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Restenosis risk factor and the primary patency rate of arteriovenous fistula after initial percutaneous transluminal angioplasty: a retrospective cohort study

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ABSTRACT

Background: Arteriovenous fistula (AVF) is the optimal vascular access for patients because of its prolonged patency and limited problems. Nevertheless, maintenance is sometimes obstructed by stenosis. This study aimed to determine the factors associated with restenosis and primary patency rate in 12 months after Percutaneous Transluminal Angioplasty (PTA).

Method: A retrospective study of patients who underwent initial PTA between January 2018 and October 2023. The clinical variables, laboratory indicators, and surgical data were observed in this study. The restenosis factors were analyzed by univariate analysis, Cox - Regression test, and Hosmer-Lemeshow test. The Receiver Operating Characteristic (ROC) Analysis identified the cut-off Platelet Count (PC). The primary patency of AVF with restenosis risk was evaluated using the Kaplan-Meier analysis and log-rank test.

Result: A total of 54 patients were included. The Cox proportional hazard model revealed PC ($p=0.004$) was a risk factor for AVF restenosis. The Hosmer-Lemeshow test ($\chi^2 = 11.130$, $p = 0.194$) indicates our logistic regression model fits the data. Analysis of ROC identified a cut-off value of $PC \geq 210.5 \times 10^9/L$ (sensitivity 85.7 %, specificity 46.2%). Primary patency rates of AVF with $PC \geq 210.5 \times 10^9/L$ at 6 and 12 months (64.1% and 35.8%) were lower than those with $PC < 210.5 \times 10^9/L$ (80.0%, 66.6%).

Conclusion: Balloon type (Drug Coated Balloon and Plain Balloon), predilatating balloon, balloon diameter, and inflammatory markers showed no association with restenosis in 12 months after PTA. Platelet Count is statistically significant associated with AVF restenosis, which can predict the primary patency of AVF after initial PTA. It assists physicians in establishing the follow-up schedule and appropriate intervention to prevent HD vascular access failure within 12 months post-PTA.

Keywords: angioplasty, restenosis, platelet, primary patency.

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INTRODUCTION

Worldwide, over 2 million individuals are undergoing dialysis treatment for renal illness.¹ In recent decades, the prevalence of chronic renal disease and the need for kidney replacement therapy have risen considerably.² The global incidence of chronic renal failure is 73.9% across 161 nations.³ The primary approach for Chronic Renal Failure patients receiving Hemodialysis is through an Arteriovenous Fistula (AVF).⁴ Nevertheless, in its subsequent development, the primary cause of AVF failure is neointimal hyperplasia (NIH), which arises from the combined impact of inflammation, hypoxia, and hemodynamic shear stress

on vascular tissue. Despite numerous systemic medicines targeting NIH suppression, none have demonstrated a definitive advantage in achieving this objective.⁵

Patency of AVF is crucial for providing hemodialysis access to patients with Chronic Kidney Disease (CKD). The 1-year functional patency rates were $67\% \pm 2.0\%$ for radial-cephalic arteriovenous fistulas (RCAVFs) and $83\% \pm 2.0\%$ for upper arm arteriovenous fistulas (AVFs).⁶ Percutaneous Transluminal Angioplasty (PTA) is a treatment initiative used to address arteriovenous fistula stenosis.⁷ The risk factor linked to the incidence of restenosis is Diabetes Mellitus (DM).⁸

Age, problems from hypertension, hypoproteinemia, and the kind and location of AVF stenosis were critical for the vascular patency of internal fistulas following PTA.⁹ Several prior studies have yielded conflicting findings about the efficacy of Drug-Coated Balloon (DCB) and Plain Balloons (PB) in reducing the occurrence of restenosis.¹⁰ A separate study showed that the use of Paclitaxel-coated DCB minimized the likelihood of target lesion and circuit patency loss in cases of arteriovenous access stenosis, as compared to PB.¹¹

The restenosis risk can significantly impact the effectiveness of PTA procedures. In addition, there are many

factors related to primary patency after PTA. Otherwise, another study had revealed an inflammatory marker that an elevated level of PLR may be a risk factor for the development of AVF restenosis following effective PTA.¹² We aimed to investigate the determinants of restenosis within 12 months following percutaneous transluminal angioplasty (PTA). The researchers sought to evaluate the risk factors associated with restenosis and the primary patency rate in 12 months after initial percutaneous transluminal angioplasty.

METHODS

Study Design and Population

This retrospective cohort study comprised 54 patients who had forearm or upper arm AVF angioplasty at Abdoel Wahab Sjahranie Hospital, Indonesia, from January 2018 to October 2023, as determined by statistical analysis of patient medical records. Patients undergoing Maintenance Hemodialysis (MHD) and diagnosed with AV fistula stenosis who subsequently underwent the first PTA were monitored until 12 months. They were identified with hemodialysis arteriovenous access restenosis, or planned for further surgery (PTA re-intervention, or Double Lumen Catheter (CDL) insertion with or without AVF ligation, AVF revision, or VA abandonment), or end of study. The factor associated with restenosis will be sought. The patients were selected as the study sample and were divided into 2 groups. Group 1 comprises individuals absence of restenosis in 12 months, while Group 2 consists of patients with restenosis occurring in 12 months after initial PTA. Primary patency denotes the interval between patients receiving PTA and satisfying the criteria for a diagnosis of AVF restenosis or mechanical complications of AVF for a duration beyond 12 months.

Inclusion criteria were: (1) AVF in the upper limb; (2) Patients who underwent first AVF angioplasty at with mature AVF and regular dialysis (1–3 times/week); (3) AVF age more than 6 weeks who underwent 3 or more punctures and successful dialysis; (4) Age of 18 years or older; (5) Clinical signs of failing access for dialysis due to presence of a high-grade

stenosis (high venous pressure during dialysis, loss of thrill or bruit, increased bleeding with prolonged hemostasis after dialysis, decreased blood flow along the dialysis circuit, pulsatility, upper limb swelling, difficult puncture, blood clot and/or recirculation); (6) Preoperative imaging evaluation for the upper limb artery and vein without constriction, calcification, or any other abnormalities to assess for AVF. (7) On Doppler ultrasound examination blood flow < 500 ml/min; (8) Angiographic examination shows stenosis $\geq$ 50% at the anastomose or in the arteriovenous; (9) No sign of AVF failure after PTA.

Exclusion criteria were: (1) peritoneal dialysis, temporary dialysis, or irregular dialysis; (2) Inadequate maturation of the AVF within 12 weeks post-procedure; (3) Arteriovenous synthetic graft; (4) Infection in AVF; (7) Thrombosis in AVF; (8) Allergy or contraindication to heparin, iodine contrast, or paclitaxel; (9) PTA using Cutting Balloon; (10) Incomplete medical record; (11) AVF failed from the beginning post-AVF surgery; (12) Presence of substantial coagulation impairment; (13) Extended use of anticoagulant and antiplatelet medications; (14) Coexisting malignant tumor (15) Lost to follow up include died.

PTA indications

PTA was indicated based on clinical symptoms of AVF dysfunction, combined with vascular ultrasound evaluation. The patients with 1 or more of the following clinical abnormalities: (1) decreased blood flow or aneurysm formation, (2) elevated venous pressure, (3) abnormally high blood urea nitrogen due to recirculation or elevated recirculation rate, (4) unexplained reduction of dialysis efficiency, and (5) an abnormal physical condition. The ultrasound examination : $\geq$ 50% stenosis and $Q_a < 500$ mL/min.^{13,14}

PTA Procedure

Anesthesia for endovascular procedures may be administered either by a brachial plexus block or general anesthesia. Antegrade or retrograde transvenous access was used according to the site of stenosis, according to preprocedural ultrasound. 22-G needle was used to

puncture the proximal part of the vein in a retrograde manner or, when combined with distal radial artery and brachial artery approach, in a prograde manner. A 5- 6-Fr sheath (Terumo, Tokyo, Japan) was inserted into the vessel. Following the administration of 2500 IU of heparin through the sheath. A 0.035-inch guidewire was introduced into the sheath and crossed the stenosis. The predilating balloon, size of the balloon, and balloon type (DCB/PB) were determined by considering the diameter of a healthy vascular segment nearest to the stenosis location and the surgeon's expertise. This procedure used a balloon diameter of 2 - 8 mm. The angioplasty procedure involved inflating a balloon to a pressure of 12-24 atm for 1-3 minutes, repeated at least 3 times.

We defined procedural technical success as a residual stenosis < 30% after PTA. Clinical success is determined by either a normal hemodialysis session following percutaneous intervention or a continuous palpable thrill extending from the arterial anastomosis.¹⁵ Successful procedures will be assessed until restenosis occurs in 12 months after the first PTA.

Follow-up

Patients who have successfully the PTA surgery successfully undergo routine follow-up at the polyclinic one week post-operation and subsequently every month. Incomplete hemodialysis due to hemodialysis access stenosis or clinical indicators, and ultrasound Doppler examination according to the inclusion criteria of restenosis were evaluated. Nonetheless, certain patients in unstable condition were admitted via the emergency room prior to the subsequent control date, and the emergency physician identified indications of AVF stenosis or edema in the hands or arms, accompanied by a history of inadequate or inaccessible hemodialysis.

Loss of primary patency was reported with significant restenosis $\geq$ 50% or post-PTA VA dysfunction, needing further intervention. Access dysfunction was characterized as the presence of a reintervention PTA or access failure.^{15,16} We defined primary patency as continuous patency following the initial PTA until

the subsequent intervention (the interval between first PTA and VA dysfunction, restenosis or until the next intervention in 12 months after initial PTA).

Statistical Methods

Data were analyzed using IBM SPSS Statistics version 29. Descriptive statistics (continuous variables) were presented as means $\pm$ standard deviations, and categorical variables (characteristic variables) as numbers and percentages. The Shapiro test the normality of data distribution - the Wilk test; data were deemed normally distributed when $p \geq 0.05$. Between-group comparisons of other clinical and biochemical variables were conducted using a Chi-square test or Fisher test and a t -test. Kaplan-Meier survival analysis was used to compare primary patency. A log-rank test is used to compare two groups for patency rates. Data following a normal distribution is presented as ($\bar{x} \pm s$), and t -test was employed for statistical analysis between 2 independent samples. Group medians were analyzed using the Mann-Whitney U test. The Factors associated with restenosis were analyzed using the Cox regression test. The Hosmer-Lemeshow test was employed to assess the validity of the regression model for risk factors related to restenosis in this investigation, confirming the logistic regression model as fit. The Receiver Operating Characteristic (ROC) Curve Analysis identified the sensitivity and specificity of Platelet Count in predicting restenosis in 12 months after PTA. All p -values were two-sided, and $p < 0.05$ was considered statistically significant.

RESULTS

A total of 54 patients (40 males and 24 females) with a mean age of 50.39 ± 10.210 years underwent maintenance Hemodialysis and PTA procedure. At the same time, 37 were excluded due to failure of follow-up (Figure 1). During the observation period, while 26 patients had good condition of AVF, 17 patients underwent a second PTA, 6 underwent AVF reconstruction, 1 underwent repair of pseudoaneurysm, and 4 underwent CDL insertion.

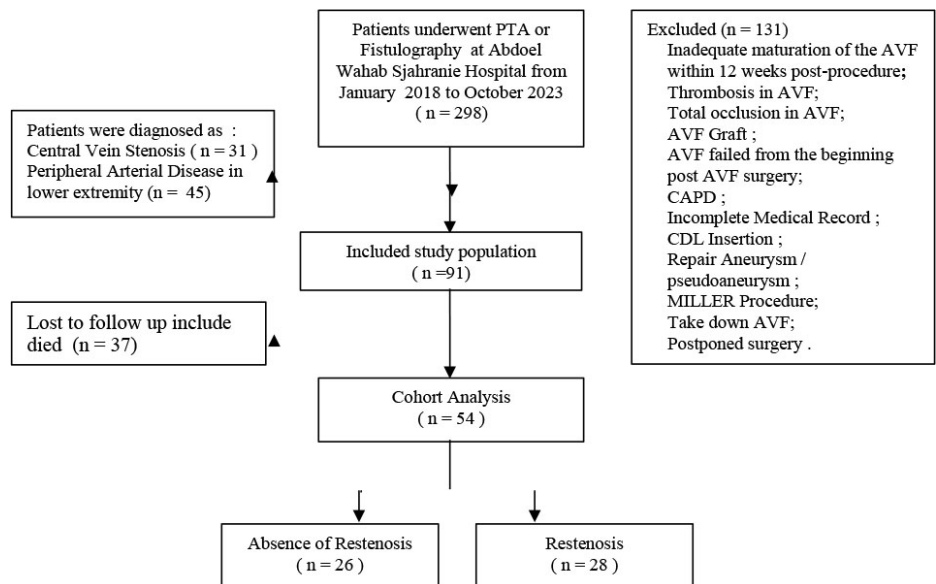


Figure 1. Study's flow chart.

Univariate analysis

The categorical and continuous variables related to restenosis 12 months post-PTA (Tables 1 and 2). Group 1 comprised patients without restenosis, while Group 2 included patients with restenosis 12 months post-PTA. The significance level for all comparisons was 0.05. This enabled us to ascertain the factors associated with PTA restenosis in 12 months post-PTA.

The mean time primary patency rate for restenosis was 5.18 ± 2.342 months after initial PTA. The mean age of patients who experienced restenosis in 12 months was 50.39 ± 10.210 , and the median BMI value was 20.4 (18.06, 24.53). There were 28 (100.0%) patients who experienced restenosis within 12 months after PTA. Table 1 shows no statistically significant differences regarding balloon diameter (≤ 5 mm and > 5 mm) during PTA ($p=0.280$), predilating balloon ($p=0.847$), residual stenosis ($p=0.509$), and the occurrence of restenosis in 12 months post-PTA in this investigation. The balloon type (PB or DCB) employed did not exhibit a significant difference in the incidence of restenosis according to either univariate analysis or log-rank test ($p>0.05$). HPR exhibited a substantial difference at less than 12 months post-PTA ($p=0.015$). Additional factors that showed significant differences included CAD ($p=0.026$), the number of stenoses ($p < 0.001$), stenosis location ($p=0.007$), platelet count ($p=0.030$), and Potassium ($p = 0.049$).

Multivariate Analysis

Factors with a p -value < 0.05 in this study and balloon type were then included in multivariate analysis using the Cox proportional hazard model. This model is to assess the association between variables and the endpoint event (restenosis in 12 months post-PTA). There were 7 candidate cofounding variables that will be further analyzed in multivariate analysis to be a predictive factor for AVF restenosis in 12 months after PTA.

Multivariate analysis revealed CAD (HR = 0.480, 95% CI: 0.196-1.174, $p = 0.108$), platelet count (HR = 1.014, 95% CI: 1.004-1.024, $p=0.004$), HPR (HR = 24.086, 95% CI: 0.489-1187.145, $p=0.110$), Potassium (HR = 1.253, 95% CI: 0.861- 1.824, $p=0.238$), number of stenoses (HR = 0.594, 95% CI: 0.054 - 6.547, $p=0.670$), stenosis location (HR = 1.722, 95% CI: 0.785-3.777, $p=0.175$), and balloon type (HR = 0.499, 95% CI: 0.146-1.707, $p=0.268$). In this study, platelet count was found to be a significant restenosis risk within 12 months (Table 3). Balloon type was not associated with restenosis risk. The Hosmer-Lemeshow test showed the predicted incidence rate of AVF restenosis and the actual probability of occurrence ($\chi^2 = 11.130$, $p = 0.194$) and p -value > 0.05 . Furthermore, ROC analysis was used to determine the cut-off value for platelet count significantly associated with restenosis at Radial-cephalic and Brachial-cephalic AVF (juxta-anastomosis, draining

Table 1. Characteristic variables associated the absence of restenosis and with restenosis in 12 months of undergoing PTA

Variables [n (%)]	Absence of Restenosis (n = 26)	Restenosis (n = 28)	p
Sex :			
Male	9(45.0%)	11 (55.0%)	0.723
Female	17 (50.0%)	17 (50.0%)	
HD Frequency :			0.569
1 time per week	2 (40.0%)	3 (60.0 %)	
2 times per week	24 (50.0%)	24 (50.0%)	
3 times per week	0 (0.0%)	1 (100.0%)	
DM	13 (48.1%)	14 (51.9 %)	1.000
HT	24 (46.2 %)	28 (53.8 %)	0.227*
PAD	3 (100%)	0 (0.0%)	0.105*
Antiplatelet	3 (42.9%)	4 (57.1%)	1.000*
Congestive Heart Failure	4 (66.7%)	2 (33.3%)	0.413*
CAD	2 (18.2%)	9 (81.8%)	0.026
Other Disease	11 (52.4 %)	10 (47.6%)	0.619
Thrill	25 (49.0%)	26 (51.0%)	1.000*
Bruit	25 (48.1%)	27 (51.9%)	1.000*
Extremity oedema	4 (44.4 %)	5 (55.6%)	0.549
AVF Type :			0.637
Radial-cephalic	19 (46.3%)	22 (53.7%)	
Brachial-cephalic	7 (53.8%)	6 (46.2%)	
AVF Side :			0.706*
Right	3 (37.5%)	5 (62.5%)	
Left	23 (50.0%)	23 (50.0%)	
Number of Stenoses :			<0.001
1	21 (67.7%)	10 (32.3%)	
> 1	5 (21.7%)	18 (78.3%)	
Stenosis Location :			0.007
Type I (juxta-anastomotic region)	10 (83.3%)	2 (16.7%)	
Type II (draining vein area)	6 (60.0%)	4 (40.0%)	
Type III (general-axillary vein and cephalic arch)	4 (50.0%)	4 (50.0%)	
Type IV (inflow artery)	1 (100.0%)	0 (0.0%)	
> 1 stenosis location	5 (21.7 %)	18 (78.3 %)	
Balloon Diameter			0.280
≤ 5 mm	17 (43.6%)	22 (56.4%)	
> 5 mm	9 (60.0%)	6 (40.0%)	
Predilating Balloon	9 (50.0%)	9 (50.0%)	0.847
Residual stenosis			0.509*
≤ 15 %	24 (47.1%)	27 (52.9%)	
> 15 %	2 (66.7%)	1 (33.3%)	
Balloon Type :			0.406
PB	20 (45.5%)	24 (54.5%)	
DCB	6 (60.0%)	4 (40.0%)	

Chi-Square and Fisher's exact (*) data are expressed as n (%) in table 1

vein, outflow excluding central vein, and inflow locations) in 12 months after PTA.

The area under the curve (AUC) of this model showed that PC had a significant ($p = 0.020$) AUC value of 0.672 (95% CI, 0.527 - 0.816). Furthermore, Youden Index ($p = 0.319$) determined the PC cut-off value $\geq 210.5 \times 10^9/L$, sensitivity of

85.7 %, and specificity of 46.2% (Figure 2). The Kaplan-Meier survival curves were later assessed for risk variables and primary patency rate. Survival Kaplan Meier analysis of high and low platelet count based on intervention (PTA, DCB, and PB) are shown figures 3, 4, 5.

DISCUSSION

Stenosis often leads to AVF malfunction and necessitates many percutaneous transluminal balloon angioplasties to restore patency.¹⁶ Understanding the risk factors associated with restenosis is crucial. This study investigated the risk

Table 2. Continuous variables associated with the absence of restenosis and with restenosis in 12 months of undergoing PTA

Variables	Absence of Restenosis (n = 26)	With Restenosis (n = 28)	p
Age (year)	52.15 ± 11.495	50.39 ± 10.210	0.554
BMI (kg/m ²)	21.09 (19.420, 23.890)	20.400 (18.060, 24.535)	0.788*
Systolic (mmHg)	172.00 (160.00, 200.00)	190.00 (160.50, 200.00)	0.472*
Diastolic (mmHg)	92.08 ± 14.653	90.50 ± 14.307	0.691
Hb (g/L)	100.00 (91.00, 104.00)	88.00 (84.50, 100.50)	0.095*
Leucocyte (/uL)	7.034 ± 1.582	7.631 ± 2.311	0.277
Platelet (x10 ⁹ /L)	232.96 ± 71.585	283.18 ± 91.330	0.030
MPV	9.527 ± 1.055	9.146 ± 0.957	0.171
P-LCR	22.390 ± 8.117	19.821 ± 5.597	0.179
PCT (%)	0.224 ± 0.081	0.257 ± 0.075	0.121
Neutrophile	4.400 (3.900, 5.100)	5.000 (4.000, 5.750)	0.179*
Lymphocyte	1.458 ± 0.586	1.518 ± 0.539	0.693
Monocyte	0.420 (0.360, 0.630)	0.470 (0.340, 0.645)	0.690*
Eosinophile	0.300 (0.190, 0.440)	0.240 (0.145, 0.480)	0.478*
MLR	0.352 (0.258, 4.587)	3.474 (0.338, 8.502)	0.107*
HPR	0.457 (0.3208, 0.545)	0.292 (0.257, 0.425)	0.015*
PLR	182.750 (112.670, 219.100)	194.840 (162.100, 229.520)	0.226*
NLR	3.333 (2.113, 4.672)	3.049 (2.590, 4.382)	0.808*
ESR (mm/hour)	52.13 ± 22.628	46.79 ± 25.747	0.434
Blood Glucose (mg / dL)	134.00 (105.00, 226.00)	128.00 (94.00, 187.00)	0.337*
Albumin (g/dl)	3.892 ± 0.4924	3.979 ± 0.560	0.555
Urea (mg / dl)	114.364 ± 49.550	129.854 ± 51.883	0.273
Creatinine (mg / dl)	8.040 ± 3.068	9.121 ± 2.925	0.195
APTT	31.492 ± 3.250	32.130 ± 3.134	0.475
PT	14.144 ± 1.247	14.259 ± 1.151	0.730
INR	1.146 ± 0.129	1.1663 ± 0.125	0.569
Na (mmol/L)	136.68 ± 3.375	135.22 ± 3.262	0.120
K (mmol/L)	4.100 (4.000, 4.600)	4.800 (4.050, 5.400)	0.049*
Cl (mmol/L)	100.96 ± 3.910	101.22 ± 4.060	0.814
Balloon Diameter (mm)	5.00 (5.00, 6.00)	5.00 (4.00, 5.00)	0.088*

Student's t-test showed mean ± standard deviation, and Mann-Whitney (*) revealed median (interquartile range) in Table 2

Table 3. Cox analysis of variables associated with restenosis in 12 months after PTA

Variables	p	β	SE	HR Exp(B)	OR (95.0% CI)
CAD	0.108	-0.735	0.457	0.480	0.196-1.174
Platelet (10 ⁹ /L)	0.004	0.14	0.005	1.014	1.004-1.024
HPR Value	0.110	3.182	1.989	24.086	0.489-1187.145
Potassium	0.238	0.226	0.191	1.253	0.861- 1.824
Number of Stenosis	0.670	-0.521	1.225	0.594	0.054 - 6.547
Stenosis Location	0.175	0.543	0.401	1.722	0.785-3.777
Balloon Type	0.268	-0.695	0.627	0.499	0.146-1.707

variables for restenosis developing within 12 months after PTA.

Female patients exhibited a higher incidence of restenosis compared to male patients, with rates of 60.7% and 39.3% respectively. This retrospective study examined medical records of 54 patients who met the inclusion criteria

and identified factors associated with AVF restenosis in 12 months post-PTA: Coronary Arterial Disease (CAD), number of stenoses, stenosis location, hemoglobin to platelet ratio (HPR), platelet count, potassium, balloon type. Other study revealed DCB group had a higher first-stage patency rate of the target

lesion.¹⁸ The balloon diameter in this study showed no significant difference between the two groups (p=0.280) according to previous investigations.^{17,18} Inflammation propels coronary artery disease. Recent studies have demonstrated a correlation between increased inflammatory marker levels and the severity of

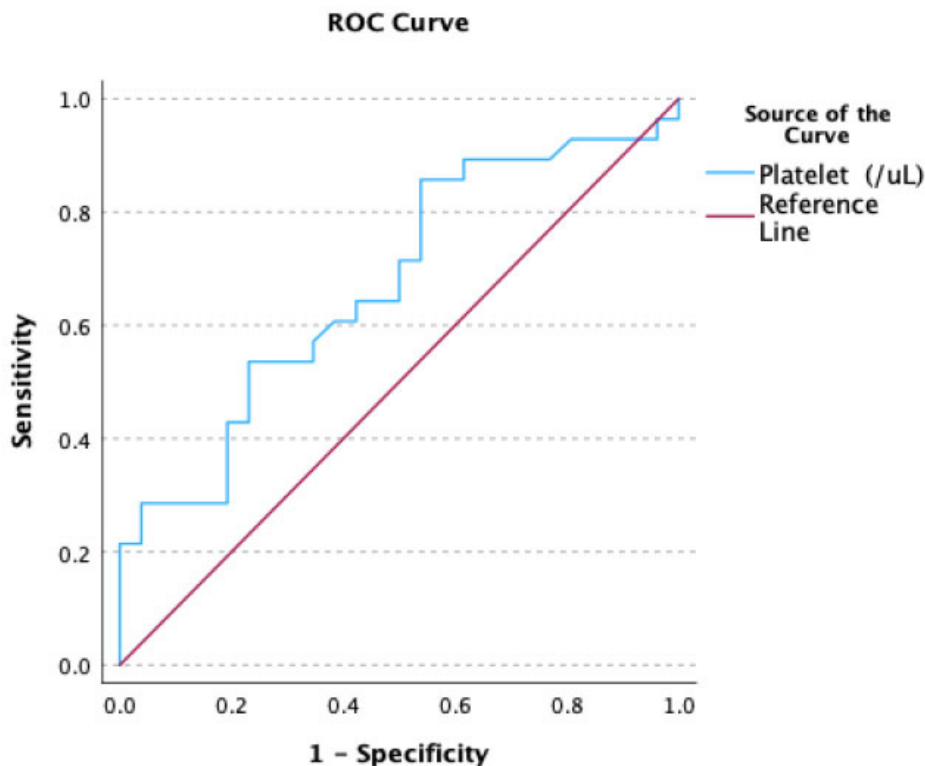


Figure 2. The ROC curve illustrates the sensitivity and specificity of the platelet count cut-off value, which will subsequently be evaluated using the Youden Index.

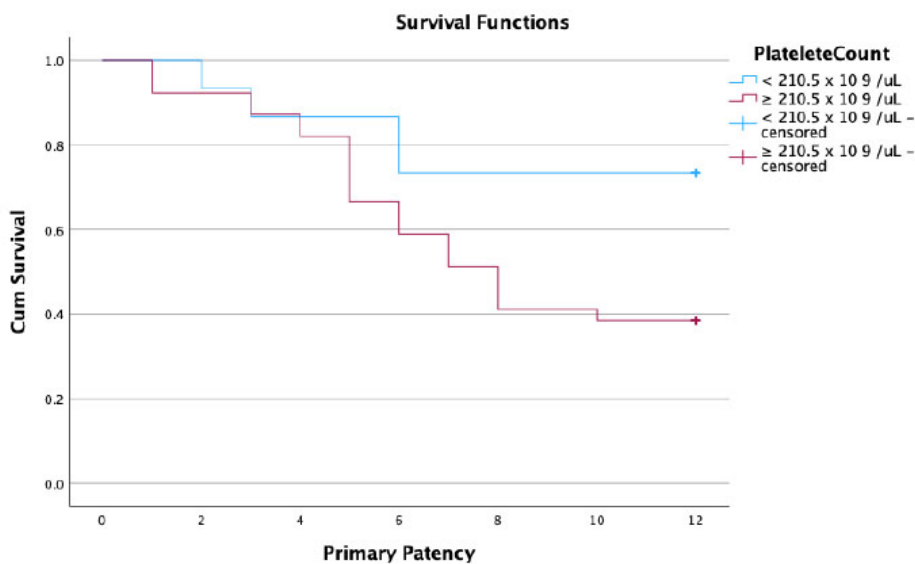


Figure 3. Kaplan Meier survival curve for patency within 12 months after PTA, stratified by PC. The primary patency rates of PC $\geq 210.5 \times 10^9/L$ at 3, 6, 9 and 12 months were 89.7%, 64.1%, 38.4 %, dan 35.8 %. The primary patency of PC $< 210.5 \times 10^9/L$ at 3, 6, 9 and 12 months were 86.6%, 80 %, 66.6%, 66.6%.

CAD.¹⁹ Hyperhomocysteinemia (Hhcy), associated with cardiovascular disorders, has been shown to promote vascular calcification.²⁰ We investigated the correlation between CAD and the occurrence of AV fistula restenosis (p=0.026) and its relationship to the incidence of restenosis. Endothelial damage, modified blood flow, and shear stress stimulate myofibroblasts, fibroblasts, and immune cells, accompanied by an elevation in pro-

inflammatory cytokines and growth factors, facilitating the proliferation and migration of smooth muscle cells (SMCs) to the intimal layer. Platelet activation during endothelial injury stimulates pro-inflammatory cytokines, including tumor necrosis factor- α , which can mediate the proliferation and migration of smooth muscle cells.²¹

Chronic inflammation is a primary contributor to vascular ageing and calcification in chronic kidney disease, whereas vascular stiffness and endothelial cell dysfunction elevate the risk of thrombosis.²² Elevated pressure and shear stress in oxygen-rich environments cause outward remodeling, facilitated by vascular smooth muscle cell proliferation and immunoregulatory mechanisms, while excessive inward remodeling occurs through endothelial cells. Post-AVF surgery, endothelial cells undergo endothelial-mesenchymal transition, causing neointima development and inflammatory mediators.²³ Additional research has examined several inflammatory markers associated with vascular disease.^{24,25,26} Inflammatory markers (Table 2), including MLR, PLR, and NLR were not significant in this investigation.

Hemoglobin and platelets are associated with cardiovascular disease.^{27,28} We attempted to ascertain the correlation between HPR and the occurrence of AVF stenosis. In univariate analysis, HPR exhibited a significant difference between the two groups in this study (p=0.015), however, multivariate analysis revealed no significant difference. AVF stenosis was previously classified into four kinds according to the lesion's location.²⁹ In this study, one patient had many stenosis locations, prompting us to categorize them into five distinct types. The analytical findings indicated a correlation between the site of stenosis and the incidence of AVF restenosis within 12 months after PTA. The Hosmer-Lemeshow test was employed to evaluate the 7 candidate variable regression model that was subsequently subjected to multivariate analysis for risk factors associated with restenosis in this study ($\chi^2 = 11.130$, p = 0.194). A p-value > 0.05 indicates that the model has passed the Hosmer-Lemeshow

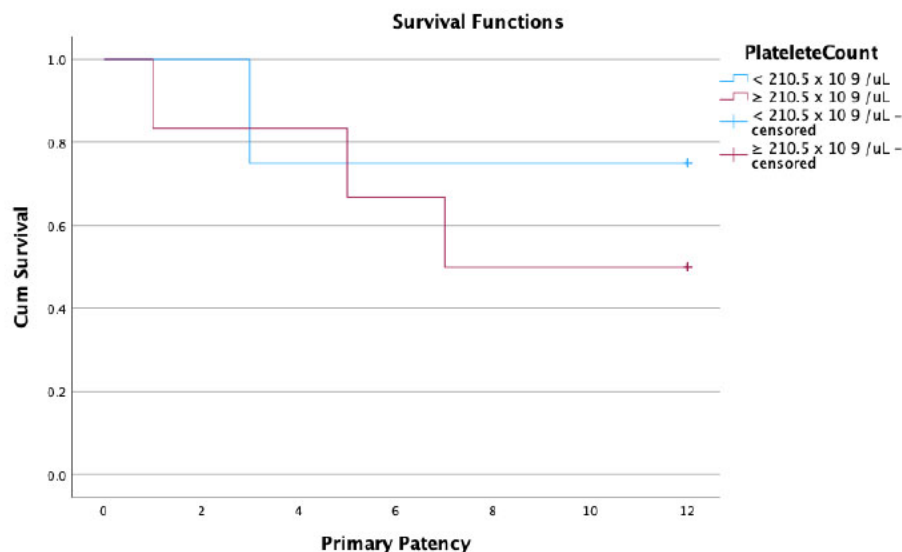


Figure 4. Kaplan Meier survival curve for patency of DCB within 12 months after PTA, stratified by PC. The primary patency rates of PC $\geq 210.5 \times 10^9/L$ at 3 and 12 were 66.6% and 33.3 %. The primary patency of PC $< 210.5 \times 10^9/L$ at 3 and 12 were 75 % and 50 %.

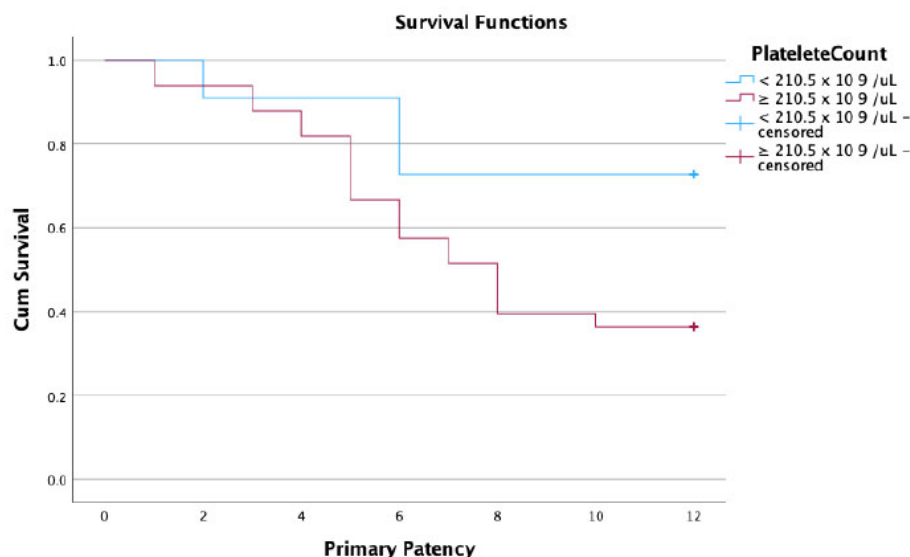


Figure 5. Kaplan Meier survival curve for patency of PB within 12 months after PTA, stratified by PC. The primary patency rates of PC $\geq 210.5 \times 10^9/L$ at 3, 6, 9 and 12 were 90.9 %, 63.63%, and 36.3 %, 33.3%. The primary patency of PC $< 210.5 \times 10^9/L$ at 3, 6, 9, and 12 were 90%, 81.8%, 63.6%, 63.6%.

test, demonstrating that our logistic regression model fits the data well. The Cox proportional hazard model (multivariable analysis) revealed that PC was a risk factor for AVF restenosis in 12 months after PTA. ROC analysis identified a cut-off value of PC $\geq 210.5 \times 10^9/L$ ($p=0.02$, sensitivity 85.7%, specificity 46.2%). Primary patency of AVF within 12 months after PTA using DC or PB with PC $\geq 210.5 \times 10^9/L$ is lower than the primary patency with PC $< 210.5 \times 10^9/L$.

This research has several limitations. This report was derived from a retrospective cohort analysis conducted at a single center. This study identified risk variables associated with the site of stenosis, excluding the central vein, necessitating adjustments based on the stenosis location identified during evaluation. Impose additional limits, including the exclusion of no thrombosis and total occlusion, which may impede clinical practice. Additionally, alternative

interventions such as cutting balloon therapy or AVF reconstruction should be considered if hemodialysis vascular access is feasible for AVF reconstruction. However, prior research has not assessed platelet counts in relation to the incidence of restenosis 12 months following PTA. Future study is anticipated to identify predictors of restenosis in DCB and PB in more significant cohorts, as well as to investigate more advanced vascular surgical interventions to enhance AVF patency duration.

CONCLUSION

Our study found no significant association between balloon type ($P=0.406$), balloon diameter ($p=0.280$), predilating balloon ($p=0.847$), inflammatory markers, and restenosis in 12 months after PTA. Platelet count is significantly associated with restenosis of RCAVFs and BCAVFs in 12 months after PTA (HR=1.014, 95% CI: 1.004-1.024, $p=0.004$). The cut-off value of PC $\geq 210.5 \times 10^9/L$. Primary patency of AVF in 12 months after PTA with PC $\geq 210.5 \times 10^9/L$ (35.8 %) is lower than the primary patency with PC $< 210.5 \times 10^9/L$ (66.6%). Physicians may consider this factor to anticipate the likelihood of restenosis in patients who have undergone PTA. Physicians can establish an examination schedule and a subsequent action plan for the potential management of restenosis within 12 months, thereby preventing vascular access failure during maintenance hemodialysis (MHD) and hemodynamic instability if MHD is compromised, ultimately enhancing the patient's quality of life. Platelet variables in the inflammatory cascade that affect AVF restenosis in this study can contribute to the future intervention development of AVF patency.

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Collaborators

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Contributors

The original research manuscript was created and written by the authors. The final manuscript has been read and approved by the author.

Ethical consideration

This study was approved by the Health Research Ethics Commission at Abdoel Wahab Sjahranie Hospital (ethics approval number: 528/KEPK-AWS/VIII/2023).

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