosis characterized by arterial stenosis or occlusion, most commonly in the lower extremities.[17] The severity of PAD, as well as the success of interventional therapies, is traditionally evaluated based on anatomical features of the lesions—most notably through the TASC II classification.[4] However, growing evidence suggests that the clinical course of PAD is shaped not only by lesion anatomy but also by systemic inflammatory and nutritional status. In this context, this study suggests that OPS, a composite biomarker-based score, is associated with PAD severity and procedural technical success in patients undergoing peripheral angiography.

The OPS was originally introduced in oncology settings as a prognostic tool incorporating CRP, serum albumin, and absolute lymphocyte count—each reflecting systemic inflammation, nutritional status, and immunologic competence, respectively.[7] In recent years, these biological domains have gained attention in the context of cardiovascular and peripheral arterial diseases. In the present study cohort, patients with higher OPS values had significantly more severe disease as classified by the TASC system, and also demonstrated significantly lower rates of successful revascularization.

In multiple logistic regression analysis, OPS remained independently associated with TASC C–D classification. This finding highlights the relevance of systemic inflammatory and nutritional parameters in the development of more complex and extensive atherosclerotic lesions. While LDL cholesterol also retained independent predictive value, its impact was notably less pronounced compared to that of OPS. This suggests that beyond lipid burden, the host's inflammatory and nutritional environment may play a central role in determining lesion severity and complexity. Despite technological advancements, technical success remains significantly lower in this group, reinforcing the importance of individualized preprocedural planning.

The present findings align with the broader literature associating high CRP levels and hypoalbuminemia with vascular disease progression. Elevated CRP not only reflects systemic inflammation but also contributes to endothelial dysfunction and plaque vulnerability, leading to accelerated atherosclerosis.[18] Low albumin, a marker of malnutrition and catabolic state, is associated with impaired vascular repair and increased oxidative stress.[19] Meanwhile, lymphopenia may reflect chronic immune activation or suppression, both of which negatively impact vascular integrity and healing capacity.[20] The integration of these 3 dimensions into the OPS makes it a multifaceted prognostic tool, capturing the

systemic milieu in a way that traditional lesion-based classifications cannot.

Consistent with the present findings, previous studies have demonstrated that circulating biomarkers such as endocan are significantly associated with systemic inflammatory markers and disease severity in cardiovascular conditions.[21] In addition, biomarker-based indices incorporating both inflammatory and nutritional parameters, such as the prognostic nutritional index, have also been shown to be closely related to lesion severity and clinical outcomes. Taken together, these findings support the concept that composite scores reflecting systemic biological status, such as the OPS, may provide incremental prognostic value beyond anatomical assessment in patients with PAD.[22]

Notably, OPS was also independently associated with procedural technical failure, defined as the inability to achieve successful revascularization with restored distal flow and residual stenosis <30%. In multiple regression, OPS maintained statistical significance, even when accounting for other variables. In ROC analysis (Figure 2), OPS yielded an AUC of 0.695, and using the optimal cutoff of 1.5 it achieved 61% sensitivity and 76% specificity. These findings suggest that patients with elevated OPS may be at increased risk for procedural complications or technical failure, likely due to underlying systemic vulnerability and diminished tissue reparative capacity. Importantly, in addition to OPS, TASC classification itself was also identified as an independent predictor of procedural technical success. This is consistent with prior studies showing that TASC C–D lesions, characterized by long-segment occlusions, diffuse disease, or multilevel involvement, are more technically challenging to treat via endovascular means and often require surgical revascularization.[23] The present study supports the role of TASC scoring in procedural planning, while also emphasizing that anatomical complexity alone does not fully account for procedural technical outcomes.

The combination of high OPS and high TASC class may represent a synergistically adverse phenotype: anatomically complex disease in a biologically compromised host. This dual burden may reduce the likelihood of achieving procedural technical success and may reflect a less favorable biological environment for endovascular intervention. In this light, OPS may serve as a valuable adjunct to TASC classification—providing a systemic context to anatomical assessments and enhancing preprocedural risk stratification.

Furthermore, unlike the TASC classification, which is fixed based on lesion anatomy, the OPS reflects the patient's systemic inflammatory, nutritional, and immunological status at the time of assessment. Its components—CRP, albumin, and lymphocyte count—may vary in response to intercurrent illness or systemic inflammatory conditions. In this context, the observed association between OPS and both lesion complexity and procedural outcomes underscores the relevance of systemic biological status in patients with infrapopliteal PAD, complementing anatomical classification.

Another key advantage of OPS lies in its simplicity and feasibility. It utilizes 3 commonly available and inexpensive laboratory parameters, making it highly accessible in both high- and low-resource clinical settings. The OPS, by integrating both inflammatory and nutritional domains, offers a broader and more clinically intuitive reflection of systemic risk.

This study also observed a progressive increase in OPS across TASC classes and a significant elevation in OPS among patients who experienced failed revascularization. This

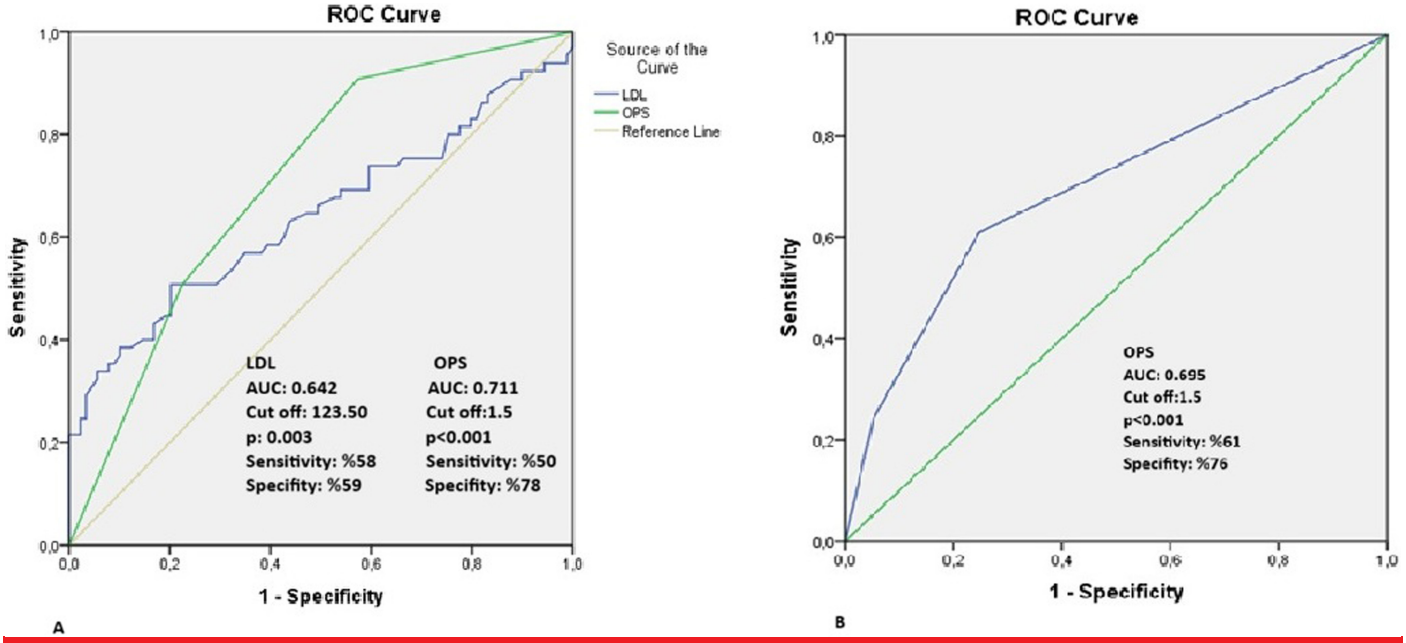

Figure 2. (A) ROC curve analysis of the OPS for disease severity assessment. (B) ROC curve analysis of OPS in assessing procedural technical success in peripheral artery disease. OPS, Osaka Prognostic Score; ROC, receiver operating characteristic.

gradual and consistent relationship between OPS and disease burden/outcome supports the construct validity of the score in the PAD population. Moreover, in ROC analyses for both disease severity and procedural technical success, OPS outperformed LDL, reinforcing the notion that biological state may trump traditional lipid metrics in predicting procedural outcomes.

Although OPS integrates CRP, albumin, and lymphocyte count into a single composite score, the present study was not designed to compare its predictive performance directly with each individual component. Therefore, whether OPS provides incremental predictive value beyond its constituent biomarkers remains to be established. Future studies should address this important question.

While LDL cholesterol remains a cornerstone in the pathogenesis of atherosclerosis and a target of preventive therapy, its limited predictive power for procedural technical failure in this study suggests that it may be more closely linked to disease initiation rather than procedural response. This highlights the importance of shifting some focus from static risk factors to dynamic biological indicators—like those captured in OPS—that better reflect current systemic status.

Lastly, these findings suggest that incorporating systemic risk assessment into preprocedural evaluation may complement anatomical assessment in selected patients undergoing endovascular intervention. For instance, in patients with borderline TASC C lesions and high OPS, clinicians might opt for more conservative management, preprocedural optimization, or surgical referral. Conversely, patients with anatomically complex disease but favorable OPS profiles may be more likely to benefit from an endovascular-first approach. Thus, OPS may assist preprocedural risk stratification and therapeutic planning.

Study Limitations

This study has several limitations that merit consideration. First, the retrospective and observational design inherently limits causal inference and is subject to residual confounding. Although multiple models were applied, unknown or unmeasured variables could have influenced the results.

Second, the sample size, while adequate for primary analyses, remains modest and originates from a single tertiary care center, potentially limiting generalizability. Multicenter, larger-scale studies are needed to validate these findings across diverse patient populations and healthcare settings.

Third, this study utilized only baseline (single time-point) measurements of CRP, albumin, and lymphocyte counts to calculate OPS. These parameters can fluctuate in response to acute illness, infection, or stress, and may not always reflect chronic status. Serial measurements could offer additional prognostic insight.

Fourth, the primary outcome of this study was procedural technical success, defined according to angiographic criteria, rather than long-term clinical outcomes. Therefore, these findings should not be interpreted as evidence of long-term clinical benefit, including limb salvage, restenosis, amputation, or survival.

Fifth, although OPS integrates CRP, albumin, and lymphocyte count into a single composite score, the study did not compare its predictive performance directly with that of its individual components. Therefore, whether OPS provides incremental predictive value beyond these individual biomarkers remains to be established.

Finally, the cutoff value for OPS (1.5) was derived using ROC analysis from the study's own dataset. While this threshold demonstrated good diagnostic accuracy within the present cohort, its external validity must be tested in future studies. Future multicenter prospective trials with larger sample sizes and long-term follow-up are warranted to validate these findings and further clarify the prognostic role of OPS in PAD.

CONCLUSION

In this study, the OPS—a simple, cost-effective, and accessible score incorporating CRP, albumin, and lymphocyte count—was independently associated with PAD severity (TASC classification) and procedural technical failure. In contrast to anatomical assessment alone, OPS may provide complementary information regarding the patient's inflammatory, nutritional, and immune status.

These findings suggest that OPS can serve as a valuable adjunct to the TASC system in the preprocedural evaluation of PAD patients, particularly in risk stratification and therapeutic planning. Given that OPS is based on routinely available laboratory markers and is potentially modifiable, it may also serve as a target for preprocedural optimization.

Future prospective and multicenter studies are warranted to validate these results, determine optimal cutoff values, and explore whether improving OPS prior to intervention can positively influence outcomes in PAD.

Ethics Committee Approval: This study was approved by the Ethics Committee of Ankara Etlik City Hospital (Approval No.: 2025-279; Date: September 2, 2025).

Informed Consent: Written informed consent was waived due to the retrospective nature of the study.

Peer-review: Externally peer-reviewed.

Acknowledgements: The authors would like to thank the clinical and laboratory staff for their support in data collection and laboratory analyses.

Author Contributions: Concept – A.T., Ç.T.; Design – A.T., E.C.Y.; Supervision – A.T., M.E.; Resources – A.T., A.Ö.İ.; Materials – A.T., M.T.Ö.; Data Collection and/or Processing – E.C.Y., M.T.Ö.; Analysis and/or Interpretation – A.T., A.Ö.İ.; Literature Search – A.T., E.C.Y.; Writing – A.T., M.T.Ö.; Critical Review – M.E., Ç.T.

Declaration of Interests: The authors have no conflicts of interest to declare.

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

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