

*Prikaz slučaja /
Case report*

RESULTS OF ENDOVASCULAR
TREATMENT OF PERIPHERAL ARTERIAL
OCCLUSIVE DISEASE OF ILIAC ARTERIES
REZULTATI ENDOVASKULARNOG
TRETMANA PERIFERNE ARTERIJSKE
OKLUZIVNE BOLESTI ILIJAČNIH
ARTERIJA

Tijana Kokovic¹, Nikola Batinić³,
Viktorija Vučaj-Ćirilović², Aleksandar Spasić¹,
Dragan Nikolić³, Viktor Till¹

Correspondence to:

Dr Tijana Koković

Centar za radiologiju
Univerzitetski klinički centar Vojvodine
Novi Sad
Hajduk Veljkova 1
tijana.kokovic@icloud.com

¹ Centar za radiologiju, Univerzitetski klinički centar Vojvodine

² Institut za onkologiju Vojvodine, Centar za imidžing dojnagnostiku

³ Klinika za vaskularnu i endovaskularnu hirurgiju, Univerzitetski klinički centar Vojvodine

Key words

peripheral arterial occlusive disease, iliac stents, TASC classification, endovascular treatment

Ključne reči

periferna arterijska okluzivna bolest, ilijačni stentovi, TASC klasifikacija, endovaskularni tretman

Abstract

Introduction The clinical manifestation of peripheral arterial occlusive disease (PAOD) highly depends on the extent of atherosclerotic lesions. Trans-Atlantic Inter Society Consensus (TASC) II Classification of PAOD based on the prevalence and characteristics of atherosclerotic disease and their benefits for endovascular or open surgical therapy classifies patients in A-D stages. The aim of this study was to show the effect of revascularization after endovascular treatment on the iliac arteries depending on the stage of the disease according to the Leriche-Fontaine classification. **Methods** The study included patients with aortoiliac occlusive disease (AIOD) treated with the endovascular revascularization during a period of six years, who were available for clinical examination (total of 87 patients). The study has prospective character. **Results** Endovascular procedure went as planned in 94,3% patients. The postprocedural course was without complications in 88,6% of patients. Preprocedurally majority of patients were in stadium IIb and III, while postprocedurally majority were in I and IIa. In 3 of patients amputation of treated lower extremity was performed. Control Duplex ultrasonography (DUS) showed in 86% of the patients the patency of stent. **Conclusion** Endovascular treatment of AIOD is a minimal-invasive therapeutic method, it is complementary to an open surgical revascularization method and in selected patients has a good revascularization effect, with acceptable mortality and morbidity.

INTRODUCTION

AIOD is a peripheral arterial occlusive disease (PAOD) that involves the presence of stenosis and/or occlusion at the level of the aortoiliac segment.¹ The main feature of the disease is a partial or complete blockage of blood flow through the blood vessels.

It was found that the overall prevalence of PAOD was based on objective testing and was evaluated on the basis of the results identified in several epidemiological studies, ranging from 3% to 10%, and rising up to 20% in the population older than 70 years.^{2,3,4}

The Leriche-Fontaine classification groups patients with progressive arterial dysfunction in four stages: I (asympto-

matic), IIa (intermittent claudications over 100m), IIb (intermittent claudication below 100m), III (pain and paraesthesia in peace) and IV (trophic changes and gangrene).

The clinical manifestation of PAOD predominantly depends on the extent of atherosclerotic lesions.

Trans-Atlantic Inter Society Consensus (TASC) II classification of AIOD, based on the extent and characteristics of atherosclerotic disease, shown by imaging diagnostic methods, and their benefits for endovascular or open surgical therapy, places patients in A to D stages (Figure 1.).

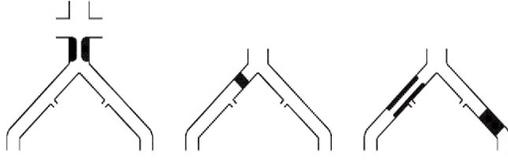
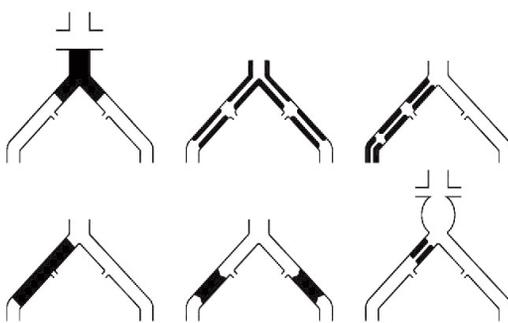
TASC A lesions <ul style="list-style-type: none"> • Unilateral or bilateral CIA stenoses • Unilateral or bilateral single short (≤ 3 cm) EIA stenosis 	
TASC B lesions <ul style="list-style-type: none"> • Short (≤ 3 cm) stenosis of the infrarenal aorta • Unilateral CIA occlusion • Single or multiple stenosis totaling 3 to 10 cm involving the EIA not extending into the CFA • Unilateral EIA occlusion not involving the origins of the internal iliac or CFA 	
TASC C lesions <ul style="list-style-type: none"> • Bilateral CIA occlusions • Bilateral EIA stenoses 3 to 10 cm long not extending into the CFA • Unilateral EIA stenosis extending into the CFA • Unilateral EIA occlusion involving the origins of the internal iliac and/or CFA • Heavily calcified unilateral EIA occlusion with or without involvement of the origins of the internal iliac and/or CFA 	
TASC D lesions <ul style="list-style-type: none"> • Infrarenal aortoiliac occlusion • Diffuse disease involving the aorta and both iliac arteries • Diffuse multiple stenoses involving the unilateral CIA, EIA, and CFA • Unilateral occlusions of both CIA and EIA • Bilateral EIA occlusions • Iliac stenoses in patients with AAA not amenable to endograft placement 	

Figure 1. - The TASC II classification of aortoiliac lesions.

METHODS

This study included patients with AIOD treated with endovascular revascularization during the period from May 2013 to June 2019, who were available for clinical examination (total of 87 patients). The study is retrospective.

All the patients had screening of the risk factors for PAOD, detailed diagnostic assessment of the comorbidity, physical examination of vascular surgeon and anesthesiologist, exam of radiologist, evaluation of the ankle-brachial index (ABI), DUS and classical arteriography (DSA), followed by endovascular revascularization.

Preoperatively patients were classified in groups IIa, IIb, III or IV according to Leriche-Fontaine classification of PAOD, with ABI values less than 0.75 and lesion type A, B, C or D according to TASC II classification.

All endovascular interventions were performed by interventional radiologists. Patients were discharged from the clinic with instructions for medication, followed by periodic examinations of vascular surgeon and control DUS examination performed by radiologist (after 1, 3, 6 and 12 months in the first postoperative year, and later once a year). The survey was performed by the same radiologist, on General Electric Logiq 7 ultrasound apparatus. The stent position was monitored and parameters indicating the occurrence of in-stent stenosis/occlusion.

In order to analyze the results of outcome of the endovascular procedures, data from Center for Radiology and the Clinic for vascular and endovascular surgery (Clinical Center

of Vojvodina, Serbia) were analyzed: clinical findings, endovascular procedure protocol, DSA findings, and post-procedural DUS findings.

The following parameters were preprocedurally monitored: 1) gender and age of the patients, 2) associated diseases (DM – diabetes mellitus, HTA - arterial hypertension, HLP - hyperlipoproteinemia, CMP – cardiomyopathy, COPD - chronic obstructive pulmonary disease, smoking), 3) ABI values and 4) TASC type of lesions.

The parameters monitored postprocedurally were: 1) the course of surgical procedure, 2) postprocedural complications, 3) stent placement site (ACI, ACE), 4) postoperative values of ABI on pedal arteries, 5) presence of stenosis/occlusion on the control DUS.

The complications that were monitored are divided into specific (related to intervention) and non-specific (general systemic). Specific complications were divided into: 1) minor complications (hematoma at the puncture site, minor defects in contrast filling of the blood vessel) and 2) major complications

(stent failure, thrombosis and embolism, ischemia and trophic changes in the lower extremity, reperfusion and compartment syndrome, amputation of the extremities).

All data were statistically processed and are shown in tables. All the patients gave informed consent for participation in the study and the study was approved by the Ethics Committee of the Clinical Center of Vojvodina (Serbia).

RESULTS

The study included 87 patients with AIOD, who underwent endovascular procedures. The group consisted of patients with a mean age of 61,1 years, predominantly males (54%, table 1). The oldest patient was 78 year old, and the youngest was 47 years old. The main characteristics of patients according to Leriche-Fontaine classification are listed in table 1. The most common risk factor were smoking, HTA and HLP.

According to TASC II classification the majority of patients were in TASC B group (table 1).

Endovascular procedure went as planned in 94,3% patients, without need to convert operation into open surgery, except in one patient with brachial artery lesion.

Preprocedurally average values of ABI were 0,36. Postprocedurally average values of ABI were 0,76.

Postoperative complications were present in 11,4% patients, with no statistically significant difference in different Leriche-Fontaine stages. The most of complications were local complication of puncture site.

Preprocedurally majority of patients were in Leriche-Fontaine stadium IIb and III, while postprocedurally majority

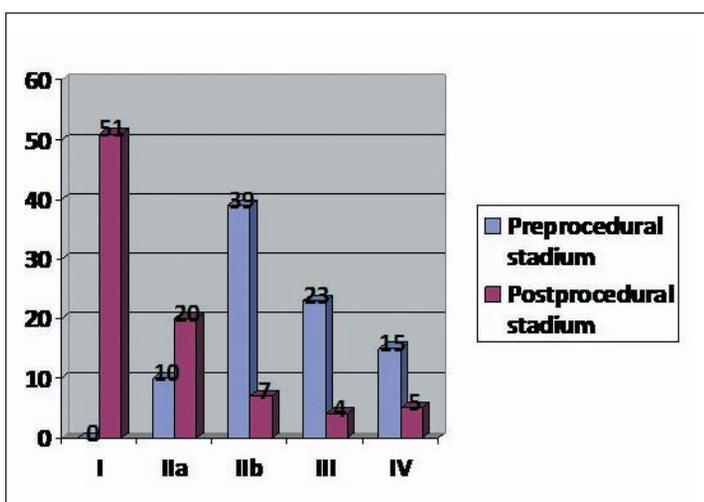
were in I and IIa (table 1). In 3 patients amputation of the prior endovascularly treated limb was performed as the final solution of the PAOD, due to ischemia.

DUS control was performed after the procedure showed in 86% patients the patency of stent.

DISCUSSION

In our study the ratio of gender structure is in accordance with literature data where PAOD is more often described in male. The data obtained in our study, in terms of the average age of patients, are in accordance with the literature data, which mainly indicate an average age around 60. ⁴

The most common associated diseases in our study were HTA, smoking and HLP. Our results are in accordance with the previous literature data, stating that those are the most common comorbidities among PAOD.^{5,6,7} Results of the analysis showed that most of the demographic and clinical characteristics according to Leriche-Fontaine classification were homogeneous except DM, which is the most common risk factor in patients with stadium IV of PAOD. ⁴



Graf. 1. – Number of patients categorized by Leriche-Fontaine classification of PAOD (pre- and postprocedurally) - p value **0,000181**

According to preprocedural DSA findings, the highest number of patients was in the TASC group B group, followed by the TASC A and the TASC C group. This is in

Stadium of PAOD	Overall	IIA	IIB	III	IV	P value
Number of patients	87	10	39	23	15	-
Age	61,1 (47-78) SD 9,1	55,1 SD 7,4	58,6 SD 8,3	65,6 SD 8,4	64,4 SD 9,1	0,856
HTA	44 50,5%	6 60%	21 53,8%	10 43,5%	7 46,7%	0,477
Smoking	51 58,6%	7 70%	19 48,7%	15 65,2%	10 66,7%	0,271
HLP	39 44,8%	5 50%	12 30,7%	14 60,8%	8 53,3%	0,4111
DM	31 35,6%	3 30%	10 25,6%	6 26%	12 80%	0,00563
CMP	11 12,6%	2 20%	5 12,8%	2 8,6%	2 13,3%	0,947
COPD	14 16%	1 10%	7 17,9%	4 17,3%	2 13,3%	0,388
TASC A	41 47,1%	6 60%	19 48,7%	9 39,1%	5 33,3%	0,128
TASC B	45 51,7%	4 40%	23 58,9%	12 52,2%	6 40%	0,235
TASC C	14 16%	1 10%	7 17,9%	3 13%	1 6,7%	0,441
ABI preoperatively	0,36	0,46	0,37	0,32	0,29	0,00118
Intraoperative complications	5 5,7%	0 0%	2 5,1%	2 8,6%	1 6,6%	0,447
Postoperative complications	10 11,4%	1 10%	5 12,8%	2 8,6%	2 13,3%	0,910
Stent location - AIE	38	3 30%	16 41%	11 47,8%	8 53,3%	0,9223
Stent location -AIC	85	10 100%	37 94,8%	23 100%	15 100%	0,877
ABI postoperatively	0,76	0,81	0,74	0,77	0,68	0,411

Table 1. - General data, risk factors, findings of pre- and postoperative findings.

accordance with the literature data, TASC B lesions are listed in literature as the most common indication for endovascular treatment.⁸⁻¹⁵

The course of endovascular procedure was without complications in 94,3% patients, while 5,7% of patients had complications. One patient had transient haemodynamic instability with angina pectoris, which had been withdrawn after adequate oxygenoterapia. In two patients there was a dissection of the blood vessel wall during stent placement. This complications was managed during the procedure with additional stent placement at the site of the lesion. One patient had atherosclerotic plaque tear, which was also resolved by placing an additional stent at the site of the lesion. One patient had an iatrogenic lesion of the brachial artery. The complication was resolved by ligation of the brachial artery, without subsequent neurological and circulatory deficits. The technical success of the performed procedures is in accordance with the literature data, and all of the above mentioned complications in our study were successfully subsequently solved.¹⁶

Regular postprocedural course had 88,6% patients, while 11,4% of patients reported complications. Non-specific systemic complications in the form of transient hemodynamic instability that did not require additional therapy in patients with numerous comorbidities was reported in 3% cases. Of the specific complications, 3,5% patients had major complications. One patient with malignant disease and prior to colectomy had the signs of thrombosis of the right brachial artery, with neurological loss on the right arm, followed by thrombectomy, with a regular postoperative course. Two patients had reperfusion sindrom of lower extremities, with compartment syndrome. This complication was resolved by fasciotomy, with adequate postoperative recovery. In 7% of cases, minor complications occurred. The incidence of reported complications is in line with literature data, and the majority are minor complications, while major complications were subsequently successfully treated.^{4,8,9,12,13}

The results suggest significant improvement in the clinical findings of our patients, with a significant number of patients translated into Leriche-Fontaine stage I or IIa of the disease, while in 10% of patients there was an improvement in terms of switching from critical ischemia to the functional stage of the disease - stage IIb.

Preoperatively ABI values showed a statistically significant difference depending of the stage of the Leriche-Fontaine stadium of the disease. Preprocedural average values of ABI (0,36) and postprocedural values of ABI (0,76) indicate an improvement and solid revascularization effect, a value higher than 0,5, which makes these patients above the critical of ischemia stage.

DUS control showed in 86% patients the patency of stent. In 3,4% patients amputation of the prior endovascularly treated limb was performed as the final solution of the PAOD, due to ischemia - in two cases in early postprocedural period (less than 30 days) and in one case in late postprocedural period (8 months) after the revascularization. This findings show the same trend previously reported in the literature.^{8,9,12,13} In 4,6% patients lethal outcome occurred, in three cases in late postprocedural period (35 days, 6 and 24 months after the procedure), and in one case in early postprocedural period (9 days after the procedure) in patient with malignant disease prior to colectomy, which agrees with the literature data.¹⁷

CONCLUSION

In our study, patients with high risk for open surgery of the aortoiliac segment and who were not suitable for classical surgical revascularization, were subjected to an endovascular procedure, thus improving the quality of their life.

Endovascular treatment of AIOD disease is a minimally invasive therapeutic method, and in selected patients has a good revascularization effect, with acceptable mortality and morbidity.

Sažetak

Uvod Klinička manifestacija periferne arterijske okluzivne bolesti (PAOB) zavisi od proširenosti aterosklerotskih lezija. Trans-Atlantic Inter Society Consensus (TASC) II klasifikacija PAOB na osnovu proširenosti i karakteristika aterosklerotske bolesti determiniše vrstu terapije i svrstava pacijente u stadijume A do D. Cilj rada je prikazati efekat revaskularizacije nakon endovaskularnog tretmana na ilijačnim arterijama u zavisnosti od stadijuma bolesti prema Leriche-Fontaine klasifikaciji. **Metode** Studijom su obuhvaćeni pacijenti sa aortoiličnom okluzivnom bolešću (AIOB) tretirani endovaskularnom revaskularizacijom u periodu od šest godina, dostupni za klinički pregled (ukupno 87 pacijenata). Studija je perspektivnog karaktera. **Rezultati** Endovaskularna procedura je protekla uredno kod 94.2% bolesnika. Postproceduralni tok je protekao uredno kod 87.3% bolesnika. Većina pacijenata je preproceduralno bila u stadijumu IIB i III, dok je postproceduralno većina bila u stadijumu I i IIa. Kod 3 pacijenta je postproceduralno načinjena amputacija tretiranog donjeg ekstremiteta. Kontrolna Duplex ultrasonografija (DUS) je pokazala je kod 83% bolesnika patentnost stenta. **Zaključak** Endovaskularni tretman AIOB je minimalno invazivna terapijska metoda, komplemetarna otvorenoj hirurškoj revaskularizacionoj metodi i kod izabranih bolesnika ima dobar revaskularizacioni efekat, sa prihvatljivim mortalitetom i morbiditetom.

LITERATURA

1. Brown KN, Muco E, Gonzalez L. Leriche Syndrome. [Updated 2022 Feb 16]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK538248/>
2. Criqui MH, Fronek A, Barrett-Connor E, Klauber MR, Gabriel S, Goodman D. The prevalence of peripheral arterial disease in a defined population. *Circulation* 1985;71(3):510-51.
3. Hiatt WR, Hoag S, Hamman RF. Effect of diagnostic criteria on the prevalence of peripheral arterial disease. The San Luis Valley Diabetes Study. *Circulation* 1995;91(5):1472-9.
4. Cvetič V, Sagić D, Koncar I, et al. Endovascular treatment of different types of iliac occlusions-Results from an observational study. *PLoS One*. 2019;14(10).
5. Fowkes FG, Housley E, Cawood EH, Macintyre CC, Ruckley CV, Prescott RJ. Edinburgh Artery Study: prevalence of asymptomatic and symptomatic peripheral arterial disease in the general population. *Int J Epidemiol* 1991;20(2):384-92.
6. Selvin E, Marinopoulos S, Berkenblit G, Rami T, Brancati FL, Powe NR, et al. Meta-analysis: glycosylated hemoglobin and cardiovascular disease in diabetes mellitus. *Ann Intern Med* 2004;141(6):421-31.
7. ADA Peripheral arterial disease in people with diabetes. *Diabetes Care* 2003;26(12):3333-41.
8. O'Hare AM, Vittinghoff E, Hsia J, Shlipak MG. Renal insufficiency and the risk of lower extremity peripheral arterial disease: results from the Heart and Estrogen/Progestin Replacement Study (HERS). *J Am Soc Nephrol* 2004;15(4):1046-51.
9. Serefli D, Saydam O, Engin AY, Atay M. Midterm results of kissing stent reconstruction of the aortoiliac bifurcation. *Ann Surg Treat Res*. 2021 Oct;101(4):247-255.
9. Management of peripheral arterial disease (PAD). TransAtlantic Inter-Society Consensus (TASC). *Eur J Vasc Endovasc Surg* 2000; 19(Suppl A):S1-xxviii. S1-250.
10. TASC. Management of Peripheral Arterial Disease (PAD) TransAtlantic Intersociety Consensus (TASC). *J Vasc Surg* 2000;31(1 part 2):S1-287.
11. TASC. Management of peripheral arterial disease (PAD). TransAtlantic Inter-Society Consensus (TASC). *Int Angiol* 2000;19(1 Suppl.1):I-XXIV. 1-304.
12. Clement DL, Boccalon H, Dormandy J, Durand-Zaleski I, Fowkes G, Brown T. A clinical approach to the management of the patient with coronary (Co) and/or carotid (Ca) artery disease who presents with leg ischaemia (Lis). *Int Angiol* 2000;19(2):97-125.
13. Hirsch AT, Haskal ZJ, Hertzner NR, Bakal CW, Creager MA, Halperin JL 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; National Heart, Lung, and Blood Institute; Society for Vascular Nursing; TransAtlantic Inter-Society Consensus; and Vascular Disease Foundation. *J Am Coll Cardiol* 2006;47:1239-312.
14. Minici R, Ammendola M, Talarico M, Luposella M, Minici M, Ciranni S, Guzzardi G, Laganà D. Endovascular recanalization of chronic total occlusions of the native superficial femoral artery after failed femoropopliteal bypass in patients with critical limb ischemia. *CVIR Endovasc*. 2021 Sep 7;4(1):68.
15. Leville CD, Kashyap VS, Clair DG, et al. Endovascular management of iliac artery occlusions: extending treatment to TransAtlantic Inter-Society Consensus class C and D patients. *J Vasc Surg*. 2006;43:32-39.
16. Sixt S, Alawied AK, Rastan A, et al. Acute and long-term outcome of endovascular therapy for aortoiliac occlusive lesions stratified according to the TASC classification: a single-center experience. *J Endovasc Ther*. 2008;15:408-416.

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