Assessment of limb salvage in single peroneal runoff versus single tibial runoff in patients with critical limb ischemia having complex lesions

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Introduction
The value of peroneal artery revascularization has always been debatable, especially in patients with tissue loss. As one of the most important factors of wound healing is the establishment of in-line flow to the foot, the role of peroneal angioplasty has to be defined.
Aim
The aim was to assess the adequacy of single peroneal vessel runoff in endovascular revascularization of patients with TASC C-D lesion and critical limb ischemia (CLI) as infrapopliteal disease.
Patients and methods
This is a prospective study involving patients with TASC C-D lesions presenting with CLI along 1 year. Patients were stratified into two groups according to their runoff states. Group P includes patients with single peroneal vessel runoff, whereas group T includes patients with single tibial runoff other than peroneal. Patients with two or three vessel runoff were excluded from the study.
Results
The study included 180 patients, with age ranging from 42 to 86 years; 55% were male patients. Of the 180 patients, 60 patients had single peroneal vessel runoff (group P) whereas 120 patients had a single tibial runoff (group T). The mortality rate along 2 years was 10 and 5% in groups P and T, respectively. Limb salvage rate along 2 years was 68.8% in group P and 79.8% in group T ($P<0.036$). The primary and secondary patency rates over 2 years in group P were 31.3 and 54.2%, respectively, and in group T were 47.7 and 62.4%, respectively.
Conclusion
In patients having CLI with TASC C-D lesion, although single peroneal runoff showed slightly lower limb salvage rate compared with single tibial runoff, it is valuable in patients with no other alternative for revascularization. We think that further studies are required to examine the importance of presence of direct pedal communication and its effect on the clinical success (limb salvage and disappearance of rest pain) of peroneal artery angioplasty.

Keywords:
critical limb ischemia, infrapopliteal disease, limb salvage, peroneal angioplasty

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Introduction

The value of peroneal artery (PA) revascularization has always been debatable, especially in patients with tissue loss. As one of the most important factors of wound healing is the establishment of in-line flow to the foot, the role of peroneal angioplasty has to be defined.

The PA is relatively spared from the terminal stages of atherosclerosis and is often the last tibial vessel to become occluded in diabetes or end-stage vascular disease. The main prejudice, on the contrary, against its use in distal revascularizations is that the perfusion of the foot is indirect, via collaterals from its anterior and posterior branches, despite an extensive collateral arterial bed, so the target vessel may be inadequate for treating a septic or gangrenous foot [1].

The aim of this study was to assess the adequacy of single peroneal vessel runoff in endovascular revascularization of patients with TASC C-D lesions having critical limb ischemia (CLI).

Patients and methods

This is a prospective study that included 180 patients with infrainguinal TASC C-D lesions presenting with CLI between June 2014 and June 2016. Patients were stratified into two groups according to their runoff states. Group P includes patients with single peroneal

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vessel runoff, whereas group T includes patients with single tibial runoff other than peroneal.

Patients with two or three vessel runoff were excluded from the study. All patients were reviewed regarding age, sex, risk factors, primary and secondary patency, limb salvage, and mortality. All patients were followed up at 1, 3, 6, 12, and 24 months by both clinical and duplex examinations.

All patients underwent clinical assessment, preprocedural investigations, selection criteria for this study, technique, procedural outcome, procedural complications, and postprocedural management.

Clinical assessment

History taking and clinical examination were done for all patients, which included age and sex and major risk factors for atherosclerosis, including diabetes mellitus, smoking, hypertension, cardiac diseases, chest diseases, renal insult, and stroke. Clinical categorization of chronic lower limb ischemia was done in accordance to the categorization by Rutherford–Baker scale of severity of peripheral arterial disease for chronic lower limb ischemia.

Preprocedural investigations

(1) Routine laboratory tests: they included complete blood picture, kidney and liver function tests, coagulation profile, lipids profile, and blood glucose level.
(2) Duplex scanning: patients were scheduled for duplex scanning before intervention, and at 6, 12, and 18 months of follow-up.

Selection criteria for our study

Inclusion criteria

The study included patients with critical chronic lower limb ischemia with lesions involving the infrapopliteal vessels with or without proximal lesions and presenting with the following:

(1) Ischemic rest pain (category 4, grade II Rutherford classification).
(2) Minor tissue loss as nonhealing foot ulcers or focal gangrene (categories 5 and 6, grade III Rutherford classification).

Exclusion criteria

The following exclusion criteria were applied:

(1) Patients with claudication either capacitating or incapacitating.
(2) Patients with more than two runoff tibial vessels.
(3) Aneurysmal disease and AVF.
(4) Known intolerance to study medications or contrast agents.
(5) Nonatherosclerotic infrapopliteal disease.

Technique

Preprocedure preparations

Patients were admitted either 1 day before or on the day of the procedure. A loading dose of clopidogrel 300 mg was given the night of the procedure.

Access site

Femoral artery access was used either ipsilateral antegrade or retrograde fashion based on the lesion site in the femoropopliteal segment from the finding of the duplex or diagnostic angiographic study. Ipsilateral antegrade femoral access was used in lesions involving the mid to distal femoropopliteal or infrapopliteal arteries. Contralateral retrograde femoral access was used in atherosclerotic lesions of the iliac, common femoral artery, ostial lesion of the profunda femoris or proximal superficial femoral artery, and obesity. Anatomic and fluoroscopic localization of the common femoral artery was done for all patients.

For every patient, the following data were recorded:

(1) Indications of the procedure.
(2) Risk factors, for example, diabetes mellitus, cardiac disease, hypertension, and renal failure.
(3) Access method.
(4) Type of the guide wire.
(5) Size of the balloon (diameter and length).
(6) Lesions were categorized as stenoses, occlusions, or both.

Procedural outcome

The procedure was considered to be successful depending on the following:

(1) Immediate success, that is, regain of pulse, revascularization warmness, edema, and disappearance of rest pain.
(2) Clinical improvements should include symptomatic improvement and change of at least one category according to categorization of Rutherford–Baker scale of severity of peripheral arterial disease for chronic lower limb ischemia.
(3) Angiographic success was defined as less than 30% residual stenosis measured at the narrowest point of vascular lumen.

Procedural complications

Complications were divided into major and minor. Major complications included death, need for emergency surgery, major bleeding, or acute thrombotic occlusion. Minor complications included hematoma, peripheral emboli, or spasm of the tibial vessels after posterior tibial artery (PTA).

Approval from the ethical committee in Cairo University, Vascular Surgery Division of General Surgery Department, was taken before the beginning of the study.

Primary outcome included primary and secondary patency rates and limb salvage rate.

Secondary outcome included amputation-free survival and mortality rate.

Data analysis

The data were analyzed with SPSS 16.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Numerical data are expressed in mean and SD. Analysis of variance *t*-test is used to compare the three groups. *P* value is significant when below 0.05.

Results

This prospective study included 180 patients, with age range from 42 to 86 years and mean age of 62 years; 55% were male patients. Of the 180 patients, 60 patients had single peroneal vessel runoff (group P), whereas 120 patients had a single tibial runoff (group T). Most of the patients are diabetics and male (demographic features and co-morbidities are shown in Table 1. The main presentation is Rutherford V (Table 2).

Table 1 Co-morbidities in each group

Risk factors and co-morbidities	Peroneal (*N*=60) [*n* (%)]	Tibial (*N*=120) [*n* (%)]
Diabetes	52 (86.6)	117 (97.5)
HTN	43 (71.6)	97 (80.8)
Smoking	38 (63.3)	47 (39.1)
Cardiac	26 (43.3)	45 (38.8)
COPD and asthmatic	1 (1.6)	3 (2.5)
Renal disease	1 (1.6)	2 (1.6)
Stroke	3 (5)	8 (6.6)

COPD, chronic obstructive pulmonary disease; HTN, hypertension.

Table 2 Presentations of different groups

Clinical presentation	Peroneal [*n* (%)]	Tibial [*n* (%)]
Rutherford IV	10 (16.6)	15 (12.5)
Rutherford V	27 (45)	77 (64.2)
Rutherford VI	23 (38.3)	28 (23.3)

The mortality rate along 2 years was 10 and 5% in groups P and T, respectively. Limb salvage rate along 2 years was 68.8% in group P and 79.8% in group T ($P<0.036$). The primary and secondary patency rates over 2 years in group P were 31.3 and 54.2%, respectively, and in group T were 47.7 and 62.4%, respectively (Table 3 and Figs. 1–5).

Discussion

To our knowledge, this is the largest series comparing the outcome in peroneal only angioplasty compared with other single tibial angioplasty in patients with infrapopliteal critical limb disease. The major finding in this study is that in patients having CLI with TASC C-D lesion, although single peroneal runoff showed slightly lower limb salvage rate compared with single tibial runoff, it is valuable in patients with no other alternative for revascularization. We think that further studies are required to examine the importance of presence of direct pedal communication and its effect on the clinical success (limb salvage and disappearance of rest pain) of PA angioplasty.

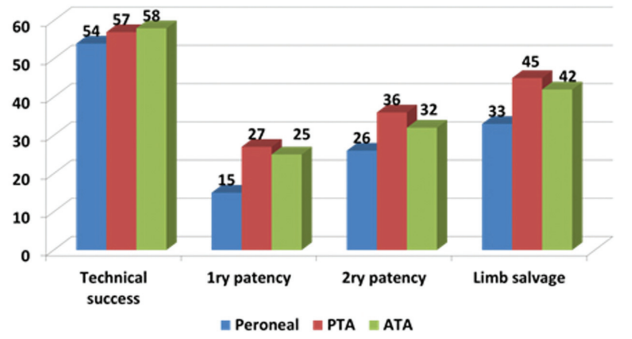
Using the PA angioplasty has been an argumentative issue. Some authors think that owing to the PA is

Table 3 Primary and secondary patency and limb salvage rate (LSR) of different groups

12 months	Peroneal [*n* (%)]	PTA [*n* (%)]	ATA [*n* (%)]	*P* value
Technical success	54 (90)	57 (95)	58 (96.6)	NA
Primary patency	15 (31.3)	27 (50)	25 (45.5)	0.044
Secondary patency	26 (54.2)	36 (66.6)	32 (58.2)	0.132
Limb salvage rate	33 (68.8)	45 (83.3)	42 (76.4)	0.036
Mortality rate	6 (10)	3 (5)	3 (5)	0.540

ATA, anterior tibial artery; PTA, posterior tibial artery.

Figure 1

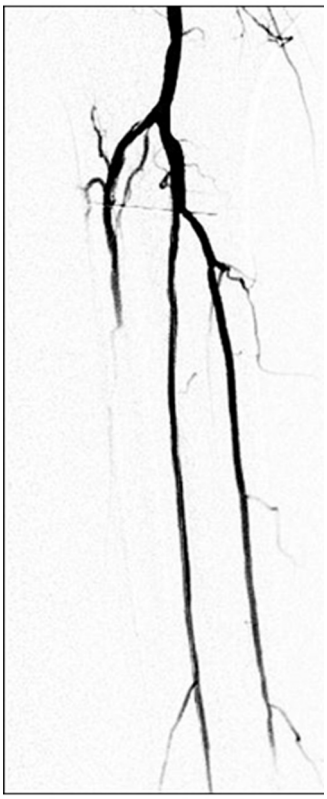


Shows the differences in TS, 1ry patency, 2ry patency, LS.

Figure 2

Shows peroneal artery before dilatation.

Figure 3



Shows peroneal artery after dilatation.

usually the last and the least tibial vessel to be affected with atherosclerosis in diabetic or end-stage tibial disease, in the meantime it has limitation in the form of indirect perfusion of the foot, in spite of an extensive collateral arterial bed, consequently it may be insufficient for treating a septic or gangrenous foot and this lead some authors to believe that it is an inappropriate outflow vessel [2–6].

On the contrary, long-term patency and limb salvage rate after PA angioplasty are mentioned by some authors to be as good as angioplasty to other tibial vessels angioplasty [1,6,7].

Although peroneal bypass surgery is the gold standard and it achieves a comparable hemodynamic result and limb salvage to other infrapopliteal bypass, provided a good quality vein is seen, its role in patients with extensive tissue loss and infection still needs to be clarified and is an arguable issue, and it is associated with considerable perioperative mortality and postoperative complications [6,8].

Review of literature revealed that no study has compared the angioplasty of peroneal only to other single tibial angioplasty. The only study that compared the adequacy of only peroneal runoff was done by Ballotta *et al.* [1] on surgical reconstruction to PA. They concluded that patency, LS, and wound healing after revascularization to the PA and other infrapopliteal arteries are comparable to each other, and this may provide an evidence that the influential outcome of the arterial reconstruction is not affected by outflow choice. Moreover, they found that PA contributes well to the tissue perfusion despite the lack of any direct communication between the PA and the major pedal vessels, and there is no reason to reject the PA as the last-choice outflow vessel for distal revascularization [1].

Other authors mentioned the importance of presence of wound blush after endovascular therapy in higher rates of limb salvage, and it may be a predictor of limb salvage in patients with CLI [9].

Although we did not study the effect of association between PA and other major pedal vessels, we think that it is important for optimal wound healing and different, at least in the hemodynamic effect, in angioplasty rather than surgery, and therefore, this issue should be elaborated more in angiolasty to study its effect on tissue healing.

Figure 4

Peroneal artery after dilatation communicating with ATA.

Figure 5

Peroneal artery after dilatation communicating with PTA.

Graziani *et al.* [7] attempted to provide, by endovascular treatment, direct straight-line flow to the foot through a native tibial artery, selecting, whenever possible, the anterior tibial artery for ischemic forefoot lesions and the posterior tibial for calcanear lesions. If neither the anterior nor the posterior tibial artery can be treated despite several intraluminal and subintimal crossing attempts, the alternative treatment may consist of providing direct flow along the PA. They achieved good results in better healing and limb salvage [7].

As suggested by Faglia *et al* [10], the adequacy of a reconstruction with peroneal only runoff in some diabetic patients with infected gangrene and major tissue loss following debridement may not be adequate, and more direct blood flow to the involved angiosome may be necessary, either with additional endovascular recanalization or direct bypass. However, Dosluoglu *et al.* [6] found that as the major determinant of limb loss is the amount of tissue loss with extensive gangrene and overwhelming infection, limb loss may still be inevitable even if normal perfusion is restored in these patients.

Although the primary patency and limb salvage were statistically significantly higher in T group than P group, PA is still of a great value when revascularization to other tibial vessels fails by all means of intraluminal, subintimal, and retrograde recanalization or absent. This results may be attributed to the high percentage of severe tissue loss in this study (~85% of cases Rutherford V and VI).

Conclusion

In patients experiencing CLI with TASC C-D lesion, although single peroneal runoff showed slightly lower limb salvage rate compared with single tibial runoff, it is valuable in patients with no other alternative for revascularization. We think that further studies are required to examine the importance of presence of direct pedal communication and its effect on the clinical success (limb salvage and disappearance of rest pain) of PA angioplasty.

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Conflicts of interest
There are no conflicts of interest.

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