

Our experience of infrapopliteal revascularization of lower extremity in ten years

Halil Basel¹, Hasan Ekim²,
Cemalettin Aydin³, Cemil Goya⁴

ABSTRACT

Objective: In this study the long term results of infrapopliteal arterial revascularization procedure was evaluated. The efficiency of distal revascularization was also searched for the treatment of critical limb ischemia.

Methodology: From 1999 to 2009 32 patients underwent infrapopliteal revascularization procedure in our hospital for the treatment of critical limb ischemia. Demographic data of patients are: 23 male, 9 female and mean age was 60.5. Hypertension (n:15, 46.3%), diabetes mellitus (n:16, 50%), smoking (n:29, 90.6%) were the risk factors. The patients were classified in Fontaine III (n:25) and Fontaine IV (n:7). Extremity viability and long term patency was detected with limb examination, Doppler Ultrasonography and angiography. The cases were evaluated for post operative mortality, morbidity and primary graft patency for one year.

Results: Mean follow up period was 21.3-/+15.9 months (12-60 months). Two patients died in early post operative period. Eight patients underwent re-operation. Re-operations were performed on six patients for the treatment of acute graft thrombosis and two patients for the control of surgical bleeding. The long term graft patency was 38% and extremity recovery rate was 46%. In post operative early period two minor and one major amputation was performed.

Conclusion: Infrapopliteal arterial revascularization procedure is an efficient method for the treatment of critical limb ischemia and high rate of long term patency is the main advantage of this procedure.

KEY WORDS: Vascular Diseases, Arterial Occlusive Diseases, Peripheral Vascular Diseases.

Pak J Med Sci January - March 2011 Vol. 27 No. 1 98-101

How to cite this article:

Basel H, Ekim H, Aydin C, Goya C. Our experience of infrapopliteal revascularization of lower extremity in ten years. Pak J Med Sci 2011;27(1):98-101

1. Dr. Halil Basel,
Associate Professor,
 2. Dr. Hasan Ekim,
Associate Professor,
 3. Cemalettin Aydin, MD,
Van Yuksek Ihtisas Egitim Ve Arastirma Hastanesi KVC Klinigi,
Van, Turkey.
 4. Cemil Goya, MD,
Van Yuksek Ihtisas Egitim Ve Arastirma Hastanesi Radyoloji Klinigi,
- 1, 2: Medical Faculty Cardiovascular Department,
Yuzuncu Yil University, Turkey.

Correspondence:

Dr. Halil Basel,
Associate Professor,
Medical Faculty Cardiovascular Department,
Yuzuncu Yil University, 65170 Van, Turkey.
E-mail: hbasel@myynet.com

- * Received for Publication: May 3, 2010
- * Revision Received: August 30, 2010
- * Revision Accepted: September 7, 2010

INTRODUCTION

Thirty two patients in whom by-pass was done to the infra-popliteal region for revascularization and extremity saving purposes at our clinics in 10 years period between 1999 and 2009 were evaluated. Information about patients were obtained directly and indirectly (from their files). Peripheral artery diseases are important morbidity causes that have significant impact on quality of life of the patients. For more than 90% of the lower extremity vascular problems the cause is atherosclerosis.^{1,2}

Cardiovascular death rates were found to be higher for cases with peripheral artery disease than normal population. For cases with peripheral artery disease risk of death is four times higher even in the absence of cardiovascular risk factors.³ Fontain classification

should be considered when deciding surgery at infra-popliteal arteries.

In our series clinical evaluation was also done according to the Fontaine classification. Fontaine I: asymptomatic, Fontaine IIa: intermittent claudication at distances more than 100m, Fontaine IIb: Intermittent claudication at distances less than 100m, Fontaine III: Pain at rest, Fontaine IV: Presence of ulceration or necrosis at extremity. According to this classification surgery is considered absolute for 3rd and 4th stages in order to save the extremity and is planned at 2nd stage for functional improvement for the patients who have active and quality life expectations.^{4,5}

METHODOLOGY

Patient Characteristics: Nine of the 32 patients included in the study were women and 23 were men. Mean age was 60.5±4.1 years. According to Fontaine classification 25 of the patients were at third stage and 7 were at fourth stage. Accompanying diseases to peripheral artery disease were diabetes mellitus in 16 patients, coronary artery disease in 11 patients (2 patients underwent coronary by-pass surgery), hypertension in 15 patients (Table-I).

By-pass Localizations: Main femoral artery, superficial femoral artery and popliteal artery were used respectively in 8, 11 and 12 patients as proximal anastomoses regions in patients in whom infra-popliteal saphenic by-pass was performed and in one patient proximal posterior tibial artery was used. As distal anastomoses region anterior tibial artery, posterior tibial artery, peroneal artery and tibioperoneal trunk were used respectively in 19, 8, 2 and 3 patients (Table-II). As regards graft material reverse saphenic vein graft (SVG) was used in all patients.

Surgical Technique: Region in which the distal anastomoses were planned was explored firstly. Popliteal artery was found by classical methods by a medial incision on the femoral region and then retraction of sartorius muscle through the posterolateral. Deep muscle fascia was also cut in order to expose the popliteal space through the knee. Proximal popliteal artery was released from neighboring tissues at just behind the femur. In order to reach posterior tibial

Table-I: Accompanying diseases or risk factors.

	No. of patients
Diabetes mellitus	16
Coronary artery disease	11
Hypertension	15
Tobacco use	29

and peroneal arteries a dissection was done through the distal from the tibioperoneal branching. Posterior tibial artery was reached near posterior tibial muscle and at medial of soleus muscle. Proximal of peroneal artery was reached at deeper regions and by lateral direction; distal of peroneal artery was reached by a lateral incision on the distal fibula. Anterior tibial artery was reached by a longitudinal incision to anterior compartment from distal 1/3 segment of the leg. Incision was done to femoral arteries at classical inguinal ligament level. Before starting anastomoses and applying anticoagulation, appropriate tunnels were prepared at required regions for the by-passes of patients. For by-passes below knee tunnel is prepared by finger in popliteal fossa and between upper segments of gastrocnemius muscle. A separate tunnel was not formed for posterior tibial and proximal peroneal arteries, however for distal peroneal and anterior tibial arteries a separate tunnel was formed from popliteal space through mid-anterior compartment via interosseous membrane.

Below knee arterial segments by-pass operations performed on 32 cases due to low extremity chronic occlusive artery disease at our clinics between 1999 and 2009 were evaluated retrospectively. Diagnoses were established by color Doppler ultrasonography and digital subtraction angiography. Patients with Buerger disease, patients who were operated due to acute artery thrombosis on chronic basis, patients on whom distal tibial and/or peroneal arteries was bypassed and patients with aorto-iliac lesions were not included in evaluation. Reversed saphenic vein was used as by-pass material. Proximal anastomoses were done to superficial femoral artery, common femoral artery, proximal popliteal artery and proximal posterior tibial artery. Distal anastomoses after the sound outlet channel for the Hunter branch of the popliteal artery was preferred (Figure-1, 2). All anastomoses

Table-II: Locations of the bypass grafts.

Location of the proximal anastomosis	No	Location of the distal anastomosis	No
Ana femoral artery	8	Anterior tibial artery	19
Superficial femoral artery	11	Posterior tibial artery	7
Popliteal artery	12	Peroneal artery	2
		Tibio peroneal trunkus	3
Proximal posterior tibial artery	1	Distal posterior tibial artery	1

were done with end-to-side continuous suture technique. Low molecular weight heparin was used in all patients until the oral feeding was started. Then oral anticoagulant and anti-aggregating drugs were added to the treatment.

RESULTS

Twenty three of cases in our study were male (71.9%) and nine were female (28.1%) and age range was between 45 and 79 years. Mean age was 60.5. Smoking, systemic hypertension and diabetes were found respectively in 29 (77.5%), 15 (43.8%) and 16 (50%) as risk factors. In our study 25 cases (78.1%) were at Fontaine III and 7 cases were at Fontaine IV. Critical coronary artery disease was diagnosed in 12 (37.5%) of the patients who had cardiac complaints an on whom coronary angiography was performed. Peripheral vascular intervention was done after PTCA for five (16.3%) of the patients in whom critical coronary artery disease was diagnosed and for three (10.8%) after coronary by-pass. One case did not accept coronary operation. For one case LIMA-LAD by-pass was performed in the same session.

For all of the 32 patients included in the study, reversed saphenic graft technique was applied. Two patients (6.2%) died during early period. One of these patients died due to cardiac and one due to cerebrovascular events. Eight patients were re-operated at early period due to acute occlusion or bleeding and thrombectomy and re-anastomoses were applied on these patients, as a result patency achieved again.



Fig-1: DSA showing open reverse saphenous vein graft between popliteal artery and tibioperoneal trunkus.

Table-III: Early postoperative complications.

Complication	No	%
Mortality	2	6.2
Wound infection	6	18.7
Hematoma	4	12.5
Thrombosed graft	1	3.1
Ischemia	2	6.2
Minor amputation	2	6.2
Major amputation	1	3.1

At long term follow-up 6 years cumulative graft patency was found to be 38% and ratio of saved extremities was found to be 46%.

Bilateral by-pass was done in two (6.3%) of the cases and unilateral by-pass was done in 30 (91.8%). Patients in whom bilateral by-pass was done were operated at separate sessions. Firstly extremity with more complaints was operated and after approximately one month second operation was done. In two (6.3%) cases finger amputation was done at the same session due to necrosis at foot fingers. Major amputation was done in one of our patients. Mortality was seen in two (6.3%) at early stage and wound infections, hematomas and graft thromboses were observed respectively in six (18.7%), two (6.2%) and six (18.7%) of the patients.

DISCUSSION

Revascularization procedures at lower extremities vary and these are conventional methods such as by-pass, end-arterectomy, patch plasty, balloon angioplasty and stents.⁶ Additionally in recent years some new clinical and experimental procedures such as arteriovenous fistula (staged arteriovenous reversal technique), omental flap transfer, muscle flap transfer are being described.⁷ Despite all these

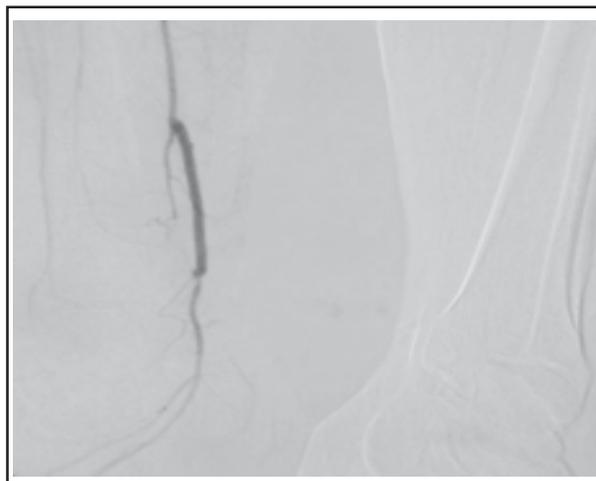


Fig-2: DSA showing bypass graft between proximal and distal portions of the posterior tibial artery.

approaches amputation rates have not decreased.⁸ Because, in some situations amputation of necrotized extremity becomes only and final solution for saving the life. There are important factors affecting the success of revascularization in infra-popliteal by-passes as all by-pass procedures. These are ideal proximal and distal anastomoses regions, appropriate graft material and successful anastomoses technique.^{9,10} Although pedal by-pass cases are increasing in recent 20 years, we only used pedal by-pass in only one case.

SVG concept started to be used extensively for infra-popliteal region after 1981.¹¹ If SVG is used as graft, short segment advantages are less surgical incision areas, fast wound healing, low infection risk as high patency ratios.^{12,13}

SVG and poly tetrafluoro ethylene (PTFE) are used as graft material. However, patency ratios of PTFE grafts are quite low for infra-popliteal by-passes.¹⁴ Four years patency ratios were found to be 39-59% for SVG's.¹⁵ Advantages of SVG as a most ideal graft are flexibility at flexion region, resistance to infection, resistance to aneurism formation, non-thrombogenic blood contact surface, suitability for surgical manipulation, keeping its aliveness for long times, feeding with diffusion and to be easy obtainable.¹⁶ Graft patency ratio was found as 38% in our follow-ups and this is comparable with the literature.¹⁵

Factors affecting saphenic vein graft patency are technical issues during preparation and preservation, varicose structure, thick wall, diameter less than 3.5mm and presence of fibrotic caps.^{6,16} After infrapopliteal by-pass mortality is 3-5%. In our series two patients (6.2%) died at early period. One of these patients died due to cardiac and one due to cerebrovascular events. Thus, cardiac system should be evaluated well pre-operatively and necessary precautions should be taken in the presence of pathologic conditions.⁵ Following infrapopliteal by-passes need for re-hospitalization emerges in 2-4 months duration in 7% ratio due to causes such as gangrene, infection or perfusion insufficiency.¹⁵ Early occlusion (first 30 days) causes in infrapopliteal by-passes are defects in anastomoses technique, wrong selection of proximal and distal placements of anastomoses and high thrombogenicity (flexion of graft, endothelial damage, long graft length). Late occlusion (after 30 days) are intimal hyperplasia, advancement of atherosclerosis at proximal/distal anastomoses region and formation of aneurisms.¹⁴ Our eight patients were taken to revision (Table-III). Graft thrombosis developed in six patients and they were re-operated. Long term openness rates of infra-popliteal by-passes

are lower when compared to by-passes at other regions.^{5,14,16} However infra-popliteal by-passes brings quite satisfactory results for regaining physical activity and saving the extremity. Our results are also pleasing and encouraging with 38% six years openness ratio and 46% extremity saving ratio. Although graft was occluded in eight patients amputations were not required.

CONCLUSION

By-pass operations performed on infrapopliteal arteries are quite effective with pleasing long term results and high extremity saving ratios. Application of this surgery to carefully selected patients is expected to increase the quality of life.

REFERENCES

- Bozer AY, Gunay I. Vascular diseases and surgery. Ankara: Hacettepe University Yayinlari, First edition. 1984: 72-100.
- Haimovici H. Atherosclerosis, biologic and surgical considerations. In: Haimovici H, ed. Vascular Surgery, Principles and Techniques. The 4th edition. New York: Blackwell Science. 1996: 127-58.
- Vraux H, Bertonecello N. Subintimal angioplasty of tibial vessel occlusions in critical limb ischaemia: A good opportunity? *Eur J Vasc Endovasc Surg* 2006;32: 663-667.
- Dorros G, Jaff MR, Dorros AM. Tibioperoneal (outflow lesions) angioplasty can be used as primary treatment in 235 patients with critical limb ischemia: Five-year follow-up. *Circulation* 2001;104:2057-2062.
- Conte MS. Bypass versus Angioplasty in Severe Ischaemia of the Leg (BASIL) and the (hoped for) dawn of evidence-based treatment for advanced limb ischemia. *J Vasc Surg* 2010;51(5):695-755.
- Melillo E, Nuti M, Buttitta F, Balbarini A. Medical therapy in critical lower limb ischemia when immediate revascularization is not feasible. *Ital Cardiol* 2006;7(5):317-335.
- Van Damme H, Baguet E, Zhang L, Creemers E, Limet R. Prevention of lower limb necrosis and amputation by femoro-crural bypass: Indications, techniques and results. *Rev Med Liege* 2003;58(6):415-428.
- Slovut DP, Sullivan TM. Critical limb ischemia: Medical and surgical management. *Vasc Med* 2008;13(3):281-291.
- Awopetu AI, Moxey P, Hinchliffe RJ, Jones KG, Thompson MM, Holt PJ. Systematic review and meta-analysis of the relationship between hospital volume and outcome for lower limb arterial surgery. *Br J Surg* 2010;97(6):797-803.
- Davis BL, Kuznicki J, Praveen SS, Sferra JJ. Lower-extremity amputations in patients with diabetes: Pre- and post-surgical decisions related to successful rehabilitation. *Diabetes Metab Res Rev* 2004;20 (1):45-50.
- Plecha EJ, Freischlag JA, Towne JB, Seabrook GR. Femoropopliteal bypass revisited an analysis of 138 cases. *Cardiovasc Surg* 1996;4(2):195-199.
- Klinkert P, Schepers A, Burger DH, Van Bockel JH, Breslay PJ. Vein versus polytetrafluoroethylene in above-knee femoropopliteal bypass grafting. Five years results of a randomized controlled trial. *J Vasc Surg* 2003;37(1):149-155.
- Veith FJ, Haimovici H. Femoropopliteal atherosclerotic occlusive disease. Haimovici H, Ascer E, Hollier LH, Strandness DE, Towne JB (editors). Haimovici's Vascular Surgery Principles and Techniques. The 4th edition, Cambridge Massachusetts, USA Blackwell Science Inc. 1996: 605-631.
- Novo S, Coppola G, Milio G. Critical limb ischemia: Definition and natural history. *Curr Drug Targets Cardiovasc Haematol Disord* 2004;4(3):219-225.
- Landry GJ. Functional outcome of critical limb ischemia. *J Vasc Surg* 2007;45:141-8.
- Sichel L, Chiavetta A, Soma PF, Failla G, Basile A, La Greca G, et al. Critical ischemia of the diabetic patient. *Minerva Chir* 2001;56(3):265-271.