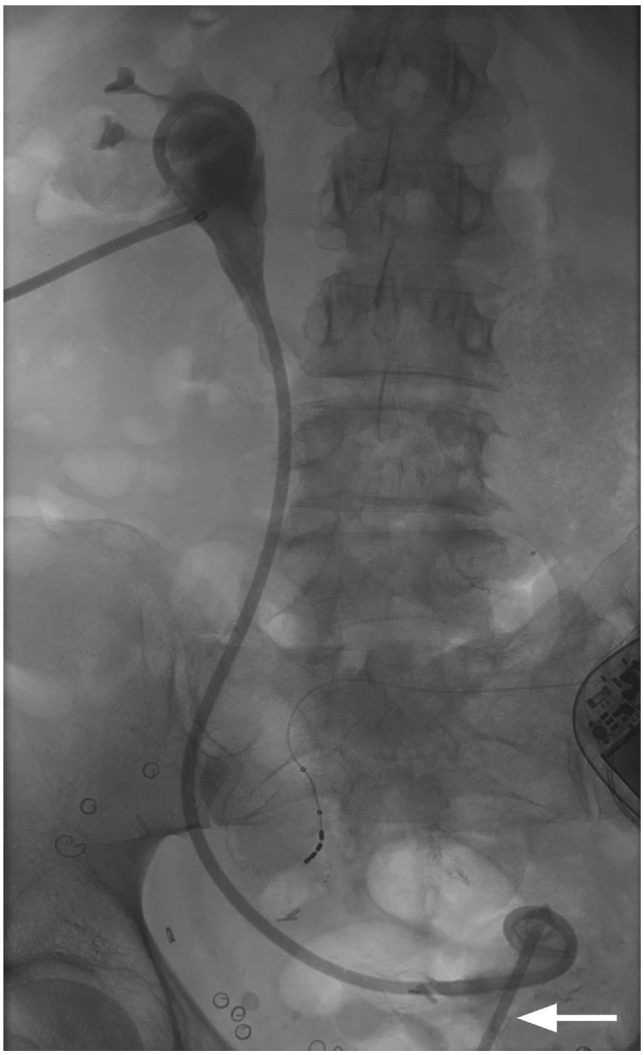

Figure 3. Successful creation of a neoureter and conversion of percutaneous nephrostomy tube to a nephroureteral stent. Injected contrast agent fills the proximal collecting system and flows out of the Foley catheter (arrow).

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Totally Percutaneous Deep Foot Vein Arterialization in a Patient with No-Option Critical Limb Ischemia, Scheduled for Bilateral Major Amputation

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Editor:

In open surgery and endovascular interventions, 14%–20% of patients with critical limb ischemia (CLI) are not considered suitable for any type of revascularization and are defined as "no-option" (1). Totally percutaneous deep foot vein arterialization (p-DVA) is considered a possible alternative treatment for these patients (2,3). This is a report of a bilateral p-DVA, with institutional board approval and informed consent obtained from the patient.

A 74-year-old woman with hypertension, insulin-treated type 2 diabetes, and chronic atrial fibrillation in oral anticoagulation presented with gangrene and TcpO2 2 mmHg on the left foot (WIfi 232) and small toe lesions and TcpO2 42 mmHg on the right foot (WIfi 110). A percutaneous transluminal angioplasty (PTA) of the tibial arteries was unsuccessful owing to the heavy calcifications and the absence of distal target vessels. Therefore, we performed a p-DVA, through an ipsilateral antegrade 6-Fr sheath, starting with a PTA of the tibioperoneal trunk and then creating an arterial-venous connection between the tibioperoneal trunk and the satellite peroneal vein using the Pioneer Plus catheter (Philips N.V., Netherlands) (4). After crossing the competent valves of the peroneal vein and of the lateral plantar arch, valid devalvulation was obtained by performing venoplasty with a semi-compliant balloon (4.00 mm and 5.00 mm). Then, p-DVA was completed by placing a covered coronary stent at the level of the arterial-venous connection (BeGraft coronary, 4.00 x 24 mm; Bentley

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None of the authors have identified a conflict of interest.

https://doi.org/10.1016/j.jvir.2020.04.031

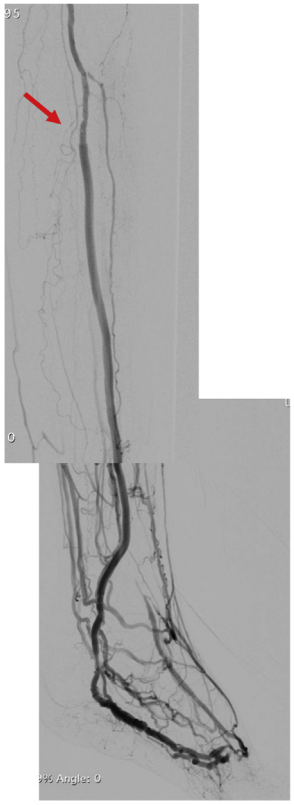

Figure 1. Left p-DVA after surgical ligation of the great saphenous vein. The arrow indicates arterial-venous proximal connection.

InnoMed GmbH, Germany) and a covered stent along the peroneal vein (Viabahn, 5 x 250 mm + 5 x 100 mm; W.L. Gore & Associates, Newark, Delaware) up to the foot. Five weeks later, we re-studied the patient, and, observing a fast circle of blood from the deep plantar system to the superficial dorsal system, we decided to surgically ligate the great saphenous vein to reduce steal effect and pressurize the forefoot vein system (Figs 1, 2). In the next days, the patient underwent tension-free foot surgery using a dermal substitute and a dermo-epidermal graft until complete healing was achieved, 195 days after p-DVA.

A week before complete healing of the left foot, the patient presented with gangrene of the entire right forefoot (Wifi 332) and TcpO2 4 mmHg. After standard PTA failure, p-DVA was performed using the same technique as the contralateral limb with the arterial-venous connection at the level of the tibioperoneal trunk on this side too. After 6 weeks, a new angiography was performed during which the origin of the small saphenous vein in the foot was embolized with coils to focalize the flow into the forefoot (Figs 3, 4). At this time, the patient underwent tension-free transmetatarsal amputation. Afterwards, multimodal therapy was applied, and healing was achieved 159 days after p-DVA.

The p-DVA is currently considered only in the case of patients with "no-option" CLI who are facing major

Figure 2. Antero-posterior view of the left foot after flow focalization.

amputation. The increased experience and the standardization of the percutaneous technique have allowed us to treat patients with indication for bilateral major amputation, as in this specific case.

In this case, the Pioneer Plus catheter was used to create an arterial-venous connection. This connection, in order to have an adequate flow rate, should take place in the proximal tract of the tibial vessels, generally in the tibioperoneal trunk or in the proximal posterior tibial or peroneal vessels. This case demonstrates that p-DVA can be performed using the peroneal deep vein as a target. In this case, it was easy to cross, at the ankle level, from the distal peroneal vein to the retromalleolar posterior tibial vein, to dilate the collateral vessel and deploy a covered stent.

The covered stent at the level of the arterial-venous connection is essential to direct the flow downwards; in this place, using a balloon-expandable stent is more precise,

Figure 3. Right p-DVA before flow focalization. The arrow indicates arterial-venous proximal connection.

and, also, it is possible to flare the vein portion to reduce turbulent flow. An additional covered stent is placed at the level of the posterior or peroneal tibial vein, to close all collaterals and open all competent valves. The flexor retinaculum could cause compression of the arterialized vein at the ankle level, and so, in our experience, it seems necessary to extend the covered stent below it.

All patients, after p-DVA, show a series of changes due to venous hypertension, characterized by different degrees of edema, cyanosis, pain, and superficial necrosis. For this reason, it is necessary, whenever possible, to wait at least 6–8 weeks before focusing the flow toward the corresponding venosome. This is achieved by surgical ligation or coil embolization of venous collaterals. Surgical ligation seems better in case of more superficial veins at the ankle level, and coil embolization might be the choice in casesof deeper veins in the foot. Waiting 6–8 weeks before flow focalization, maintaining vein outflow in different ways, is to reduce the risk of "stagnation syndrome," described by Lengua et al (5), during the period of progression of the arterialization to the forefoot.

Foot surgery can then be performed, and it involves the use of multimodal therapies and "tension-free" techniques, respecting the new vascularization. In conclusion, p-DVA can be considered an alternative treatment in patients with "no-option" CLI, provided that it is performed in compliance with defined technical key points and associated with specific foot surgery.

Figure 4. Antero-posterior view of the right foot after flow focalization with coil embolization at the origin of the small saphenous vein.

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