Infrapopliteal angioplasty: the more arteries are treated the better?

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Introduction

Atherosclerosis is considered as a civilization disease, which grows with it and increasingly affects younger individuals.[1,2] With an apparently irregular worldwide distribution, it is manifested in around 3-10% of the population,[2-4] increasing to 15-20% in people aged 70 years or older.[3,4] Mean annual incidence of symptomatic peripheral arterial occlusive disease (PAD), atherosclerosis, according to a study by Framingham,[5] is 26/10,000 men and 12/10,000 women, increasing with age.

In its initial presentation, 20-30% of patients aged 50 years or older are asymptomatic, 30-40% have atypical leg pains, 10-35% have typical intermittent claudication, and 1-3% have critical ischemia.[3,4] After 5 years of evolution, among patients who initially did not have critical ischemia, 70-80% stabilized the claudication symptoms, 10-20% had their claudication worsened, and 5-10% developed critical ischemia.[3,4] In patients who have critical ischemia initially, 45% survive with both limbs, 30% are amputated, and 25% die.[3,4]

Based on many epidemiological studies conducted over the past decades, risk factors for PAD influencing its natural course have been established, increasing its incidence and accelerating its progression.[3,4] The main risk factors are age, gender, dyslipidemia, smoking habit, hypertension, diabetes mellitus (DM), obesity, hyperhomocysteinemia, and genetic or family factors of atherosclerotic disease.[1,3,4] Diabetic patients have twice as more symptoms of intermittent claudication, four times higher chance of developing critical ischemia and five to ten times higher

likelihood to undergo amputation than non-diabetic patients.[3,4]

In diabetic patients, particularly in those who often have critical ischemia with multisegmental and predominantly distal lesions (infrapopliteal), successful revascularization, especially using venous conduits, reduces risk of major amputations.[2-4,6-14] More recently, due to the development of new endovascular materials, catheters, lower profiles and improvement in surgeons' learning curve, infrapopliteal angiography has become an attractive alternative, since it is less invasive and has good immediate outcomes.[3,4,6-8,11-22]

This article aims at discussing, using an illustrative case, to what extent distal revascularization should keep on using the endovascular technique.

Part I - Clinical case

Previous history and surgical description

The patient is a 68-year-old woman, born in São Manoel (SP, Brazil), hypertensive, diabetic, cardiac, ex-alcoholic (4 to 5 doses of alcohol/day for 20 years) and smoker (38 years/pack), with PAD, diabetic macroangiopathy and microangiopathy.

Two months ago, the patient was successfully submitted to an angioplasty using self-expandable primary stent of the right proximal superficial femoral artery, angioplasty using balloon-catheter of the femoropopliteal transition and tibiofibular trunk (TFT) lesion. She started presenting popliteal pulse, maintaining distal pulses absent, but with important clinical improvement. Ankle-brachial indexes (ABI) of the anterior tibial artery (AT) and fibular artery, which were initially 0.46, raised to 0.57, and the posterior tibial artery (TP) index remained zero.

She was lost to follow-up for 2 months and was admitted at the emergency room complaining of rest pain and ulcer worsening, with necrotic ulcer and purulent secretion, extending through the back of the foot, lateral side of the right hallux and second toe (Figure 1). An arterial *duplex* scan of the right lower limb was performed, showing the superficial femoral artery patent, with no signs of significant stenosis, and TFT close to the fibular artery junction with ultrasound signs of stenosis > 70% (Figure 2).

Figure 1 - Necrotic ulcer and purulent secretion, extending through the back of the foot until the lateral aspect of the right hallux and second toe

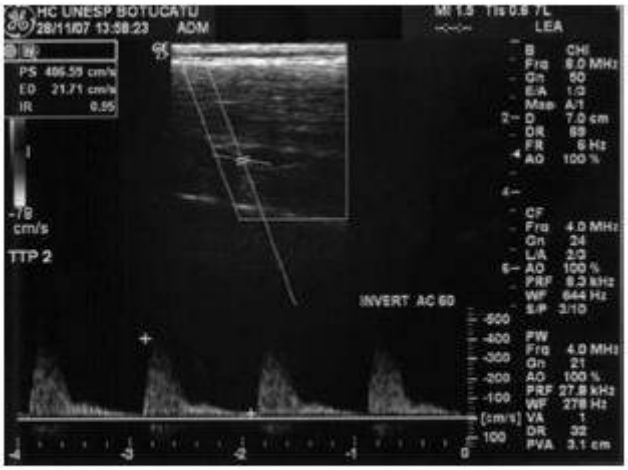

Figure 2 - *Arterial* duplex of the right lower limb with tibiofibular trunk close to the fibular artery junction (stenosis > 70%)

The patient was hospitalized for a new endovascular treatment. Choice was for contralateral puncture to spare the patent stent, which was located in the proximal superficial femoral artery. The puncture was performed using an 18G needle, and through it a 260 cm, 0.035 mm Stiff hydrophilic guide wire was crossed. The needle was removed and a valved 5F 11-cm sheath was passed. A mammary diagnostic catheter was introduced through the guide wide to perform a crossover maneuver. A control selective angiography was performed, and then the 5F sheath was replaced by a 6F/90 cm (Bright Tip). At that moment, endovenous 5,000 IU unfractioned heparin was administered. Using a road-map view, the long sheath was advanced through the guide wire until reaching the infragenicular region. A new angiography was performed to locate the lesions aimed to be treated. Angiography showed patent TFT, occluded AT soon after its emergence, occluded TP in its origin and critical stenosis (±90%) close to the fibular artery origin, which was patent in all its extension, but with several moderate and diffuse parietal irregularities. In its distal portion, it gave origin to the anterior perforating artery, which refilled the dorsal artery of foot (Figure 3).

Figure 3 - Preprocedure angiography: patent tibiofibular trunk, occluded anterior tibial artery soon after its emergence, occluded posterior tibial artery in its origin; fibular artery: critical stenosis (±90%), patent in all its extension, with parietal irregularities; it originates the anterior perforating artery distally, which refills the dorsal artery of the foot

Guided by road-map, the fibular artery lesion was transposed with a 260 cm, 0.035 mm Stiff hydrophilic guide wire and vertebral catheter with difficulty, since it was a calcified lesion. After transposition, a selective angiography was performed to ensure that the guide wire was in the vessel lumen (Figure 4). An angioplasty of the lesion was performed using a 3.0 X 120-mm catheter-balloon (Sailor, Invatech, OTW, 0.035 mm, 5F), with immediate success shown in angiographic control, showing patent fibular artery, with no parietal irregularities and ending at its distal branch, and anterior perforating artery, which refilled the dorsal artery of foot, as shown in previous arteriography (Figure 5).

Figure 4 - Selective angiography of the fibular artery: ensuring that the guide wire was in the vessel lumen

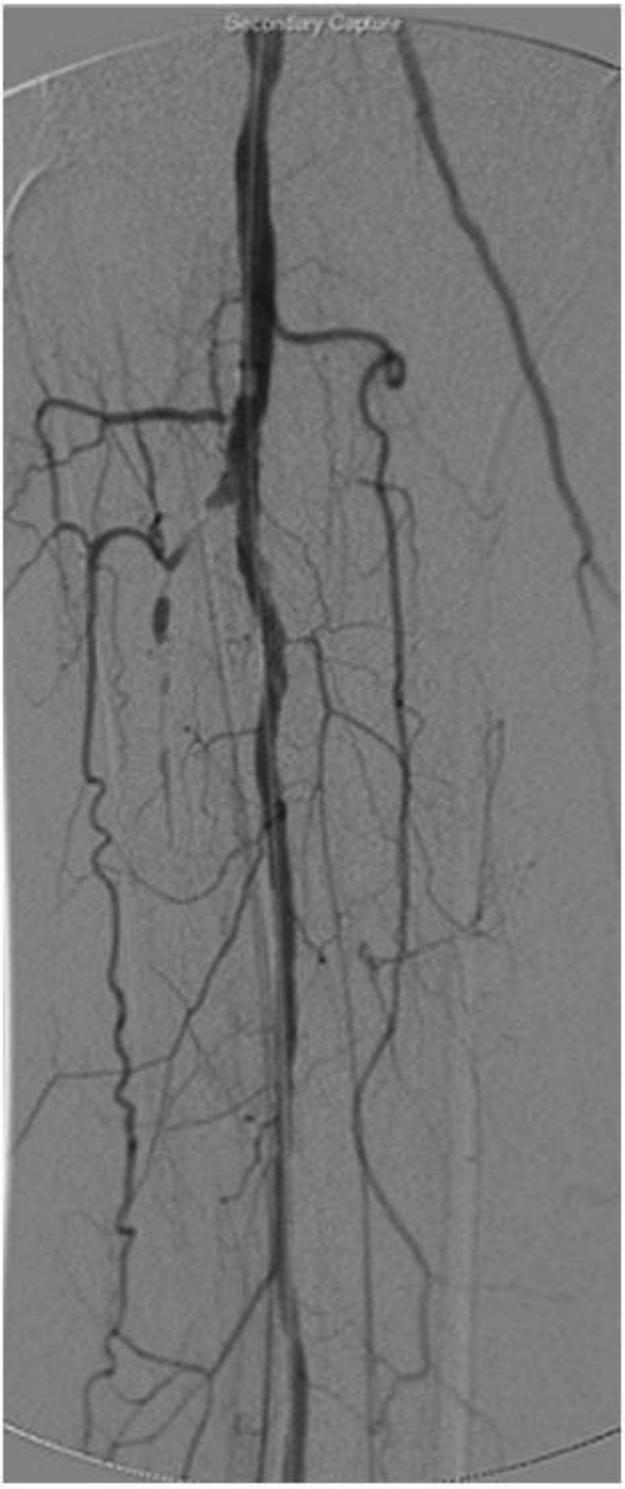

Figure 5 - Angiographic control after simple angioplasty of the fibular artery lesion showing immediate success of the procedure

Therapeutic challenge

-Once the fibular artery refilled the dorsal artery of foot through the anterior perforating artery, should we stop there?

- Would the treatment of AT artery mean any risk of losing it?

- Would such additional treatment, if successful, be cost-effective?

Part II - What was performed?

Surgical description

The choice was for approaching the AT artery and trying to recanalize it. A selective catheterization of the AT artery arch was performed using the guide wire and catheter of the previous procedure. The guide wire was inserted distally, with a certain resistance, until reaching the dorsal artery of foot, which was patent Figure 6). The vertebral catheter was replaced by the catheter-balloon used in the previous procedure. Control arteriography using the catheter-balloon showed that the catheter was inside the vessel lumen. Thus angioplasty of this vessel was performed in three stages, distal-proximal, with immediate success.

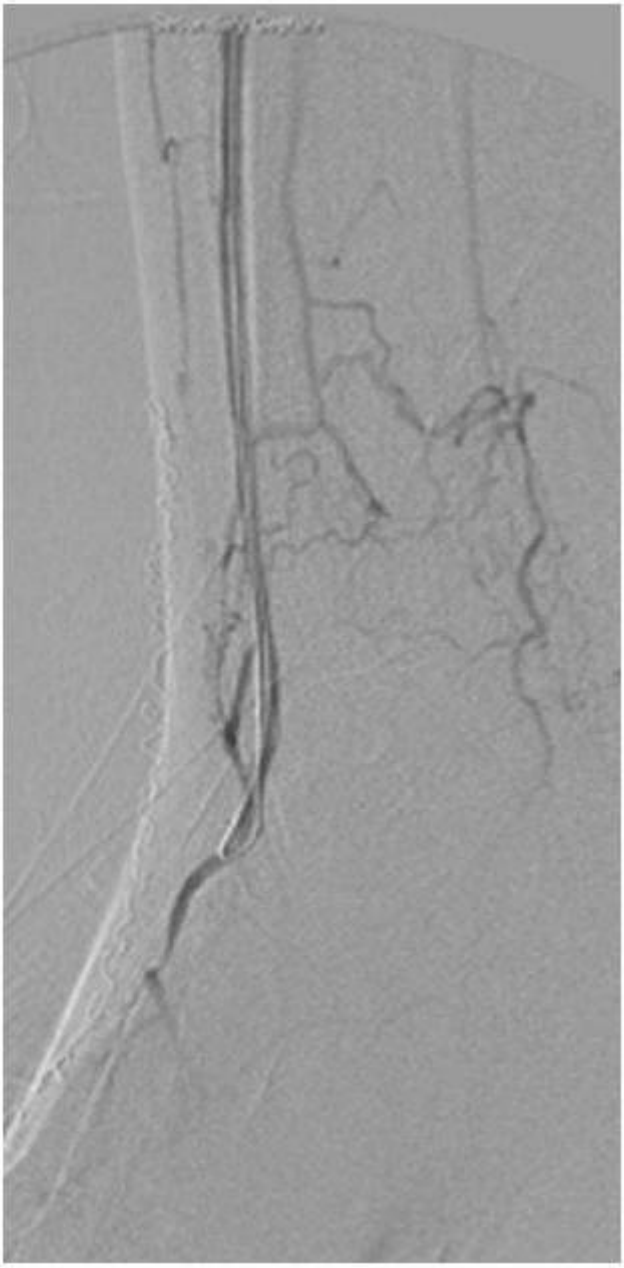

Figure 6 - Preprocedure angiographic control in the anterior tibial artery: guide wire in the vessel lumen

Final control showed wall dissection at the origin of fibular and AT arteries (Figure 7), choosing for stenting both arteries. The guide wire had to be replaced by a floppy-tipped 300 cm, 0.014 wire. Initially, the fibular artery was stented with a 3.0 x 56-mm stent (self-expandable Cromis, Invatech), followed by stenting of the AT artery with a 3.0 x 40-mm stent (self-expandable Cromis, Invatech), both successfully. Final angiographic control showed normal flow through the AT and fibular arteries (Figure 8). The long sheath was removed and replaced by an 11-cm 6F sheath for further manual compression.

Figure 7 - Angiographic control after recanalization of the anterior tibial artery showing proximal dissection of anterior tibial and fibular arteries

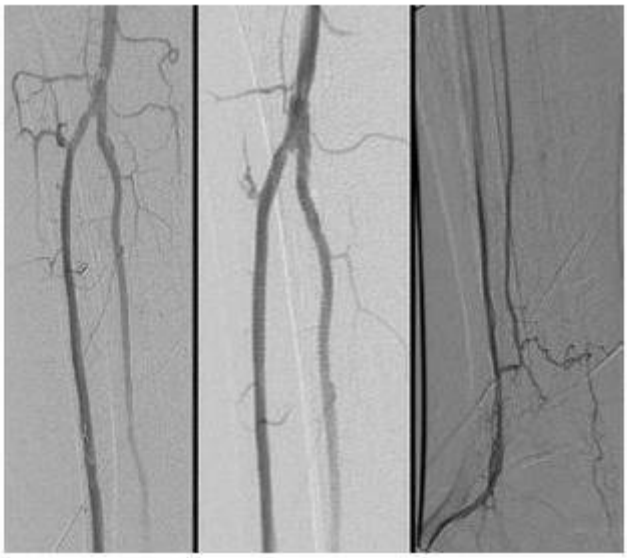

Figure 8 - Final result: normal flow through the anterior tibial and fibular arteries:

By the end of the procedure, there was pulse in the AT artery and in the dorsal artery of foot, and the ABI of the fibular artery was 1.0. The 11-cm 6F sheath was removed 2 hours after the procedure, with no adverse events or hematoma.

The patient was maintained with platelet antiaggregating drugs, acetylsalicylic acid (200 mg/day) and clopidogrel (75 mg/day), in addition to her usual medications, progressing with significant reduction of pain, and not requiring use of analgesic drugs, with maintenance of pulse in AT and dorsal artery of foot until her last visit 1 month after the procedure.

Discussion

The simplicity and technical elegance of introducing intraarterial catheters caused a revolution in the diagnosis and treatment of peripheral cardiovascular disease[23,24] that, in addition to the contributions by Dotter & Judkins,[25] Amplatz[26] and Gruntzig et al.,[27], accelerated the development of endovascular interventions. These were the first minimally invasive therapies currently applied to other types of atherosclerotic disease, such as PAD. However, not all peripheral vascular territories have well-defined consensus treatment.[3,4,13]

Experience with infrapopliteal angioplasty is limited. According to TASC II,[3,4] there is growing evidence supporting this treatment for limb salvation in patients who have stenotic or occluded infrapopliteal arteries, but only when there is presence of distal run-off in the foot in patients at high surgical risk and to save previous distal grafts. Indication to treat intermittent claudication is still controversial,[3,4] as well as use of stents in this territory.[3,4,18,19]

There is 90% success rate in immediate outcomes of the endovascular treatment of distal lesions, according to TASC II.[3,4] A meta-analysis[13] including 1,282 treated limbs showed 93% immediate success of limb salvation, and 74% after 1 year. In a previous case series, limb salvation rates were between 76 and 94%.[6-8,10-12,14,16-18,20-22]

However, endovascular treatment of infrapopliteal lesions has a high potential of complications, among which are arterial spasm, arterial perforation using guide wire, usually self-limited, intimal dissection with no artery occlusion, intimal dissection with artery occlusion, distal embolism and balloon-related artery rupture, and thrombosis of treated vessel.[28] There may be situations in which, in the attempt of recanalizing an artery, another adjacent artery is occluded, especially in bifurcations in which the plaque is not only limited to the artery being treated.[28]

However, some situations remain uncertain. It has been well defined by TASC II[3,4] that in patients who have critical ischemia with proximal and distal lesions, both of them should be treated concomitantly to cause healing, improve procedure patency and reduce risk of limb loss. On the other hand, there is no definition as to how many and which arteries should be treated, especially in case of occlusive arteries. In addition, in diabetic patients, in whom the distal lesions are prevalent,[3,4,7] it is not known whether the independent treatment of an artery, the fibular artery, which is the most preserved, is enough to heal wounds and reduce amputation rate, or whether there is need of revascularization of at least one tibial artery to obtain better results.[7,8]

Only one case series study has discussed these issues. Faglia et al.[7] observed that some patients who had initial technical success presented worsening of lesions and did not heal as expected. In these patients, angiographic control showed that the treated arteries remained patient, with no hemodynamically significant stenoses. Thus, analysis of the case series showed that:

-In angioplasty performed only in the proximal segment, in patients with concomitant distal impairment, the probability of major amputation is still high.[7]

-In patients with independent distal impairment, treatment restricted to the fibular artery (commonly more preserved in diabetic patients) did not prevent major amputation.[7]

-Recanalization of at least one tibial artery implied reduction in major amputation rates.[7]

-Measurement of partial oxygen tension (pO2) before angioplasty had no statistical difference in patients who needed or not amputation, and was not a predictor for it. On the other hand, success of angioplasty associated with increase in pO2 above the initial basal value was related to limb salvation. Therefore, increase in pO2 above basal values after angioplasty may be a predictor of limb salvation.[7]

Although this study[7] is not multi-centered or randomized, major issues have been raised, which will serve as guide for further studies. Based on this case report, it might be inferred that the endovascular treatment of infrapopliteal lesions is an elegant form of treating these lesions, with good outcomes in limb salvation. Decision as to which arteries should be treated in distal lesions should be the object of more studies for the establishment of protocols, aiming at better results.

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