Journal of Radiology Medicine in

Original Article

Doi: 10.51271/JRM-0017

Doppler findings before and after endovascular treatment in peripheral artery disease

Yunus Yılmazsoy, Samet Genez, Hamza Özer, Sümeyra Nur Atasoy

Department of Radiology, Faculty of Medicine, Bolu Abant İzzet Baysal University, Bolu, Turkiye

Received: 30.09.2024 ◆ **Accepted**: 17.10.2024 ◆ **Published**: 30.10.2024

Cite this article: Yılmazsoy Y, Genez S, Özer H, Atasoy SN. Doppler findings before and after endovascular treatment in peripheral artery disease. *J Radiol Med.* 2024;1(4):65-68.

Corresponding Author: Yunus Yılmazsoy, yunusyilmazsoy@gmail.com

ABSTRACT

Aims: Peripheral arterial disease is a significant health problem affecting approximately 50 million people in the United States and Europe, which can lead to disability, limb loss, and poor quality of life. This is the main cause of significant morbidity and mortality. In this study, we aimed to share our early Doppler findings in patients who underwent endovascular procedures in our clinic.

Methods: The radiological findings of 9 patients who applied to our clinic and treated with endovascular interventional methods in the last 6 months were evaluated retrospectively and the results were analyzed with descriptive statistical methods.

Results: Patients with peripheral arterial occlusion or sever stenosis treated with endovascular treatment showed significant increase in lower extremity arterial flow evaluated by color Doppler ultrasound regardless of endovascular technique.

Conclusion: Doppler ultrasonography is a useful technique showing increase of the flow dynamics before and after the successful endovascular treatment procedure of lower extremity peripheral arterial disease are a method that provides useful data to predict outcome of the patients.

Keywords: Peripheral arterial disease, Doppler ultrasound, endovascular treatment

INTRODUCTION

Peripheral artery disease is a significant health problem affecting approximately 50 million people in the United States and Europe, leading to disability, limb loss, and diminished quality of life.[1] It predominantly affects individuals over 50 years of age, with incidence increasing with age.

Risk factors for PAD include advanced age, male gender, obesity, sedentary lifestyle, hyperlipidemia, low HDL levels, hypertension, smoking, diabetes mellitus, coronary artery disease, renal failure, elevated fibrinogen levels, hypercoagulability, hyperhomocysteinemia, elevated CRP levels, and family history of cardiovascular disease, which are typical of atherosclerotic diseases.[2-4]

Atherosclerosis is a systemic disease closely associated with cardiovascular and cerebrovascular diseases.[5,6] The prevalence of cardiovascular disease in patients with peripheral artery disease is 2-3 times higher, contributing significantly to morbidity and mortality.[7]

Many patients with PAD are asymptomatic. Intermittent claudication is the most common symptom in symptomatic cases, and more severe cases may involve tissue loss.[8]

Treatment options for peripheral artery disease include endovascular procedures such as balloon angioplasty, stenting, plaque aspiration, thrombolysis, percutaneous thrombectomy, as well as surgical methods like autogenous-synthetic bypasses and endarterectomy.[9] With advancements in technique and technology, endovascular procedures are increasingly preferred over open vascular bypass surgery.

Literature discusses the advantages and disadvantages of endovascular techniques. Advantages include less invasiveness, low complication rates, shorter hospital stays, and lower costs, while disadvantages include less suitability for long segment lesions and disease recurrence.[10]

In this study, we aimed to share our Doppler findings before and after endovascular procedures of patients with lower limb ischemia.

METHODS

After the local ethic committee approval was taken (Date: 07.11.2023, Decision No: 2023/383) response of the patients with lower limb ischemia accepted to the procedure with

decreased walking distance measured by Doppler ultrasound were evaluated retrospectively.[11,12] Patients with puncture site infection, sepsis and patients with complication such as hematoma due to perforation were excluded from study. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Before the procedure, distal flows were measured and recorded with Doppler ultrasound which is evaluated by 5 year experienced radiology expert. (**Figure 1**). Patient positioned with supine position and main femoral artery, superficial femoral artery, popliteal artery , anterior tibial artery and posterior tibial artery evaluated respectively.

In addition, the vessel in which the patient's occlusive plaque was located and the endovascular method with which it was treated were noted.

After the patients were taken to the angiography suit, antegrade or retrograde access was made from the femoral artery according to the vessel where the stenosis-occlusion was located by an interventional radiologist with 10 year experience. In addition, brachial artery access was made in iliac occlusions. After the occlusion was passed with catheter and wire manipulation, balloon dilatation was applied. In cases accompanied by intimal flap or residual stenosis, stenting was performed. The procedure was terminated after control angiography images were obtained. The patients were kept under observation for 6 hours. After 6 hours, control USG and Doppler findings were recorded. If there were no complications, the patient was discharged. Demographic data of the patients were analyzed using descriptive statistics. Flow rates before and after the procedure were analyzed using the Student's t test. P value <0.05 was considered significant. SPSS ver. 24 (IBM corp. Armonk, NY, USA) program was used for statistical analysis.

RESULTS

The data of 9 patients with pre-procedure and Doppler findings were evaluated retrospectively. The demographic data of the patients are summarized in **Table 1**.

The average Rutherford category of the patients was 3.

Five patients had total superficial femoral artery (SFA) occlusion, three patients had total iliac artery occlusion, and one patient had distal abdominal aorta and both iliac branches occlusion.

Table 1. The demographic data of the patients

	Male	Female
Age	62.8	86.5
Smoking *	27.7	13
Comorbid disease		
Diabetes	3	0
Hypertension	2	2
COPD	1	1
Rutherford class	3	4

COPD: Chronic Obstructive Pulmonary Disease; *** :** Box per year

Regardless of the examination and method used, a significant increase was detected in distal blood flow measurements after the procedure. Doppler USG findings are summarized in **Table 2**.

While stenting was performed in 4 of the patients, only balloon dilatation was performed in the remaining 5 patients (**Figure 2**).

Table 2. Doppler findings of the patients

		Before procedure	After procedure	*P value
Pic-systolic velocity (cm/sec)	CFA	53.2	127.4	0.001
	SFA	15.2	75.8	
	Popliteal	16.8	65	
	ATA	10.4	45.4	
	ATP	10.7	30.5	
End-diastolic velocity(cm/sec)	CFA	11.4	21.4	0.001
	SFA	3.8	15.2	
	Popliteal	5.4	17.3	
	ATA	3.2	14.6	
	ATP	3.7	8.7	

* Student t test was used; CFA: Common Femoral Artery; SFA: Superficial Femoral Artery; ATA: Arteria Tibialis Anterior; ATP: Arteria Tibialis Posterior

DISCUSSION

In this study, we evaluated Doppler ultrasonography findings before and after endovascular treatment in patients with peripheral arterial disease (PAH). The findings show that endovascular interventions have significant positive effects on hemodynamic parameters. In most patients before treatment, arterial flow velocity and peripheral resistance values were significantly impaired due to disease progression. Significant improvements were observed in these values after treatment.

Doppler ultrasonography is an effective method to non-invasively evaluate changes in vessels in PAH. Previous studies have also shown similar findings; for example, Normahani et al.[13] (2021) reported an increase in flow velocity and improvement in vascular permeability after endovascular treatment. In line with this study, our findings also reveal that

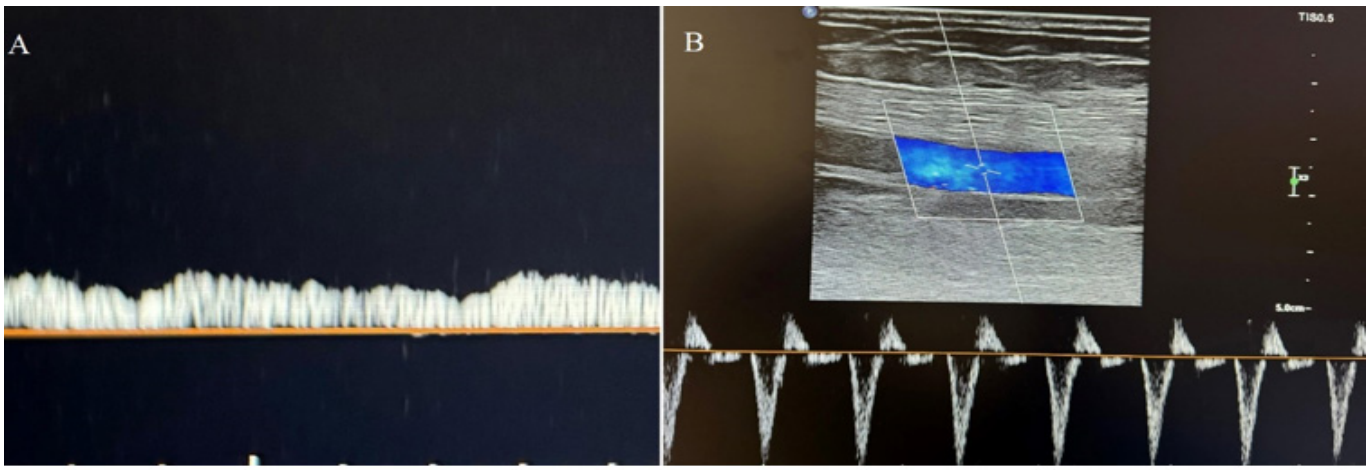

Figure 1. Monophasic flow pattern in the ipsilateral SFA due to iliac artery occlusion (A), and normal triphasic flow pattern is observed after endovascular treatment (B).

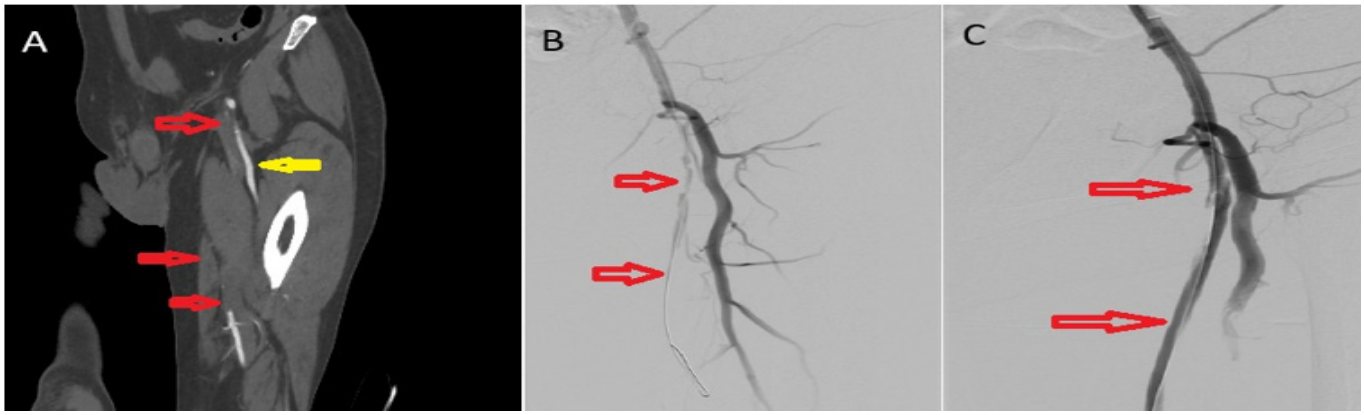

Figure 2. Occluded SFA (red arrow) and deep femoral artery (yellow arrow) without filling are observed in coronal reformatted tomography section (A), angiographic image of SFA occlusion (B), Flow is observed to be restored after balloon dilatation of the occlusion (red arrow) (C).

Doppler ultrasonography plays an important role in the treatment of PAH.

Endovascular treatment is a minimally invasive approach that positively affects the course of the disease. Lukacs et al.[14] (2024) reported significant increases in the quality of life and functional capacity of patients after treatment. Our study also supports the direct contribution of hemodynamic improvement to quality of life.

However, there are some limitations to this study. For example, the limited number of patients and the lack of long-term follow-up data may limit the generalizability of the results. In addition, the contribution of experienced experts is important in interpreting the data obtained with Doppler ultrasonography, therefore, the accuracy of the results can be further increased by standardizing the evaluations.

CONCLUSION

Doppler ultrasonography is an effective tool in monitoring hemodynamic changes in patients with PAH before and after endovascular treatment. Such studies are of great importance in optimizing treatment approaches and improving the clinical outcomes of patients. In the future, long-term follow-up studies with larger patient groups may better reveal the prognostic value of Doppler findings after endovascular treatment.

ETHICAL DECLARATIONS

Ethics Committee Approval

Ethics committee approval was obtained from Faculty of Medicine, Bolu Abant İzzet Baysal University was also taken (Date: 07.11.2023, Decision No: 2023/383).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Sarıcaoğlu MC, Aytekin B, Yiğit G, Özen A, Zafer İşcan H. Endovascular balloon angioplasty for infrainguinal arterial occlusive disease: Efficacy analysis. *Turk Gogus Kalp Damar Cerrahisi Derg*. 2021;29(1):5-12.
2. Hirsch AT, Haskal ZJ, Hertzer NR, et al. ACC/AHA 2005 guidelines for the management of patients with peripheral arterial disease (lower extremity, renal, mesenteric, and abdominal aortic): executive summary: a collaborative report from the American association for vascular surgery/ society for vascular surgery, society for cardiovascular angiography and interventions, society for vascular medicine and biology, society of interventional radiology, and the ACC/AHA task force on practice guidelines (Writing committee to develop guidelines for the management of patients with peripheral arterial disease) endorsed by the American association of cardiovascular and pulmonary rehabilitation; 90 national heart, lung, and blood institute; society for vascular nursing; transatlantic inter-societyconsensus; and vascular disease foundation. *J Am Coll Cardiol*. 2006;47(6):1239-1312.
3. Tendera M, Aboyans V, Bartelink ML, et al. ESC Guidelines on the diagnosis and treatment of peripheral artery diseases. *Eur Heart J*. 2011;32(22):2851-2906.
4. De Sanctis JT. Percutaneous interventions for lower extremity peripheral vascular disease. *Am Fam Physician*. 2001;64(12):1965-1972.
5. Bendermacher BL, Teijink JA, Willigendael EM, et al. Symptomatic peripheral arterial disease: the value of a validated questionnaire and a clinical decision rule. *Br J Gen Pract*. 2006;56(533):932-937.
6. Goyen M, Ruehm SG, Debatin JF. MR angiography for assessment of peripheral vascular disease. *Radiol Clin North Am*. 2002;40(4):835-846.
7. Zheng ZJ, Sharrett AR, Chambless LE, et al. Associations of ankle-brachial index with clinical coronary heart disease, stroke and preclinical carotid and popliteal atherosclerosis: the Atherosclerosis Risk in Communities (ARIC) Study. *Atherosclerosis*. 1997;131(1):115-125.
8. Crawford F, Welch K, Andras A, Chappell FM. Ankle brachial index for the diagnosis of lower limb peripheral arterial disease. *Cochrane Database Syst Rev*. 2016;9(9):CD010680.
9. Mills JL. Lower extremity arterial disease. In: Cronenwett JL, Johnston KW, editors. Rutherford's vascular surgery. *Philadelphia: Elsevier*. 2011;93(2):176.
10. Rowe VL, Lee W, Weaver FA, Etzioni D. Patterns of treatment for peripheral arterial disease in the United States: 1996-2005. *J Vasc Surg*. 2009;49(4): 910-917.
11. Fontaine R, Kim M, Kieny R. Surgical treatment of peripheral circulation disorders [in German] *Helv Chir Acta*. 1954; 21(5-6):499-533.
12. Rutherford RB, Baker JD, Ernst C, et al. Recommended standards for reports dealing with lower extremity ischemia: revised version. *J Vasc Surg*. 1997;26(3):517-38. doi: 10.1016/s0741-5214(97)70045-4. Erratum in: *J Vasc Surg*. 2001; 33(4):805.

13. Normahani P, Khosravi S, Sounderajah V, Aslam M, Standfield NJ, Jaffer U. the effect of lower limb revascularization on flow, perfusion, and systemic endothelial function: a systematic review. *Angiology*. 2021;72(3):210-220.

14. Lukacs RA, Weisshaar LI, Tornyos D, Komocsi A. Comparing endovascular approaches in lower extremity artery disease: ınsights from a network meta-analysis. *J Clin Med*. 2024;13(4):1024