Endovascular Management of Critical Limb Ischemia: A Case-Based Review

BY CRAIG WALKER, MD

Critical limb ischemia (CLI) refers to a condition that is characterized by the development of rest pain, ischemic ulceration, or gangrene secondary to insufficient arterial blood supply. It is typically chronic in onset and should be distinguished from acute limb ischemia. CLI is more common in diabetics, the elderly, and smokers. It is associated with higher rates of cardiovascular mortality and is the most common etiology of nontraumatic amputations.

CLI is most commonly caused by infrapopliteal arterial obstruction with or without concomitant inflow disease. Endovascular therapy is a viable option for these patients. It may even succeed when there are no further surgical options because of inadequate conduits or distal targets. It can be performed under local anesthesia with minimal hemodynamic stress in critically ill patients. Endovascular therapy can easily be repeated, and multiple infrapopliteal vessels can be revascularized in a single setting.

The first step in interventional therapy for CLI is to cross the occlusion. This can be accomplished with guidewires or crossing devices and may be true luminal or subintimal. The site of arterial access may improve crossing success. Antegrade femoral access facilitates pushability and torque transmission, and it also allows operators to reach distal lesions. Transpedal access may

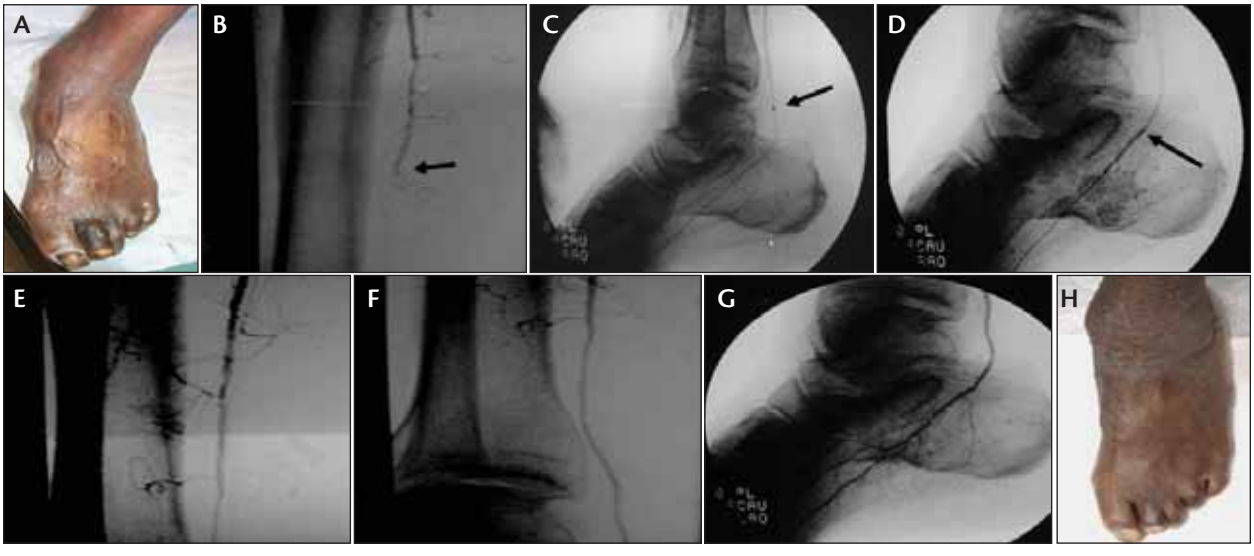

Figure 1. A patient with a 4-mm nonhealing ulcer (A). Angiogram showing an occluded posterior tibial occlusion (arrow) (B). Atherectomy is performed with a 0.9-mm laser probe (arrow) (C). The vessel is dilated with a 2-mm coronary balloon (arrow) (D). Angiograms obtained after successful laser and percutaneous transluminal angioplasty (E through G). Eight-week follow-up showing total healing of the ulcer (H).

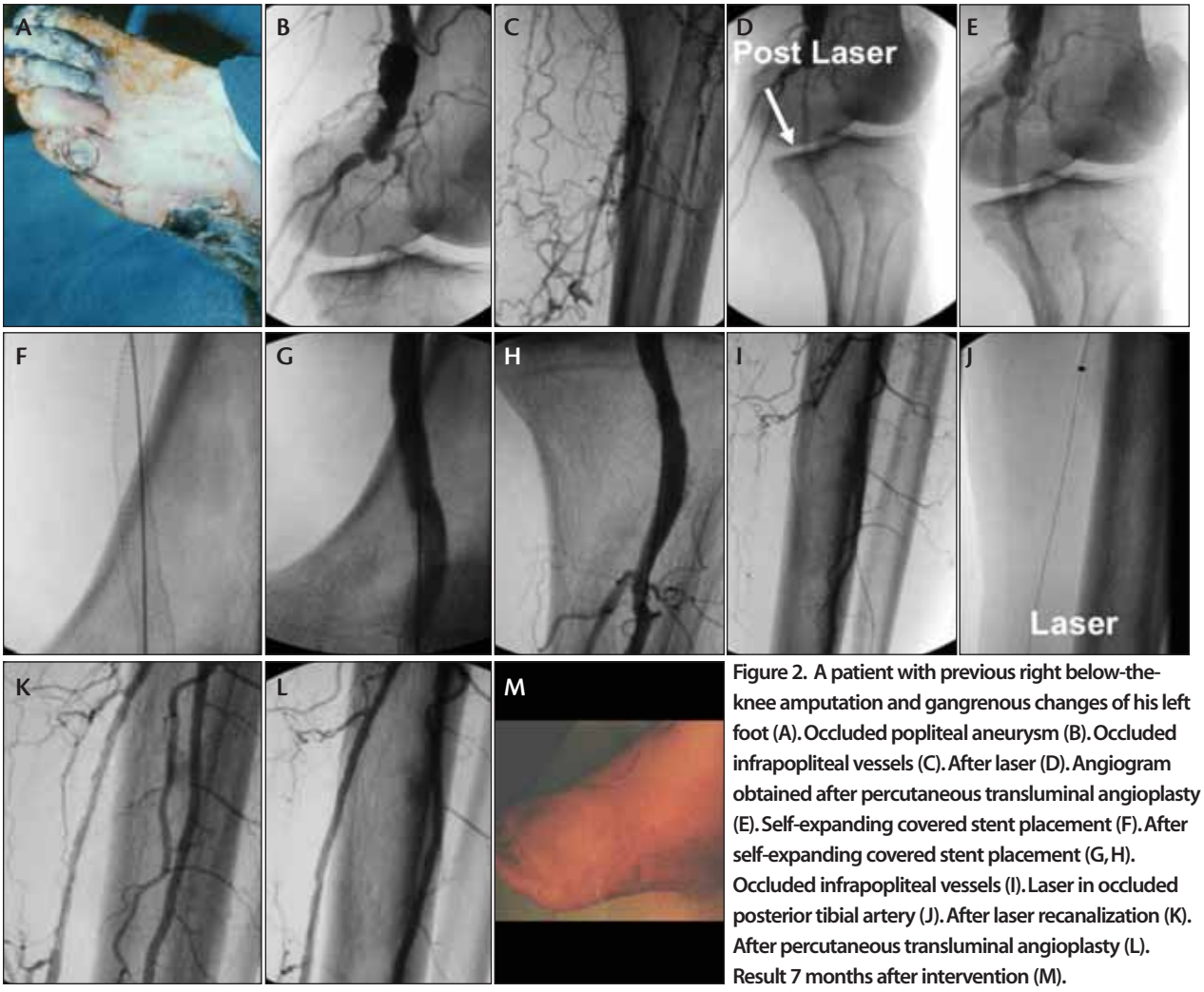

Figure 2. A patient with previous right below-the-knee amputation and gangrenous changes of his left foot (A). Occluded popliteal aneurysm (B). Occluded infrapopliteal vessels (C). After laser (D). Angiogram obtained after percutaneous transluminal angioplasty (E). Self-expanding covered stent placement (F). After self-expanding covered stent placement (G, H). Occluded infrapopliteal vessels (I). Laser in occluded posterior tibial artery (J). After laser recanalization (K). After percutaneous transluminal angioplasty (L). Result 7 months after intervention (M).

facilitate wire passage when an antegrade approach has failed. Transcollateral passage of a wire can also improve crossing success. Once crossing has been achieved, channels are created by balloon angioplasty, atherectomy, or stenting. The greatest published experience has been with balloon angioplasty.

The goal of interventional therapy is to establish sufficient blood flow to the foot to alleviate pain, heal ulcers, and heal surgical wounds. Long-term patency is desirable, particularly with large ulcers, but is of lesser importance. Following restoration of flow, control of infection, wound care, and unloading are necessary to achieve limb salvage. The subsequent case presentations illustrate interventions in cases of CLI.

CASE 1

A 54-year-old man with a history of diabetes, smoking, and previous coronary artery bypass surgery was referred by a vascular surgeon for interventional therapy. He had a 4-mm, shallow, nonhealing ulcer under the hallux with pregangrenous changes of the hallux and ischemic rest pain. The patient had undergone two previous femorotibial bypass procedures, and he had occluded and had a recent surgical cutdown showing no suitable distal targets for bypass. Angiography showed that the anterior tibial and peroneal arteries were occluded at their origins with no distal filling. The posterior tibial artery was stenotic at its origin and occluded distally at the site of the previous distal graft anastomosis, with faint filling of the lateral plantar branch of the posterior tibial artery under the foot.

After antegrade left common femoral access was achieved, the posterior tibial arterial occlusion was easily crossed into the lateral plantar artery with a floppy, hydrophilic-tipped, 0.014-inch Choice PT extra-support guidewire (Boston Scientific Corporation, Natick, MA). Atherectomy was performed with a 0.9-mm laser (Spectranetics Corporation, Colorado Springs, CO), after

Figure 3. A patient who was referred for interventional therapy with severe ischemia (A) after surgical cutdown (B) revealed no graftable distal vessels. Initial right infrapopliteal angiogram from the left contralateral approach (C) and oblique right infrapopliteal angiogram (D) showing no continuous vessels to the foot. Distal right infrapopliteal angiogram (E). Right lower extremity angiogram showing a wire in the anterior tibial artery via the distal peroneal collateral (F). Retrograde and antegrade wires in the anterior tibial artery facilitating the crossing of a chronic total occlusion (G). Antegrade wire in the right anterior tibial artery (H). Percutaneous transluminal angioplasty of the proximal right anterior tibial artery (I). Final angiograms postintervention (J through L).

which, the entire vessel was dilated with a 2-mm balloon. This established straight-line flow to the foot. At 8-week follow-up, there was total healing of the ulcer, and the toe was normal. All pain was gone. This patient has remained amputation free for 9 years (Figure 1).

CASE 2

A 71-year-old man had undergone right below-the-knee amputation 3 years previously and had been able to ambulate with a prosthesis until he developed rest pain and then extensive gangrenous changes of his left foot. The patient had diabetes with hyperlipidemia and a history of cigarette smoking. Four years before presenting to our facility, he underwent left popliteal artery bypass for a popliteal artery aneurysm that had been complicated by wound infection. Angiography showed that there was a popliteal artery aneurysm with popliteal arterial occlusion and an occluded graft. The left posterior tibial artery was occluded proximally and filled distally with runoff to the foot.

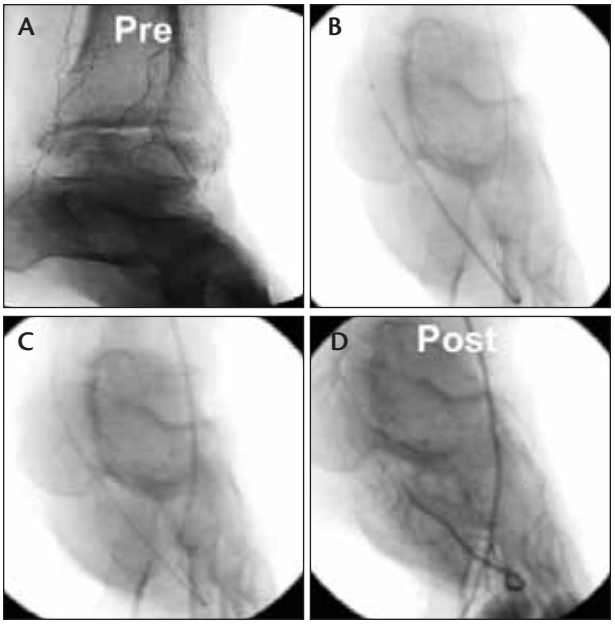

Figure 4. Occluded infrapopliteal arteries after previous unsuccessful interventional treatment (A). A 1.5-mm-diameter balloon was used to dilate the vessels of the foot (B), and a 2-mm balloon was used to dilate the anterior tibial artery (C). Posttreatment angiogram (D).

The popliteal and posterior tibial occlusions were crossed with a 0.035-inch hydrophilic wire, and then a 0.035-inch Glide catheter (Terumo Interventional Systems, Somerset, NJ) was advanced into the distal posterior tibial artery. The occlusions were dilated, and Viabahn self-expanding covered stents (Gore & Associates, Flagstaff, AZ) were placed across the aneurysmal segment and postdilated. There was an excellent final result with brisk flow to the foot. The patient had subsequent transmetatarsal amputation, skin grafts, and extended antibiotic therapy. At 7 months, the patient's wounds were healed, and he was able to ambulate again by 9 months (Figure 2). The patient died 4 years later from heart failure.

CASE 3

A 69-year-old man was referred for interventional therapy by a vascular surgeon after surgical cutdown, showing no graftable distal vessels. The patient had presented to the vascular surgeon with ischemic rest pain and a 3-mm ulcer at the tip of the left hallux. The patient had diabetes with a history of dyslipidemia and hypertension. Angiography revealed that all infrapopliteal arteries were occluded at their origins with reconstitution of a severely diseased anterior tibial artery that reached the foot. The surgeon had measured the vessel lumen at 0.5 mm.

After antegrade femoral entry, attempts were made, unsuccessfully, at crossing the anterior tibial artery in an antegrade fashion with multiple 0.014-inch guidewires. The anterior tibial artery was entered via a distal collateral, facilitating successful crossing of the occluded proximal anterior tibial segment with a Confianza Pro wire (Abbott Vascular, Santa Clara, CA). The wire was then steered into the femoral sheath. A 0.014-inch-compatible, 2.5-mm balloon catheter was advanced over the distal wire across the occlusion. The wire was removed and reintroduced in an antegrade manner to cross the distal diseased anterior tibial artery into the foot. The balloon was then used to dilate the entire artery, establishing brisk antegrade flow to the foot. At 6-week follow-up, the patient's ulcer was healed, and he was pain free (Figure 3).

CASE 4

A 72-year-old woman was experiencing true ischemic rest pain of her left foot for 2 months. The patient had diabetes and was hypertensive. Previous angiography showed all infrapopliteal arteries to be occluded, and she had undergone a previous attempt at interventional therapy, which was unsuccessful. After antegrade left femoral artery access, repeat angiography showed all infrapopliteal vessels to be occluded with no visible runoff to the foot. The anterior tibial artery occlusion was crossed to the ankle with a 0.014-inch Confianza Pro guidewire, and distal angiography showed only microcaliber vessels. The wire was exchanged for a floppy, hydrophilic, 0.014-inch wire that was advanced through the dorsal arch into the plantar branches of the posterior tibial artery. A 12-cm-long, 1.5-mm-diameter balloon was then used to dilate the vessels of the foot, and a 2-mm balloon was used to dilate the anterior tibial artery. At 1-month follow-up, the patient was pain free and had an easily palpable dorsal pedal artery (Figure 4).

CONCLUSION

Patients with advanced atherosclerotic peripheral arterial disease do have many viable interventional and surgical options. It is my opinion that no viable patient should be subjected to an amputation without consideration of revascularization options. ■

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