TJVS Turkish Journal of Vascular Surgery

Turk J Vasc Surg 2025;34(2):147-54
DOI: 10.9739/tjvs.2025.05.024

Available online at www.turkishjournalofvascularsurgery.org

Original Article

Prognostic significance of neutrophil-to-lymphocyte and platelet-to-lymphocyte ratios in endovascular treatment success and recurrence in peripheral arterial disease

Uzeyir Yilmaz[1], Mehmet Fatih Kaya[2], Yusuf Taspinar[3], Mustafa Mert Ozgur[4]

[1]Kastamonu Training and Research Hospital, Department of Cardiovascular Surgery, Kastamonu, Türkiye
[2]Kartal Dr. Lütfi Kırdar City Hospital, Department of Radiology, İstanbul, Türkiye
[3]Sivas Cumhuriyet University Hospital, Department of Cardiovascular Surgery, Sivas, Türkiye
[4]Kartal Koşuyolu High Specialization Training and Research Hospital, Department of Cardiovascular Surgery, İstanbul, Türkiye

Received: May 01, 2025 Accepted: July 17, 2025 Published online: July 21, 2025

Abstract

Aim: Peripheral artery disease (PAD) can create a clinical picture ranging from pain to amputation. Additional diseases and lifestyle can increase the risk and level of the disease. Although the advancement of endovascular intervention technologies has increased the success rate of PAD treatments, comorbidities pose a risk for recurrence. Inflammation plays a role in the formation and recurrence of PAD. Neutrophil/Lymphocyte ratio (NLR) and Platelet/Lymphocyte ratio can be markers indicating a destructive, thrombogenic inflammatory response. The aim of this study is to evaluate the association between systemic inflammatory markers—specifically NLR and platelet-to-lymphocyte ratio (PLR)—and post-treatment recurrence in patients undergoing endovascular intervention for PAD, and to investigate the prognostic value of these biomarkers".
Material and Methods: Patients diagnosed with PAD who underwent endovascular intervention were included in this retrospective study. Demographic data, comorbidities, and laboratory markers (NLR and PLR) were recorded. Recurrence was assessed based on follow-up Doppler ultrasound findings. Data analysis was performed using SPSS version 22.
Results: Restenosis developed in 182 of 286 patients included in the study. Diabetes mellitus, hypertension, active smoking, critical ischemia, revascularization method and high post-procedure NLR PLR ratios were found to be statistically significantly associated with recurrence. Age and pre-procedure NLR PLR were not significantly associated with recurrence.
Conclusion: Endovascular revascularization methods, additional comorbid conditions and high NLR and PLR rates after the procedure are important factors causing recurrence, but larger sample groups and more studies are needed to investigate this situation.

Keywords: Peripheral angioplasty, recurrence, neutrophil/lymphocyte ratio, platelet/lymphocyte ratio

INTRODUCTION

Peripheral artery disease (PAD) describes a clinical condition characterized by intimal fibrosis, often associated with atherosclerosis, thrombosis, or arterial embolism. This disease is closely linked to major cardiovascular events. PAD can present with a variety of symptoms, including ischemic ulcers, claudication, and pain. Worldwide, approximately 100 million people undergo amputations due to PAD each year [1].

Major risk factors include hypertension (HT), diabetes mellitus (DM), smoking and hypercholesterolemia. These factors cause an exponential increase in the risk of developing the disease [2].

Endovascular interventions and surgery are the two primary treatment methods for PAD. During surgical repair of arterial

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Yilmaz U, Kaya MF, Taspinar Y, Ozgur MM. Prognostic significance of neutrophil-to-lymphocyte and platelet-to-lymphocyte ratios in endovascular treatment success and recurrence in peripheral arterial disease. Turk J Vasc Surg. 2025;34(2):147-54.

Corresponding Author: Uzeyir Yilmaz, Kastamonu Training and Research Hospital, Department of Cardiovascular Surgery, Kastamonu, Türkiye
Email: uzeyiryilmaz10@gmail.com

diseases, autografts such as saphenous or synthetic grafts such as polytetrafluoroethylene graft (PTFE) can be used [3]. Due to the high morbidity and mortality associated with distal vascular surgery, there has been a growing trend in recent years favoring endovascular procedures [4].

Endovascular procedures, a minimally invasive treatment option, offer several methods for treating patients with PAD. Techniques such as balloon angioplasty, atherectomy, and stent implantation can provide effective solutions for various types of PAD. Factors such as old age, smoking, and comorbidities can influence both the success and recurrence rates of these treatments [5].

The inflammatory response plays an important role in PAD recurrence. Neutrophil/lymphocyte ratio (NLR) and platelet/lymphocyte (PLR) has been suggested as an inflammatory marker. It may be related to the prognosis of cardiovascular and ischemic events. In our study, we investigated the relationship of these rates with the development of restenosis [6].

Some studies have shown that high NLR and PLR ratios are closely associated with an increased risk of developing critical ischemia in PAD patients. However, these studies did not provide concrete data on the revascularization of patients, and all PAD patients were included in the analysis [7,8].

Objective

The primary aim of this study is to evaluate the association between hematological parameters—specifically the NLR and the PLR, which are considered surrogate markers of systemic inflammation—and clinical recurrence in patients undergoing endovascular treatment for PAD. Additionally, the study seeks to investigate the prognostic utility of these biomarkers in predicting adverse clinical outcomes such as restenosis and recurrent symptoms following endovascular interventions. Although previous studies have reported a link between elevated NLR and PLR values and the prognosis of cardiovascular diseases, their specific role in recurrence among selected PAD patients treated with endovascular revascularization remains unclear. Therefore, this study aims to contribute to the current literature by assessing the potential use of these readily available markers in clinical risk stratification and long-term outcome prediction in PAD management.

MATERIAL AND METHODS

This study was conducted in chronic PAD patients in a tertiary care public hospital. It was designed retrospectively to investigate the association of recurrences with demographic data and inflammatory markers in patients with ilio-femoro-popliteal PAD who underwent endovascular treatment.

Ethics Committee Approval

This retrospective study was discussed at the Kartal Koşuyolu Training and Research Hospital ethics committee meeting and approved with the decision numbered 2024/17/917 on 01.10.2024. All patients included in the study were informed about the subject and their consent was obtained. This information was added to the ethics committee application.

Primary and Secondary Outcome Measures

The primary outcome of the study was the presence of restenosis at the target lesion site at 6-month follow-up, defined as ≥50% luminal narrowing identified by Doppler ultrasonography. In symptomatic patients, imaging was performed in response to signs of peripheral ischemia; in asymptomatic patients, routine imaging was conducted at the 6-month visit.

The secondary outcome was the evaluation of systemic inflammatory markers—including post-procedural neutrophil-to-lymphocyte ratio (post-NLR) and post-procedural platelet-to-lymphocyte ratio (post-PLR) as potential predictors of restenosis. These markers were derived from blood samples obtained during the 1-week follow-up and evaluated using ROC curve analysis to determine diagnostic performance.

Study Population

Between April 2022 and February 2024, the medical records of a total of two hundred and eighty-six chronic PAD patients, thirty-six of whom were female and two hundred and fifty were male, were reviewed. A consecutive non-probability sampling method was employed, including all eligible patients who underwent peripheral endovascular treatment for PAD between April 2022 and February 2024.

Inclusion Criteria

- Age above 18 years,
- Diagnosis of peripheral artery disease based on Doppler USG or CT angiography,
- Rutherford classification of class 2 or higher (i.e., moderate claudication or worse).

Exclusion Criteria

- Patients who underwent surgical intervention due to complications following endovascular procedures (n=7),
- Patients with failed angioplasty (n=11),
- Dialysis-dependent patients who underwent angioplasty (n=23).

Hypothesis

We hypothesized that systemic inflammatory markers measured after peripheral angioplasty, particularly post-NLR and post-PLR, are significantly associated with the risk of restenosis and may serve as predictive biomarkers for recurrence in patients with chronic peripheral artery disease.

Baseline Assessments

Patient characteristics such as age, gender, and comorbid conditions (diabetes mellitus, hypertension,

hypercholesterolemia), as well as HbA1c levels, were obtained from archived medical records. Laboratory parameters including WBC, neutrophil, lymphocyte, and platelet counts were retrieved from pre-procedural test results. NLR was calculated as the ratio of neutrophil to lymphocyte counts. Standard biochemical test results were also extracted from patient files. Smoking status, lesion location, and lesion severity were documented based on angiographic and clinical records.

Peripheral Angioplasty and Endovascular Procedures

Details of procedural planning and interventions were obtained from the digital procedural notes and operative reports. All patients received antiplatelet therapy (aspirin and clopidogrel) before the procedure as per institutional protocol. In cases where angioplasty was performed within 72 hours of evaluation, an additional clopidogrel dose was administered. The intervention was carried out under local anesthesia with sedation. Femoral access was achieved using an 8F sheath, and weight-adjusted heparin (70 IU/kg) was administered to reduce thromboembolic risk. Procedural details such as balloon angioplasty, atherectomy, and stent placement were extracted from operative records. Post-procedural antiplatelet management was also reviewed.

Follow-Up Assessments

Patient follow-up data at 1 week, 1 month, 3 months, and 6 months were extracted retrospectively from outpatient clinic visit records and imaging reports. Post-procedure laboratory values at 1 week were obtained from institutional databases. Doppler ultrasonography findings were reviewed for both symptomatic and asymptomatic patients at 6 months. Restenosis was defined as ≥50% luminal narrowing at the treated segment on follow-up imaging.

Power Analysis

A post hoc power analysis was performed using G*Power version 3.1.9.7 to evaluate the adequacy of the sample size for detecting a difference in restenosis rates between patients with elevated and normal post-NLR values. Based on an effect size of 0.35 (moderate), a two-tailed α level of 0.05, and a total sample size of 286, the calculated power was 0.92, indicating sufficient statistical power for the primary outcome.

Statistical Analysis

Continuous (quantitative) variables were expressed as mean±standard deviation (SD) if normally distributed, and as median (interquartile range) if non-normally distributed. Categorical (qualitative) variables were presented as frequencies and percentages. Comparisons between groups for continuous variables were made using the Student's t-test or Mann–Whitney U test, as appropriate. Categorical variables were compared using the chi-square test or Fisher's exact test. Relationships between two continuous variables were evaluated using Spearman's rank correlation. To determine independent predictors of in-stent restenosis (ISR), a multivariate Cox proportional hazards model with forward stepwise selection was applied, including variables with a univariate p-value less than 0.05. Kaplan-Meier survival analysis was conducted to estimate the cumulative incidence of ISR across groups. All statistical analyses were conducted using SPSS version 22.0 (IBM Corp., Armonk, NY, USA).

RESULTS

Peripheral angioplasty was performed on 286 patients from April 2022 to February 2024. Of the 286 patients who underwent endovascular procedures, 182 (63.6%) developed restenosis, while 104 (36.4%) did not. 36 of our patients were female and 250 were male. In our study, the number of female (n=36) and male (n=250) participants differed significantly (P=0.006). The mean age of the patients was 67.15 years (SD: 8.7; range: 47–86). The mean ages of patients who developed restenosis and those who did not were 68.08 years (standard deviation [SD]: 9.22; range: 47 to 86) and 66.62 years (SD: 8.49; range: 48 to 84), respectively. There was no statistically significant difference between these two groups (P=0.208).

Critical ischemia was observed in 76 patients (26.6%) in our study population. Among those with restenosis, 50 patients (48.1%) had critical ischemia, compared to 26 patients (14.3%) in the non-restenosis group. The difference was statistically significant (P<0.001).

A total of 32 patients (11.2%) underwent stent implantation, all of whom underwent procedures in the suprapopliteal region. Among these, 18 patients (17.3%) were in the restenosis group, while 16 patients (8.8%) were in the non-restenosis group. This difference was statistically significant (P=0.027).

The stenosis level at which the procedure was performed was at the suprapatellar level in 204 patients (71.3%), while 82 patients (28.7%) had stenosis at the infrapatellar level. Within the restenosis group, 72 patients (69.2%) presented with stenosis at the suprapatellar level, whereas 132 patients (72.5%) in the non-restenosis group also had stenosis at the suprapatellar region.

A total of 188 patients (67.5%) underwent total and subtotal atherectomy. The number of patients who developed restenosis was 86 (82.7%), compared to 102 (56%) in the non-restenosis group. The difference was statistically significant (P<0.001).

Among the restenosis and non-restenosis groups, no statistically significant differences were observed for pre-procedure neutrophil (pre-NEU), platelet (pre-PLT), and lymphocyte (pre-LYMPH) counts; post-procedure platelet (post-PLT), and lymphocyte (post-LYMPH) counts; or in the pre-NEU/pre-LYMPH (pre NLR) and pre-PLT/pre-LYMPH ratios (Table 1).

LDL levels did not differ significantly between the two groups (P=0.905). Additionally, no statistically significant difference was observed when comparing patients with LDL>134 between the restenosis and non-restenosis groups (P=0.186) (Table 1).

Table 1. Basal demographic, clinical, and biochemical parameters

	All n (286)	Restenosis n=104	No restenosis n=182	P value
Age, mean (SD)	67.1 (8.7)	68.08 (9.22)	66.62 (8.49)	0.208
Smoking, n (%)	168 (58.7)	78 (75)	90 (49.5)	<0.001
DM, n (%)	170 (59.4)	84 (80.8)	86 (47.3)	<0.001
HbA1C, mean (SD)	8.49(1.96)	8.94 (1.97)	8.05 (1.86)	0.002
Hypertension, n (%)	242 (84.6)	102 (98)	140 (76.9)	<0.001
Critical ischemia, n (%)	76 (26.6)	50 (48.1)	26 (14.3)	<0.001
Stent performed, n (%)	32 (11.2)	18 (17.3)	16 (8.8)	0.027
Atherectomy, n (%)	188 (65.7)	86 (82.7)	102 (56)	<0.001
LDL, mean (SD)	119.07 (33.6)	117.5 (27.4)	119.93 (36.68)	0.905
Pre-NEU, mean (SD)	5.84 (2.27)	5.85 (2.05)	5.84 (2.4)	0.605
Pre-PLT, mean (SD)	257 (85.2)	254 (98.8)	258 (76.5)	0.114
Pre-LYMPH, mean (SD)	2.33 (2.72)	2.05 (0.86)	2.5 (3.35)	0.532
Post-NEU, mean (SD)	5.23 (2.08)	6.14 (2.14)	4.71 (1.87)	<0.001
Post-PLT, mean (SD)	262.4 (90.8)	265 (99.4)	260.9(85.7)	0.542
Post-LYMPH, mean (SD)	2 (0.85)	1.86 (0.62)	2.08 (0.95)	0.503
Pre-NEU/LYMPH, mean (SD)	3.56 (2.97)	3.75 (3.35)	3.46 (2.74)	0.246
Pre-PLT/LYMPH, mean (SD)	150 (117)	162.4 (158.2)	142.95 (86.48)	0.748
Post-NEU/LYMPH, mean (SD)	2.98 (2.06)	3.22 (3.54)	2.84 (2.42)	<0.001
Post- PLT/LYMPH, mean (SD)	160.82 (107)	176.89(103.75)	151.63 (100.4)	0.001

DM: diabetes mellitus, NEU: neutrophil, PLT: platelet, LYMPH: lymphocyt

In the entire patient cohort, the number of patients who were actively smoking was 168 (58.7%). In the group that developed restenosis, this number was 78 (75%), whereas in the group that did not develop restenosis, it was 90 (49.5%). The difference was statistically significant (P<0.001). In the restenosis subgroup, comparisons between smokers and non-smokers revealed no statistically significant differences in NLR or PLR prior to the procedure, with p-values of 0.274 and 0.300, respectively. Post-procedural assessments similarly demonstrated no substantial differences in either parameter between the two groups (p=0.32 for NLR and p=0.543 for PLR) (Table 2).

Table 2. Association of NLR and PLR ratios with DM, HT, and smoking

	Pre-NLR	Pre-PLR	Post-NLR	Post-PLR
DM	0.089	0.142	0.65	0.076
Smoking	0.274	0.3	0.32	0.543
Hypertension	0.97	0.26	0.13	0.098

DM: diabetes mellitus, NLR: neutrophil-to-lymphocyte ratio, PLR: platelet-to-lymphocyte ratio

A total of 170 patients (59.4%) were diagnosed with DM. Among those who developed restenosis, 84 patients (80.8%) had a DM diagnosis, whereas in the group without restenosis, 86 patients (47.3%) were diagnosed with DM. The observed difference between the two groups was statistically significant (P<0.001). Among the 170 patients with diabetes, the mean HbA1c values were 7.62 (SD: 1.91) for those who developed restenosis and 9.23 (SD: 1.88) for those who did not. A statistically significant difference was observed (P<0.001). In the ROC curve analysis (AUC: 0.731) for patients with diabetes mellitus, a cutoff value of

8.45 predicted restenosis with a sensitivity of 73.8%, a specificity of 72.1%, a positive predictive value (PPV) of 72.09%, a negative predictive value (NPV) of 73.81%, and an overall accuracy of 72.94% (Figure 1). In patients who developed restenosis, a comparison between those with and without a diagnosis of DM revealed no statistically significant differences in pre-procedural NLR and PLR, with p-values of 0.089 and 0.142, respectively. Similarly, post-procedural NLR and PLR values did not differ significantly between the two groups, with corresponding p-values of 0.65 and 0.076 respectively (Table 2).

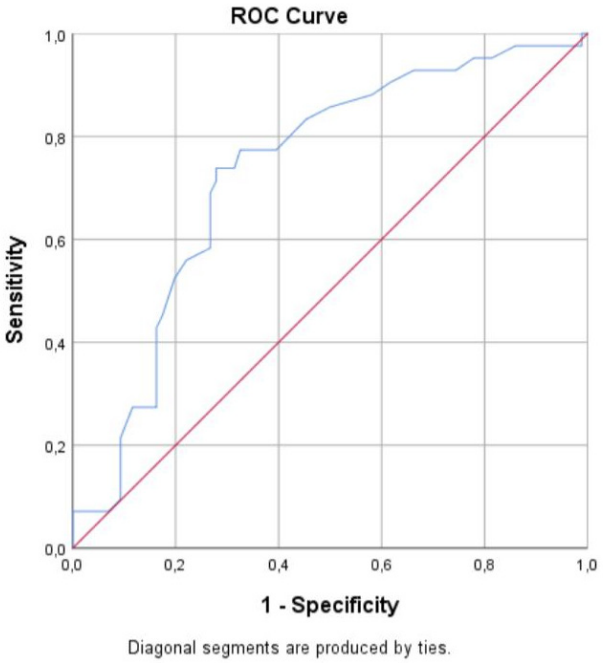

Figure 1. ROC curve for HbA1c among 170 patients with DM, AUC=0.731

Hypertension was diagnosed in 84.6% of the patients in our study. Within the group that developed restenosis, the prevalence of hypertension was 98%, while it was 76.1% in the group that did not develop restenosis. This difference was statistically significant (P<0.001). Among patients who experienced restenosis, the presence of hypertension was not associated with significant variations in baseline pre-procedural NLR or PLR; the p-values were calculated as 0.97 and 0.26, respectively. Post-procedural evaluations likewise demonstrated no meaningful differences in NLR and PLR between hypertensive and non-hypertensive individuals, with p-values of 0.13 and 0.098 (Table 2).

The mean post-NEU/post-LYMPH ratio (post-NLR) was 3.22 (SD: 3.54) in the restenosis group and 2.84 (SD: 2.42) in the non-restenosis group (P<0.001) (Table 1). In the ROC curve analysis (AUC=0.7), a cutoff value of 2.5157 yielded a sensitivity of 70.2%, specificity of 64.3%, positive predictive value of 52.9%, negative predictive value of 79.1%, and an overall accuracy of 66.4% (Figure 2).

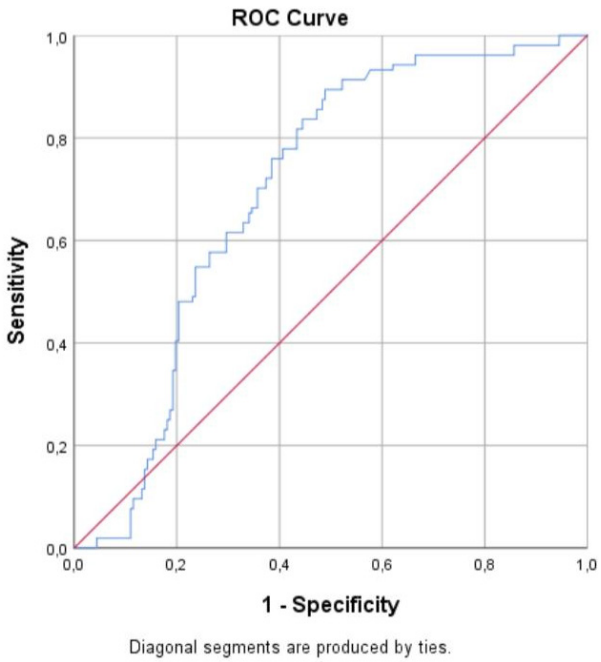

Figure 2. ROC curve for postNLR ratio, AUC=0.7

The mean post-PLT/LYMPH ratio was 164.4 (SD: 117.6) in the restenosis group and 151.8 (SD: 100.4) in the non-restenosis group (P=0.001) (Table 1). In the ROC curve analysis (AUC=0.615), a cutoff value of 131.86 yielded a sensitivity of 64.4%, specificity of 60.4%, positive predictive value of 52.9%, negative predictive value of 74.8%, and an overall accuracy of 61.8% (Figure 3).

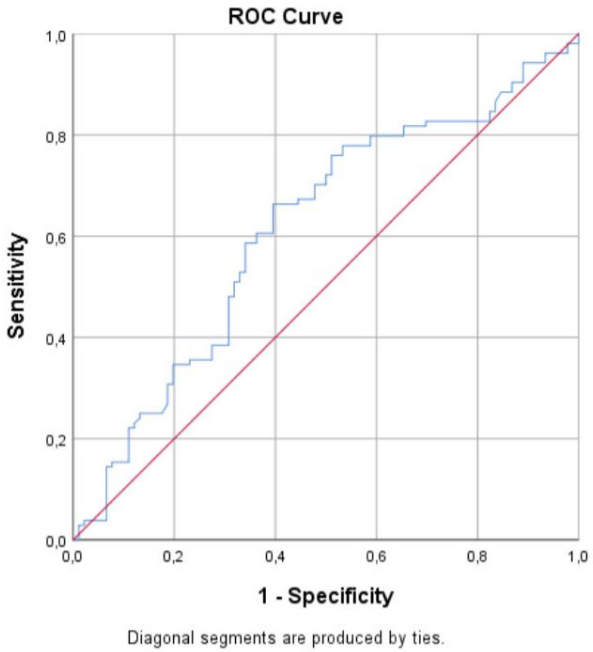

Figure 3. ROC curve for postPLR ratio, AUC=0.615

When patients were classified into three groups according to the TASC classification, no statistically significant differences were observed in pre-procedural NLR and PLR values among the groups (p=0.08 and 0.620, respectively). Post-procedural NLR values differed significantly between the groups (p=0.039). Post hoc analysis revealed that the significant difference was between group A and group C (p=0.025). No significant difference was found in post-procedural PLR values (p=0.339). Based on the TASC II classification, 124 patients (43.4%) were categorized as Group A, 126 (44.1%) as Group B, and 36 (12.6%) as Group C out of a total of 286 patients. The distribution of TASC II categories differed significantly between the groups (p=0.003).

DISCUSSION

Inflammation is known to play a significant role in the recurrence of conditions following angioplasty. Among the inflammation indicators, NLR and PLR are cheap and easily accessible markers [9]. They have stated as an effective indicator in terms of prognosis of atherosclerotic cardiovascular diseases [10]. Patients with PAD often experience severe atherosclerosis. After endovascular angioplasty of the arteries, platelet migration and fibrin deposition occur in the vascular bed. Once the acute phase is complete, typically within a few weeks, smooth muscle cell migration takes place, and acute inflammation transitions into chronic inflammation. This is followed by a granulation tissue response. As a result of this process, a neointimal layer forms in the treated artery [11]. In this whole process, Neutrophils can aggravate neointimal hyperplasia due to their effect of increasing inflammation. Lymphocytes can have an effect of suppressing inflammation. This can reduce the risk of intra-arterial stenosis. In this context, the NLR may serve as a clinically effective biomarker [12]. In the study conducted by Pan et al., the NLR was significantly higher in patients who developed restenosis compared to those who did not (3.53 vs. 2.70; p=0.011) [13]. Similarly, our results demonstrated that the NLR was 3.22 in the restenosis, compared to 2.84 in the non-restenosis group (p<0.001). When the NLR was set at a cutoff value of 2.51, it demonstrated a sensitivity of 70.2%, a specificity of 64.3%, a positive predictive value of 52.9%, a negative predictive value of 79.1%, and an overall accuracy of 66.4% in predicting restenosis (Figure 2).

In a study, a statistically significant difference was found between the groups that benefited from the treatment and those that did not, in terms of NLR and PLR values in patients with acute and chronic PAD, prior to starting interventional treatment [14]. In our study, however, we did not observe a significant difference in these values before the procedure. Instead, our findings indicated that both the NLR and the PLR values after the procedure were statistically significant, with p-values of 0.001 for both ratios. These results showed us that the neointimal proliferation process is more closely related to inflammation markers such as NLR and PLR measured after the procedure. In our study, while preoperative PLR was not significantly different between the two groups, postoperative PLR was calculated as 176.89 in the restenosis group and 151.63 in the non-restenosis group. A statistically significant difference was found between the two groups (p=0.001). Based on this, we believe that higher postoperative PLR rates may be associated with restenosis. When the PLR was established at a cutoff value of 131.86, it demonstrated a sensitivity of 64.4%, a specificity of 60.4%, a positive predictive value of 52.9%, a negative predictive value of 74.8%, and an overall accuracy of 61.8% in the prediction of restenosis

Neointimal proliferation after endovascular procedures in vascular diseases has been shown to be closely associated with increased restenosis in diabetic patients [15]. In the study conducted by Singh et al., high blood sugar levels following popliteal and infrapopliteal angioplasty were shown to be closely associated with an increased risk of early restenosis [16].

In our study, the prevalence of DM was significantly higher in the patient group that experienced recurrence. A statistically significant difference was identified in the number of patients diagnosed with DM between restenosis and non-restenosis group.

Lee et al. demonstrated in their study that HGB A1C levels are associated with platelet activation after revascularization. Elevated HGB A1C levels were shown to be closely linked to prothrombotic tendencies through platelet mapping [17]. Similarly, in our study, we observed that the mean HGB A1C levels in the patient group who developed restenosis were significantly higher than in the group who did not

Several studies have indicated that the risk of recurrence may be high following endovascular angioplasty in patients with critical foot ischemia [16,18]. This could be linked to the impact of active inflammation in ulcerative tissue on vascular proliferation. In addition to procedural vascular treatments, inflammation-suppressing therapies may be considered as an option. In our study, the number of patients with critical ischemia in the group that developed recurrence was significantly higher.

In the study conducted by Halbert et al., it was determined that the atherectomy procedure had better early patency results compared to isolated balloon angioplasty. However, they found that recurrence occurred at a higher rate in patients who underwent atherectomy over a period of one year or longer. It was suggested that this might be due to the higher disease burden in the vessels treated with atherectomy compared to those treated with isolated balloon angioplasty [19]. Similar results were observed in our study, where the number of patients who underwent atherectomy in the restenosis group was statistically significantly higher than non-restenosis group (p<0.001). In our study, atherectomy was performed on total or subtotal vascular lesions. We believe that this difference may be related

to the high disease burden and the larger size of the lesions. Additionally, numerous studies have shown that the combined use of atherectomy and balloon angioplasty, particularly in the treatment of heavily calcified lesions, yields promising results for maintaining primary patency [20].

Chiabrando et al. found in their study that infrapatellar lesions resulted in worse clinical outcomes and had higher recurrence rates after intervention in the follow-up and treatment of PAD patients [21]. However, in our study group, we did not observe any difference in recurrence rates after intervention between suprapatellar and infrapatellar lesions

Zhengze et al. demonstrated in their study that the rate of smoking after the procedure was higher in patients who developed stent restenosis following carotid artery stenting. This suggests that smoking may increase the risk of restenosis [6]. Similarly, in our study, we found that the rate of continued smoking was higher in the group that developed restenosis.

In our study, we performed subgroup analyses to evaluate the impact of comorbid conditions such as DM, HT, and smoking on restenosis rates in patients undergoing peripheral angioplasty. Although NLR and PLR were assessed within these subgroups, no statistically significant differences were observed. Interestingly, despite hypertension, diabetes mellitus, and smoking being well-established risk factors for restenosis, our subgroup analyses did not reveal significant differences in NLR and PLR values between affected and unaffected patients. This finding suggests that these systemic inflammatory markers may have limited discriminatory power in high-risk populations with chronic inflammatory states, and therefore, it may represent a novel observation rather than a contradiction of existing evidence.

On the other hand, the TASC classification demonstrated a significant association with restenosis, suggesting that the anatomical complexity and extent of lesions remain critical determinants of post-procedural outcomes. These findings highlight that while inflammatory markers such as NLR and PLR have been proposed as potential predictors of vascular events, their role in restenosis following angioplasty may be limited, particularly when lesion characteristics play a dominant role.

No matter how successful endovascular interventions are in the treatment of PAD, certain predisposing factors may always increase the risk of recurrence. This condition should be considered as part of a chronic, progressive process. For the patient group at high risk of recurrence, implementing closer follow-up after the procedure and adding new-generation anticoagulant therapy to dual antiplatelet treatment, especially in the early period, may be an effective strategy.

Study Limitations

Our study has several limitations. Firstly, as a retrospective analysis, it may have inherent limitations. Secondly, the single-center design may have reduced the statistical power of our findings. To enhance the validity of our results, multicenter and, particularly, prospective studies are warranted.

CONCLUSION

Assessing NLR and PLR levels from blood samples is a straightforward and cost-effective method. The key finding of our study is that elevated NLR and PLR levels in patients following peripheral angioplasty significantly predict restenosis.

Ethics Committee Approval: This retrospective study was discussed at the meeting of the Kartal Koşuyolu Training and Research Hospital ethics committee and approved with the decision number 2024/17/917 on 01.10.2024.

Patient Consent for Publication: All patients included in the study were informed about the subject and their consent was obtained. This information was added to the ethics committee application.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: All authors contributed equally to the article.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

REFERENCES

1. Gheini A, Shakarami A, Namdari P, Namdari M, Pooria A. Frequency of recurrence of peripheral artery disease among angioplasty and stenting patients. Ann Med Surg (Lond). 2021;72:103146.
2. Shamaki GR, Markson F, Soji-Ayoade D, Agwuegbo CC, Bamgbose MO, Tamunoinemi BM. Peripheral artery disease: a comprehensive updated review. Curr Probl Cardiol. 2022;47:101082.
3. Tamtekin B, Gülsen Ersoy G. Our surgical results in popliteal and infrapopliteal artery injuries: 21 cases without amputation. Emerg Med Int. 2024;2024:1721047.
4. Helou B, Bel-Brunon A, Dupont C, et al. Patient-specific finite element simulation of peripheral artery percutaneous transluminal angioplasty to evaluate the procedure outcome without stent implantation. Int J Numer Method Biomed Eng. 2023;39:e3685.
5. Kaya İÇ, Bulut Hİ, Özkan AH. Endovascular treatment for femoro-popliteal artery disease with chronic total occlusions: short-term outcomes in local state hospital. Bull Cardiovasc Acad. 2023;1:12-6.
6. Dai Z, Li R, Zhao N, Han Y, Wang M, Zhang S, et al. Neutrophil to lymphocyte ratio as a predictor of restenosis after angioplasty and stenting for asymptomatic carotid stenosis. Angiology. 2019;70:160-5.

7. Belaj K, Pichler M, Hackl G, Rief P, Eller P, Hafner F, et al. Association of the derived neutrophil–lymphocyte ratio with critical limb ischemia. Angiology. 2016;67:350-4.

8. Gary T, Pichler M, Belaj K, et al. Platelet-to-lymphocyte ratio: a novel marker for critical limb ischemia in peripheral arterial occlusive disease patients. PLoS One. 2013;8:e67688.

9. Joviliano EE, Piccinato CE, Dellalibera-Joviliano R, Moriya T, Évora PRB. Inflammatory markers and restenosis in peripheral percutaneous angioplasty with intravascular stenting: current concepts. Ann Vasc Surg. 2011;25:846-55.

10. Bhat TM, Afari ME, Garcia LA. Neutrophil lymphocyte ratio in peripheral vascular disease: a review. Expert Rev Cardiovasc Ther. 2016;14:871-5.

11. Inoue S, Koyama H, Miyata T, Shigematsu H. Pathogenetic heterogeneity of in-stent lesion formation in human peripheral arterial disease. J Vasc Surg. 2002;35:672-8.

12. Chang Z, Zheng J, Liu Z, Guo Q. The relationship between the neutrophil-lymphocyte ratio and in-stent restenosis in patients with femoropopliteal chronic total occlusions. Angiology. 2018;69:177-82.

13. Pan T, Tian SY, Liu Z, Zhang T, Li C, Ji DH, Wang F. Relationship between neutrophil–lymphocyte ratio and drug-coated balloon restenosis in patients with femoropopliteal arterial disease. Angiology. 2023;74:252-8.

14. Erdoğan SB, Selçuk ÜN, Baştopçu M, Arslanhan G, Çakmak AY, Kuplay H, et al. Critical limb ischemia patients clinically improving with medical treatment have lower neutrophil-to-lymphocyte and platelet-to-lymphocyte ratios. Vascular. 2021;29:920-6.

15. Park SH, Marso SP, Zhou Z, Foroudi F, Topol EJ, Lincoff AM. Neointimal hyperplasia after arterial injury is increased in a rat model of non–insulin-dependent diabetes mellitus. Circulation. 2001;104:815-9.

16. Singh S, Armstrong EJ, Sherif W, Alvandi B, Westin GG, Singh GD, et al. Association of elevated fasting glucose with lower patency and increased major adverse limb events among patients with diabetes undergoing infrapopliteal balloon angioplasty. Vasc Med. 2014;19:307-14.

17. Lee I, Agrawal A, Ghandour S, Suarez S, Patel S, Young E, et al. The influence of diabetes on thrombotic profiles and outcomes on patients with peripheral artery disease. Ann Vasc Surg. 2025;110:246-59.

18. Meloni M, Izzo V, Giurato L, Del Giudice C, Da Ros V, Cervelli V, et al. Recurrence of critical limb ischemia after endovascular intervention in patients with diabetic foot ulcers. Adv Wound Care (New Rochelle). 2018;7:171-6.

19. Bai H, Fereydooni A, Zhuo H, Zhang Y, Tonnessen BH, Guzman RJ, Ochoa Chaar CI. Comparison of atherectomy to balloon angioplasty and stenting for isolated femoropopliteal revascularization. Ann Vasc Surg. 2020;69:261-73.

20. Zia S, Juneja A, Shams S, Faheem B, Shariff MA, Singh K, et al. Contemporary outcomes of infrapopliteal atherectomy with angioplasty versus balloon angioplasty alone for critical limb ischemia. J Vasc Surg. 2020;71:2056-64.

21. Chiabrando JG, Garagoli FD, Abraham Foscolo MM, Corna G, Fleitas MLM, Valle-Raleigh J, et al. Clinical impact of the infrapatellar location in symptomatic peripheral arterial disease patients. Arch Cardiol Mex. 2022;93:318-27.