



# Our Hybrid Approach in the Treatment of Peripheral Vascular Diseases

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## Abstract

**Objective:** Peripheral arterial disease is an important health problem with an incidence of approximately 13 % in the population over 50 years of age. Although endovascular interventions provide successful results as sole treatment in many patients, in complex peripheral vascular disease cases concomitant surgical interventions may be necessary to provide complete revascularization of the target extremities. In this study, we aimed to present the early results of 21 patients who underwent hybrid peripheral vascular intervention.

**Methods:** 21 patients who underwent hybrid procedures for peripheral arterial disease between January 2018 and June 2018 were included in the study. One of the patients underwent open surgery primarily and then endovascular intervention applied after 1 month to surgery. Endovascular and surgical procedures were performed simultaneously in all other patients.

**Results:** Fifteen of the patients were male (71.4 %), and 6 were female (28.6 %). The mean age of patients was  $61.95 \pm 7.88$  years, with an age range of 52-75 years. The average ankle-brachial index of the target extremity was  $0.25 \pm 0.12$ .

**Conclusion:** The hybrid procedures provide the best benefit possible for the complex arterial lesions with increase of both inflow and distal flow.

**Keywords:** Hybrid method, peripheral vascular diseases, endovascular treatment.

## INTRODUCTION

Peripheral arterial disease is an important health problem with an incidence of approximately 13% in the population over 50 years of age (1). Although there are many etiological factors, atherosclerosis is the most common cause (2). Because of the systemic nature of atherosclerosis, 60% of these patients have simultaneous coronary artery disease and 30% have cerebrovascular pathologies (3). 10-15% of the patients with intermittent claudication die of cardiovascular diseases within 5 years. Although a significant number of patients may be asymptomatic, the indication of the intervention and the clinical classification are determined according to the severity of the symptoms. Claudication is the main reason for intervention in the majority of patients and the type of intervention depends on the severity of the disease.

In the last two decades, as a result of the rapidly improving endovascular intervention methods and increasing experience

on this field, the catheter-based procedures have become the first line of treatment in the peripheral artery disease (PAD). This approach is considered as 'Endo-first' approach.

Although endovascular interventions provide successful results as sole treatment in many patients, in complex peripheral vascular disease cases concomitant surgical interventions may be necessary to provide complete revascularization of the target extremities. Although hybrid operating room settings provide ideal conditions, the C-arm scopy device in standard operating rooms can be sufficient in many cases.

In this study, we aimed to present the early results of 21 patients who underwent hybrid peripheral vascular surgery with the help of C-arm scopy device under standard operating room conditions between January-June 2018 in our clinic.

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## METHODS

### Patient Selection

In this study, data from the clinical database were analyzed retrospectively. The patients who were admitted to the Cardiovascular Surgery clinic and diagnosed with PAD and then underwent hybrid intervention were analyzed.

The ankle-brachial index (ABI) of all patients was measured after a detailed history and physical examination. In patients with ABI <0.9, computed tomographic angiography was performed. All patients underwent carotid doppler and cardiac examination, except for two patients who were operated on under emergency conditions. Patients were classified by using Fontaine classification, and patients with Fontaine 2B or higher with comorbidities were considered and treated with hybrid therapy.

All patients participating in the study were informed about the study and their consents were taken. Ethical committee approval was taken since for this the study.

### Surgical Technique

Operations were performed under either general anesthesia, local anesthesia or peripheral nerve block. Long (> 25 cm) superficial femoral artery occlusions were treated with prosthetic by-pass grafting in elective conditions. Endarterectomy was performed for the lesions which may cause anatomic and physiological stenosis in the main femoral artery or to relieve stenoses limiting the inflow. In addition, simultaneous profundoplasty was performed in the presence of osteal stenosis of deep femoral artery.

Endovascular treatment methods were applied to patients with aorta-iliac lesions shorter than 5 cm, SFA lesion shorter than 25 cm or distal arterial lesions. Endovascular techniques used were atherectomy, percutaneous balloon angioplasty and/or drug coated percutaneous balloon angioplasty. Since most patients had simultaneous endovascular and surgical procedures, catheterization was performed from the explored artery for endovascular treatment.

### Statistical Analysis

Statistical analyses were performed using SPSS (SPSS Inc., Chicago, IL, USA) version 16.0. Continuous variables are given as mean  $\pm$  standard deviation and categorical variables as n and percentage values.

## RESULTS

21 patients who underwent hybrid procedures for peripheral arterial disease between January 2018 and June 2018 were included in the study. 15 of the patients were male (71.4%), and 6 were female (28.6%). The mean age of patients was  $61.95 \pm 7.88$  years, with an age range of 52-75 years. The most common risk factor was smoking (80,9%), the other risk factors related to the patients were summarized in Table 1.

2 of patients (9.5%) had ischemic wounds (Fontaine class 4), 14 of patients (66.6%) had claudication (Fontaine class 2B), and 5 of patients (23.9%) had rest pain (Fontaine class 3). The average ABI in the target extremity was  $0.25 \pm 0.12$ .

Interventions were performed in 18 of the patients under general anesthesia, in 2 of them under local anesthesia and in one of them with peripheral nerve block. Femoro-popliteal by-pass was performed in 10 patients due to long segment superficial femoral artery lesions (> 25 cm). 6 patients underwent endarterectomy to main femoral artery. Extra anatomic femoro-femoral by-pass was performed in two patients, interposition with autogenous vein, bilateral embolectomy and extra anatomic axillo-femoral bypass were performed in each one patient. In the same session, 6 patients underwent self-expandable main iliac artery stent implantation, 11 patients underwent anterior tibial artery percutaneous transluminal balloon angioplasty, and 3 patients underwent superficial femoral artery percutaneous transluminal balloon angioplasty. Detailed data on patient procedures are summarized in Table 2.

To the patient who underwent femorofemoral bypass and the deep femoral artery plasty as well as transposition from the superficial femoral artery to the deep femoral artery was performed percutaneous transluminal balloon angioplasty. In this patient, an application of VAC (Vacuum Assisted Closure) for prolonged service hospitalization and wound infection was required in the inguinal incision. This patient increased the

Risk factor	Number (n)	Percent (%)
Hypertension	9	42,8
Diabetes Mellitus	13	61,9
Hyperlipidemia	6	28,5
Coronary artery disease	8	38
Smoking	17	80,9
Infrarenal abdominal aortic aneurysm	1	4,7
Carotid artery stenosis	1	4,7
Small cell lung cancer	1	4,7

average length of stay. The mean length of hospitalisation was  $3.15 \pm 2.94$  days.

There was no acute renal failure or mortality in the postoperative period. Two patients with ischemic injuries were referred to hyperbaric oxygen therapy at the end of postoperative follow-up.

One of the two patients who underwent interposition surgery with autogenous graft to the popliteal artery under emergency conditions and the other patient underwent bilateral femoral artery embolectomy operation.

One of the patients underwent at first endovascular intervention prior one month to open surgery. This patient was underwent endovascular intervention guided by arterial doppler ultrasonography of the main femoral artery.

The mean of AAI was  $0.83 \pm 0.15$  in the postoperative follow-up period.

## DISCUSSION

This retrospective study presents our experience in 21 patients who underwent a hybrid intervention. We performed simultaneous endovascular and surgical treatment in 20 patients and staged hybrid in one patient. The hybrid approach is defined as the combined utilization of open surgery and endovascular methods in same case. PAD is a systemic disease. Ozkan et al., reported their serie of the 626 patients, 400 (64%) had multisegmental disease, the most common form of which

was combined femoropopliteal and crural disease (25%). (4) Neither open surgery nor endovascular approach could provide complete revascularisation in some of these complex cases. Present study aimed to discuss an importance of the hybrid approach in accordance with current European Society for Vascular Surgery (esvs) guidelines recommendations.

While the discussion on the choice of treatment still continues, the latest published European Society of Cardiology (ESC) guideline suggests endovascular treatment as the first choice for occlusive lesions shorter than 5 cm in terms of revascularization of aorta-iliac disease and aorta-bifemoral by-pass class-I defined as indicated for aorta-iliac occlusions without serious comorbidity. In patients with long and / or bilateral aorta-iliac occlusive lesions with severe comorbidity, the need for endovascular intervention was emphasized as the first strategy with class I indication.

In the same guideline; Endovascular treatment for occlusive femoro-popliteal lesions below 25 cm, and autologous vein grafting for lesions above 25 cm are presented as the first strategy with class I indication. Transluminal balloon angioplasty and stenting process of the aorta-iliac region has a high primary and secondary patency rate. Primary patency in short lesions (<5 cm) after transluminal angioplasty is reported as 64.5% and secondary patency is found to be 81.8%. (5)

Aortoiliac occlusive disease is generally associated with severe comorbidities. Aortobifemoral or aortobiliac bypass are still preferred approach in complex cases with 5 and 10 years patency rates approximately 90% and 75% respectively. (6, 7) Aortic bifurcated surgery is a high risk procedure. Bredahl and colleagues reported the 30-day mortality as 3.6% and the 30-day major complication rate as 20% in their 20 years experience. (8) In the last decade, EVAR (EndoVascular Aneurysm Repair), CERAB (Covered Endovascular Repair of Aortic Bifurcation) and kissing stent technique have become a current first line treatment in experienced centers. Endovascular approach has a comparable mid term results but has a better early term outcomes regarding mortality, hospital stay, bleeding, infection and mesenteric ischemia. We also prefer both CERAB and kissing stent technique in complex cases. In this serie, we reported 7 patients underwent simultaneous uniiliac endovascular intervention and peripheric arterial surgery with 100% procedural success. Primary iliac stenting was preferred technique in each cases. Peripheric surgery was planned considering both preoperative CT angiography and DSA during the iliac procedure.

Joshery and colleagues compared hybrid interventions with peripheral bypass with saphenous vein and prosthetic graft

**Table 2. Surgical and endovenous procedures applied to the patients**

Procedure	Number of patients
Right CFA endarterectomy + Right CIA stent	3
Right femoro-popliteal bypass + Right ATA angioplasty	3
Left femoro-popliteal bypass + Left ATA angioplasty	4
Right CFA endarterectomy + Right ATA angioplasty	2
Femoro-femoral bypass + Left SFA angioplasty	2
Femoro-femoral bypass + Right CIA stent	1
Right femoro-popliteal bypass + Right CIA stent	3
Left popliteal artery vein graft interposition + Left ATA angioplasty	1
Left axillo-femoral bypass + Left ATA angioplasty	1
Bilateral femoral embolectomy + Right SFA angioplasty	1

ATA: Anterior tibial artery, SFA: Superficial femoral artery, CIA: Common iliac artery, CFA: Common femoral artery

in patients with complex pad. And they reported that hybrid procedures have favorable perioperative outcomes compared with open bypass for femoropopliteal revascularization. In our serie, we combined femoropopliteal bypass and distal angioplasty in 7 cases, common femoral endarterectomy and angioplasty in 2 cases and bilateral embolectomy and angioplasty in 1 case. Each case was discharged uneventfully with 100% early term success (9).

## CONCLUSION

In conclusion, the hybrid procedures provide the best benefit possible for the complex arterial lesions with increase of both inflow and distal run-off. Hybrid procedures may also reduce hospital stay, mortality and morbidity.

## Ethics

**Ethics Committee Approval:** Okmeydanı Training and Research Hospital Clinical Research Ethics Committee (number: 48670771-514.10).

**Informed Consent:** All patients participating in the study were informed about the study and their consents were taken.

**Peer-review:** Externally and internally peer-reviewed.

## Authorship Contributions

Surgical and Medical Practices: C.Y., S.K., Concept: N.K., Design: N.K., Data Collection or

Processing: C.Y., S.K., B.Ç.K., Analysis or Interpretation: M.G., Literature Search: M.G., B.Ç.K., Writing: C.Y.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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## REFERENCES

1. 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;9:010680.
2. Aronow WS. Management of peripheral arterial disease of the lower extremities in elderly patients. *J Gerontol A Biol Sci Med Sci*. 2004;59:172-7.
3. Viles-Gonzalez JF, Fuster V, Badimon JJ. Atherothrombosis: a widespread disease with unpredictable and life-threatening consequences. *Eur Heart J*. 2004;25:1197-207.
4. Ozkan U, Oguzkurt L, Tercan F . Atherosclerotic risk factors and segmental distribution in symptomatic peripheral artery disease. *J Vasc Interv Radiol*. 2009 Apr;20(4):437-41.
5. Abello N, Kretz B, Picquet J, Magnan PE, Hassen-Khodja R, Chevalier J, et al. Long-term results of stenting of the aortic bifurcation. *Ann Vasc Surg* 2012; 26: 521-6.
6. Lun Y, Zhang J, Wu X, Gang Q, Shen S, Jiang H et al. Comparison of midterm outcomes between surgical treatment and endovascular reconstruction for chronic infrarenal aortoiliac occlusion. *J Vasc Interv Radiol* 2015; 26(2): 196-204
7. Grimme FA, Goverde PC, Verbruggen PJ, Zeebregts CJ, Reijnen MM. First Results of the Covered Endovascular Reconstruction of the Aortic Bifurcation (CERAB) Technique for Aortoiliac Occlusive Disease. *Eur J Vasc Endovasc Surg*. 2015; 50(5): 638-47
8. Bredahl K, Jensen LP, Schroeder TV, Sillesen H, Nielsen H, Eiberg JP. Mortality and complications after aortic bifurcated bypass procedures for chronic aortoiliac occlusive disease. *J Vasc Surg*. 2015 Jul;62(1):75-82.
9. Jorshery SD1, Skrip L2, Sarac T1, Ochoa Chaar C13. Hybrid femoropopliteal procedures are associated with improved perioperative outcomes compared with bypass. *J Vasc Surg*. 2015 Jul;62(1):75-82. doi: 10.1016/j.jvs.2015.02.025.