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Original Article

Endovascular reconstruction of popliteal and infrapopliteal arteries for limb salvage and wound healing in patients with critical limb ischemia – A retrospective analysis

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ABSTRACT

Background: Advancement in endovascular techniques has led to rapid growth in endovascular revascularization, and it has emerged as a treatment for critical limb ischemia (CLI). Clinical effectiveness of revascularization has been frequently judged by vessel patency and limb salvage, but there is paucity of reports on outcomes of the wound. We present a retrospective analysis of immediate angiographic and 3-month clinical outcome of patients who underwent endovascular reconstruction of popliteal and infrapopliteal arteries for CLI. **Methods:** All patients who underwent endovascular reconstruction of popliteal and/or infrapopliteal arteries for CLI and >70% stenosis on digital subtraction angiography between March 2010 and November 2014 and had a clinical follow-up of at least 3 months were selected for analysis.

Results: 34 patients underwent endovascular reconstruction. 9 patients (26%) underwent only POBA and remaining 25 (74%) underwent additional stenting. 13 patients (38%) had multiple segmental revascularization. 24 patients (71%) had successful vessel recanalization. Linear flow to foot in at least one artery could be achieved in 20 patients (59%) post revascularization. Successful wound healing occurred in 11 (35%) patients with an additional 7 (21%) patients showing clinical improvement in their wounds. Limb salvage was achieved in 33 patients (97%) at 3-month follow-up.

Conclusion: Endovascular revascularization of popliteal and infrapopliteal arteries is a feasible, safe, and effective procedure for the treatment of CLI. Normal inflow and outflow with at least one of the three infrapopliteal vessels being patent is essential for adequate healing of chronic ulcers and prevention of major amputation.

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1. Introduction

Critical limb ischemia (CLI) occurs, when arterial blood flow to the part or entire foot is markedly reduced, in most cases as a result of progressive obstructive atherosclerosis.¹ Although surgical bypass has long been considered the gold standard treatment for CLI patients, its use is limited by absence of suitable conduits, advanced age, and presence of comorbidities, resulting in high morbidity and mortality rates.² Advancement in endovascular techniques and technology has led to rapid growth in endovascular revascularization of popliteal, tibial, peroneal, and pedal arteries, and it has emerged as a treatment for CLI secondary to popliteal and infrapopliteal artery stenosis/occlusion.³ Clinical effectiveness of endovascular revascularization has been frequently judged by vessel patency and limb salvage, but still there is a paucity of reports on outcomes of the wound.¹ We present a retrospective analysis of immediate angiographic and 3-month clinical outcome of patients who underwent endovascular reconstruction of popliteal and infrapopliteal arteries for CLI.

2. Methods

All patients who underwent endovascular reconstruction of popliteal and/or infrapopliteal arteries for CLI and >70% stenosis on digital subtraction angiography between March 2010 and November 2014 and had a clinical follow-up of at least 3 months were selected for analysis. CLI was defined as >2 weeks of rest pain or ulcer/gangrene attributable to peripheral arterial disease. Serum creatinine value was determined before and after the procedure. A nephroprotection protocol was used in all nondialyzed patients with baseline creatinine above 1.3 mg% (N-acetylcysteine 600 mg twice a day and Trimetazidine 35 mg twice a day, both given orally for 5 days). Patients were preloaded with 600 mg of clopidogrel, 60 mg of prasugrel, or 180 mg of ticagrelor 1 h prior to the procedure.

Percutaneous transluminal angioplasty (PTA) was performed under local anesthesia through contralateral puncture of the common femoral artery, and vascular access was accomplished using 7 F Introducer Sheath (Cordis Corporation, Florida, USA). If obstructions were present at duplex scanning in the contralateral iliac or common femoral artery, the arterial puncture was performed through an antegrade puncture of ipsilateral common femoral artery. 7500 U bolus of heparin was administered intra-arterially at the beginning of the procedure and ACT was maintained above 250 s. A double length (300 cm; Cougar XT, Medtronic USA) 0.014-in. guide wire was used to cross the lesion.

PTA was performed with standard angioplasty balloons (2–15 cm in length; 2–10 mm in diameter) selected to match the length of the lesion and the diameter of the artery. Balloon size selection was based on the visual estimate of the size of the vessel. Balloon inflation pressures ranged from 4 to 16 atmospheres and were repeated routinely two to three times (for at least 60 s) at the same segment. A variety of balloon catheters (Maverick Monorail-Boston Scientific, Ireland;

Admiral xTreme – Invatec, Italy; and Amphirion Deep – Invatec, Italy) were used.

Stents used were either bare metal stents (BMS) (Prozeta PS, Vascular Concepts, Bangalore, India) and drug eluting stents (DES) (Pronova, Vascular Concepts, Bangalore, India; Biomime Aura, Meril, Brussels, Belgium), or self expanding stents (Complete SE, Medtronic Inc, Minneapolis, USA). All popliteal/infrapopliteal lesions were stented only if >30% residual stenosis or flow limiting dissection occurred following plain balloon angioplasty and associated inflow (ileal/femoral) lesions were also stented.

Dual oral antiplatelet therapy with aspirin (150 mg/day) and clopidogrel (75 mg/day), prasugrel (10 mg/day) or ticagrelor (90 mg/day) was continued long term (at least 1 year) and the duration of treatment was life-long for aspirin.

Vessel recanalization was considered successful when direct flow was obtained in the treated vessel, with no significant residual stenosis along the whole artery. Wound healing was considered successful when the index wound got completely healed within 3-month follow-up. In patients presenting with rest pain without foot ulcer, the disappearance of pain was considered limb salvage successful. In patients with foot ulcers, we considered limb salvage successful when the plantar stand was maintained, even when achieved by a tarsal-metatarsal amputation. Any above-the-ankle amputation was considered a failure.

3. Results

34 patients underwent endovascular reconstruction of popliteal and infrapopliteal arteries for CLI between March 2010 and November 2014 (Table 1). Mean age was 65 years (range 43–84 years) and majority (97%) had diabetes. 8 patients (24%) had coronary artery disease, and 3 (9%) had associated LV dysfunction (LVEF <40%). 31 patients (91%) had an ulcer, while 3 patients (9%) presented with rest pain.

Obstructions of >70% of vessel diameter were present in the infrapopliteal arteries in all patients except two ($n = 32$, 94%). 15 patients (44%) had lesions affecting all 3 infrapopliteal

Table 1 – Clinical and demographic characteristics of patients.

Variable	Study subjects ($n = 34$)
Age	
40–60	15 (44%)
61–75	16 (47%)
>75	3 (9%)
Men	22 (65%)
Women	12 (35%)
Diabetes mellitus	33 (97%)
Smoking	2 (6%)
Coronary artery disease	8 (24%)
LV dysfunction	3 (9%)
Baseline high creatinine (>1.3 mg%)	9 (26%)
Rest pain	3 (9%)
Ulcer	31 (91%)
Gangrenous ulcer	9 (26%)
Prior toe amputation	8 (24%)

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