Endovascular retrograde tibial access for limb salvage in Chronic Limb-Threatening Ischemia: A Case Report

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Research Article

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Abstract

Background:

 Peripheral artery disease is a chronic disorder characterised by stenosis and/or occlusion of peripheral large and medium-sized arteries. It most commonly affects the lower limbs, causing claudication, and foot ulcers/gangrene, which if not treated correctly can lead to Chronic Limb-Threatening Ischemia. This condition requires revascularization to improve limb perfusion and limit the risk of amputation.

Case presentation:

 We describe the case of a 76-year-old Latin American male who presented to the emergency department with ischemic rest pain and ulceration of the left limb. Angiotomography showed severe stenosis in the left common femoral, superficial femoral, and popliteal left arteries. Percutaneous angioplasty intervention was made to restore the blood flow and limb salvage. A retrograde approach was obtained via ultrasonography-guided tibial anterior artery puncture. The post-procedural course was uneventful. The retrograde puncture technique allowed adequate blood flow without complications. Follow-up 2 months later showed resolution of foot ulcer.

Conclusions:

 There are still limited studies available to evaluate the effectiveness and long-term success of tibio-pedal access for revascularization, nevertheless, it shows a promising option for patients with poor surgical options in need of urgent intervention.

Background

 Peripheral artery disease (PAD) is a chronic disorder characterised by stenosis and/or occlusion of large and medium-sized peripheral arteries excluding coronary and cerebral vessels. Most commonly, it affects the lower limbs, causing claudication and foot ulcers or gangrene, which, if not treated appropriately, can lead to chronic limb-threatening ischemia (CLTI) [Shu & Santulli, 2018]. CLTI requires revascularization to improve limb perfusion and limit the risk of amputation [Farber et al., 2022]. The endovascular approach for revascularization has become a viable and safe option for patients for whom open surgery is not possible. Usually, the approach is made by antegrade insertion in the superficial femoral artery. However, in about 20% of cases, this technique is not possible due to the extent and occlusion. An alternative technique consists of retrograde access using the pedis or tibial artery [El-Sayed et al., 2016]. In this case we present the need for consideration of a retrograde access for endovascular revascularization when the antegrade approach is not possible, which could lead to improvement of symptoms and ultimately limb salvage.

Case Presentation
A 76-year-old Latin American male patient presented to the emergency department with intense 7/10 left lower limb rest pain of several days of evolution. His past medical history was significant for supracondylar amputation of the right lower limb (1 month before) due to an infected diabetic foot ulcer and chronic peripheral artery disease. Furthermore, the patient had hypertension, diabetes mellitus type 2, and ischemic heart disease. Physical examination was positive for skin coloration changes, and a 4cm x 4cm necrotic ulcer at the medial side of left leg, classified as a Rutherford type V lesion (Figure 1).

Angiotomography (Figure 2a) and plethysmography showed severe stenosis in the left common femoral, superficial femoral, and popliteal arteries with evidence of distal beds and adequate defense by collaterals (TASC C lesion).

As a salvage measure for the left limb, due to the high surgical risk of an open procedure, a percutaneous angioplasty intervention was selected. The left common femoral artery was punctured anterogradely with an angiographic needle, and a 5-French sheath introducer was inserted. The lower limb arteriography was then performed, finding chronic total occlusion of the proximal segment of the superficial femoral artery (Figure 2b). A 0.035-inch guidewire was advanced in an antegrade direction to cross the occluded lesion; however, it failed, so a rigid guide of 0.35 x 150 was passed, overcoming the obstruction site, and balloon angioplasty was performed with an Admiral™ Xtreme PTA 5.0 x 120 mL x 130 cm, resulting in a partial improvement in flow.

A hydrophilic working guide was changed, and angioplasty was attempted with evidence of venous leakage (Figure 3b). It was not possible to continue flow towards the distal vessels, so a retrograde approach was obtained via ultrasonography-guided tibial anterior artery puncture followed by insertion of a hydrophilic 035 x 260 retrograde wire (Figure 3c), which was passed through the chronic total occlusion (CTO) and then recovered at the femoral. Angioplasty of the femoral, popliteal, and tibioperoneal trunk was performed with an Admiral™ Xtreme PTA 4 x 60, and angioplasty of the anterior tibial artery was made with a SLEEK® RX PTA Dilatation Catheter 12. 5 x 220 with a manometer syringe kit. Angiographic control showed adequate flow, and no additional paths (Figure 4). Femoral closure was carried out with Perclose™ ProGlide™. The patient had an adequate clinical course and was discharged. Control angiotomography was made 1 month after the procedure, showing improvement in flow on the superficial femoral and popliteal arteries (Figure 4f).

The patient was assessed after two months in the outpatient clinic; he had adequate distal capillary refill and resolution of the ulcer.

**Discussion**

PAD represents the second most common manifestation of atherosclerosis worldwide, affecting more than 200 million people [Beckman et al., 2021]. CLTI represents the most severe clinical presentation of PAD. The clinical definition of CLTI proposed by the Global Vascular Guidelines includes either ischemic rest pain or tissue loss (ulcers or gangrene) present for at least 2 weeks with objective evidence of PAD (Conte et al., 2019). This entity threatens the life and integrity of the limb, and usually, revascularization is
needed to improve limb perfusion, limit the risk of amputation, minimize tissue loss, and reduce mortality by reversing hemodynamically significant stenosis (Beach, 2021; Beckman et al., 2021). Furthermore, it allows relief of pain, healing of wounds, preservation of functional extremities, and improvement of the quality of life [Beckman et al., 2021]. Without revascularization therapy, the incidence of limb amputations 1 year after diagnosis may be about 25% [Farber et al., 2022].

Restoration of flow can be obtained through different methods, surgical bypass and endovascular therapy are the main strategies used to treat CLTI. The technique to be chosen depends on the pattern of the disease, surgical risk, availability of an autogenous conduit for vein bypass, and patient preferences. Many CLTI patients are unsuitable surgical candidates due to poor conduit, poor distal runoff, and high operative risk. In these patients, endovascular revascularization is being used more frequently [Beckman et al., 2021]. Likewise, when occlusion at the femoral-popliteal level is present, especially in long compromised and heavily calcified arteries, other strategies may be required, such as true-lumen wire drilling techniques, crossing devices, subintimal dissection, reentry devices, or retrograde access (e.g., retrograde popliteal, tibial or pedal access) [Beckman et al., 2021].

Endovascular therapy has proven to have similar results to an open surgical intervention, which is the gold standard for treating CLTI, with an 85% chance of technical success and a range of complications between 0 and 16%, as shown in case reports and single-center studies [Lejay et al., 2009; Walker et al., 2016]. This approach usually involves a contralateral or ipsilateral antegrade insertion in the superficial femoral artery. However, in approximately 20% of cases, this is not possible due to the extent of the occlusion, forcing surgeons to find new ways to access the infrapopliteal vessels. The use of tibial-pedal access after a failed antegrade approach to cross-infrainguinal lesions has become a critical intervention strategy commonly used in patients with poor surgical options [Walker et al., 2016]. This type of practice is still controversial due to the possibility of injury to smaller arteries such as the pedis, which could increase the risk of limb loss in some patients who only have a single viable artery.

Tibiopedal revascularization has proven to be a viable technique with additional advantages over open surgery or endovascular therapy. Thus, this access allows crossing following a failed antegrade attempt. Moreover, it provides less bleeding risk, a reduced time of procedure, and less time to discharge [Giannopoulos et al., 2021]. In our experience, the lesion was traversed anterogradely and promoted clinical improvement. In symptomatic PAD, a chronic total occlusion (CTO) occurs in approximately 40% of patients [Kuserli & Kavala, 2020]. Commonly, these lesions tend to be diffuse and severe. We found a CTO at the proximal segment of the superficial femoral artery after an antegrade puncture. This approach didn't allow continued flow towards the distal vessels, requiring retrograde access through the tibial anterior artery. This technique allowed successful angioplasty of the femoral, popliteal, tibioperoneal, and anterior tibial arteries.

The retrograde access makes the crossing of chronic total occlusions more likely and makes it feasible to use an endovascular approach in patients with complex CLTI [Schmidt et al., 2019]. This may be due to the cap theory
[Giannopoulos et al., 2021], which states that some CTO lesions are easier to cross depending on the morphology of their proximal and distal caps during angiographic imaging, assuming the direction of flow. The term “cap” is used to describe the layer that covers the atherosclerotic plaque, which can take a convex or concave shape. This often represents a challenge to determine the total length of a CTO. Usually, contrast columns can’t penetrate the caps located at the proximal and distal ends of the occlusion. This morphology is necessary to plan the crossing of the lesions in an antegrade or retrograde technique [Saab et al., 2018]. A clearly defined proximal cap favors the upfront use of an antegrade approach, whereas a poorly defined proximal cap favors a primary retrograde approach [Hanna & Prout, 2016; Karatasakis et al., 2017].

**Conclusions**

Endovascular therapy has become a feasible and safe approach for patients who cannot undergo an open surgical procedure in CLTI; however, a classic antegrade approach can fail. A nonconventional retrograde approach using the pedis artery may be used. There are still limited studies available to evaluate the effectiveness and long-term success of tibio-pedal access for revascularization, nevertheless, it shows a promising option for patients with poor surgical options in need of urgent intervention.

**Abbreviations**

PAD
Peripheral artery disease

CLTI
Chronic limb threatening ischemia

CTO
Chronic total occlusion

**Declarations**

**Ethics approval and consent to participate**

All required measures were undertaken to preserve the information’s confidentiality. All procedures performed in studies involving human participants were in accordance with the ethical standards of Comité de Ética en Investigación Clínica de la Fundación Cardioinfantil- Instituto de Cardiología (No. 047-2022) at which the studies were conducted and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Consent for publication**

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.
Availability of data and materials

All the data and supporting files have been presented within the case report.

Competing interests

The authors declare that they have no competing interests.

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Authors’ contributions

JGBC, PFA and JRCA performed the clinical examination, diagnosis and interventional treatment of the patient. MIM and JMCR contributed to literature review and manuscript writing. All authors contributed with the revision of the manuscript. All authors read and approved the final manuscript.

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References


Figures
Figure 1

Illustration of 4 x 4 cm ischemic necrotic ulcer, perilesional skin color changes and minimal tissue loss on the medial side of the left leg Rutherford scale Class 5.
Figure 2

Intraoperative sequence, showing long-segment occlusion of the superior femoral artery (12 cm) showing distal reconstitution.

a. Angiotomography showing common and deep femoral arteries with good trajectory and caliber, calcified atheromatous plaques in its walls, without significant stenosis of the vascular lumen. Superficial femoral artery with calcified atheromatous plaques in its walls promoting segmental stenosis of the vascular lumen predominantly distal, with collateral vascular flow and distal recanalization towards the popliteal artery.

b. Anterograde arteriography with evidence of permeability of the common femoral artery, superficial femoral artery and deep femoral artery.

c. Chronic total occlusion of the superficial femoral artery with collaterals originating from the deep femoral artery.

d. Chronic total occlusion of the distal superficial femoral artery.

e. Chronic total occlusion of the popliteal artery.
f. Proximal cap with concave shape during angiographic imaging.

Figure 3

Intra operative procedure images, showing:

a. Hydrophilic guide moving forward on CTO

b. Venous leakage after angioplasty

c. Retrograde approach by puncture of the anterior tibial artery guided by ultrasonography, achieving advances over the CTO.

d. Subintimal progression through CTO

e,f. Common femoral artery guidewire recovery
Figure 4

Intra operative sequence, showing:

a-b. Selective injection to demonstrate flow in the femoropopliteal segment.

c. Angiography demonstrating patency in tibioperoneal trunk.

d-e. Control angiography following anterior tibial artery angioplasty.

f. Control angiotomography one month after intervention demonstrated primary patency.