CASE REPORT

Utilizing IVUS Below the Knee

The importance of invasive imaging to guide treatment decisions and improve outcomes.

BY STEVE HENAO, MD, FACS, FACC

It should be considered among the best practices of endovascular therapy to reserve intervention of diseased tibial arteries for critical limb ischemia (CLI) cases. This should be an individualized decision based on the assessment of an available venous conduit for possible bypass options, patient comorbidities, lesion morphology, and tissue loss characteristics.[1] This challenging subset of patients exhibits lower procedural success rates due to increased lesion complexity (eg, plaque length, chronic total occlusions [CTOs], calcific wall involvement).[2] For the vascular specialist, procedural success should be seen as a high-stakes endeavor because failure to revascularize is more likely to lead to major amputation or death during follow-up.[3]

The optimal regimen for tibial interventions in patients with CLI has yet to be defined. Angioplasty is still considered the primary therapeutic modality for the infrageniculate distribution, whereas antiproliferative strategies are still being evaluated and are not approved for use in the United States at this time. Atherectomy is considered a reasonable strategy to optimize the vessel for percutaneous transluminal angioplasty (PTA) and minimize dissection, especially within the calcific pathology seen in these patients.[4] Strategic evaluation of the arterial target to ensure true lumen position, assess plaque morphology, and obtain the precise vessel diameter using intravascular ultrasound (IVUS) has been extrapolated from results seen in the coronary circulation,[5] and promising data regarding these benefits in the setting of peripheral artery disease continue to evolve.

CASE REPORT

A 57-year-old man receiving appropriate wound care and nutrition presented to the limb preservation service with a nonhealing left fourth digit amputation of the foot, sustained 2 months prior to our consultation. He had a 40 pack-year smoking history, as well as chronic renal insufficiency (stage 3B), type 2 diabetes, hypertension, and dyslipidemia. Our podiatry team performed arterial duplex examination of his lower extremity, which demonstrated monophasic tibiopedal flow and a toe-brachial index of 0.2. Ultrasound vein mapping obtained at the time of his initial visit demonstrated a previous vein harvest for a coronary artery bypass graft on the ipsilateral limb and an inadequate vein < 2 mm in diameter within the contralateral leg. With a diagnosis of CLI, absence of a usable conduit, and list of comorbidities, the patient was offered endovascular evaluation and therapy via a right retrograde femoral approach. His renal insufficiency was also taken into consideration, so carbon dioxide (CO_2) was planned for use as the principal contrast medium.

Within 48 hours, the patient was taken to the hybrid operating room and placed supine on the table, where conscious sedation was administered. Ultrasound-guided right femoral access was achieved followed by placement of a 0.035-inch wire and a 6-F retrograde sheath. An Imager™ II Angiographic Catheter (Boston Scientific Corporation) was advanced into the abdominal aorta under fluoroscopic guidance. Digital subtraction CO_2 angiography was then performed. This demonstrated a patent aorta and bilateral iliac systems. Selective catheterization of the left common and external iliac arteries was then performed. CO_2 angiography performed at this level demonstrated patency of the common femoral, profunda femoral, superficial femoral, and popliteal arteries. Below the knee, imaging demonstrated intermittent CTOs of all three tibial vessels (Figure 1). There was a common trunk joining the anterior tibial artery and the peroneal artery, with a posterior tibial artery arising directly from the popliteal artery.

With the absence of inline flow to the foot appearing to be directly related to the patient's ischemic situation, intervention was warranted (Figure 2). A 7-F, 90-cm sheath was then placed up and over the bifurcation and positioned at the P2 segment of the popliteal artery. A Savion FLX™ Guidewire (Boston Scientific Corporation) and Rubicon™ Support Catheter (Boston Scientific Corporation) were then directed into the CTO of the posterior tibial artery, where an exchange was made for a 0.014-inch RotaWire™ for use with the Rotablator™ Rotational Atherectomy System (Boston Scientific Corporation).

Prior to this, the nature of the plaque morphology as well as the relative sizing of the tibial vasculature was determined using the Opticross™ 18 Peripheral Imaging Catheter (Boston

Results from case studies are not necessarily predictive of results in other cases. Results in other cases may vary.

Figure 1. CO_2 angiography of the infrageniculate circulation demonstrating CTOs of all three tibiopedal arteries.

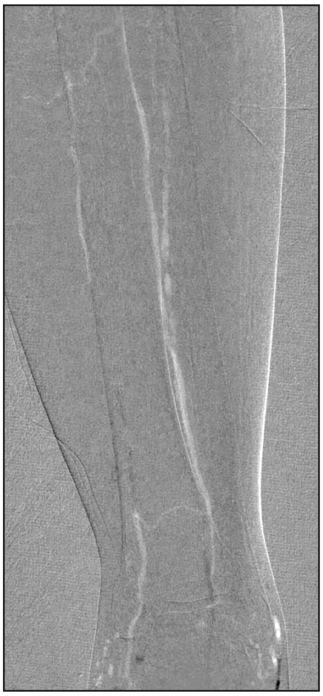

Figure 2. CO_2 angiography showing distal reconstitution of the posterior tibial artery representing the dominant supply to the foot.

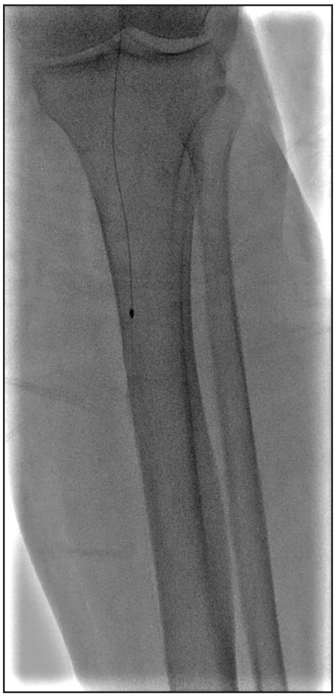

Figure 3. Rotational atherectomy of the tibiopedal arteries after IVUS assessment.

Scientific Corporation) for IVUS, which demonstrated a 3.5-mm overall diameter of the posterior tibial artery. A 2-mm burr was selected for plaque modification of the critically stenosed segments using rotational atherectomy, followed by angioplasty using the selected 3.5-mm-diameter PTA balloon at low pressure for 3-minute intervals (Figure 3). A follow-up CO_2 angiogram demonstrated no evidence of extravasation, injury, or dissection. Selective catheterization of the anterior tibial artery was performed, using similar maneuvers for rotational atherectomy positioning. Plaque modification was performed with rotational atherectomy, followed by postdilation directed by IVUS, which demonstrated a 4- to 5-mm range in diameter (Figure 4). Both PTA balloon sizes were included in the treatment of this vessel, with a completion CO_2 angiogram demonstrating excellent flow through the system. To finalize the procedure, selective catheterization of the peroneal artery was then performed. Rotational atherectomy was performed again in this vessel, in which IVUS had demonstrated a relative size of 3.5 mm and thus dictated PTA balloon selection.

After treatment of all three vessels, a total of 10 mL of iodinated contrast was used for completion imaging to provide granular detail of the flow to the foot, lower leg, and below the knee (Figures 5 and 6). This demonstrated a robust three-vessel runoff with excellent flow into the foot, predominantly via the posterior tibial artery. Upon completion of successful therapy, the sheath was removed over a 0.035-inch wire, and a closure device was successfully deployed at the right femoral access site. The patient tolerated the procedure nicely and was discharged home after several hours of observation, intravenous fluids, and bed rest. Optimal wound care, off-loading, and smoking cessation efforts were continued, with improved healing seen at follow-up evaluation.

DISCUSSION

It has been established that angiography alone provides luminal characteristics of the peripheral arteries, yet yields very little information on the true extent of the underlying plaque burden, objective knowledge of morphology, or the true size of the entire vessel.[6] A similar pattern has been noted in the coronary circulation, where IVUS use in this territory has yielded additional information for the operator that may result in a change in procedural strategy in up to 74% of patients, requiring placement of larger or longer devices or additional poststent dilatation because of incomplete expansion or incomplete stent apposition and thus leading to improved outcomes in percutaneous coronary intervention.[5]

Recent studies have also shown better outcomes in peripheral interventions with IVUS use. A meta-analysis of 13 studies composed of more than 2,250 patients demonstrated a significant difference in amputation rates and frequency of reinterventions favoring the use of IVUS.[7] Another study including over 90,000 patients demonstrated significantly lower postprocedural complications, lower amputation rates, and a nonsignificant increase in hospitalization costs with IVUS use.[8]

Percutaneous interventions to correct tibial occlusive lesions in patients with CLI warrant the highest level of

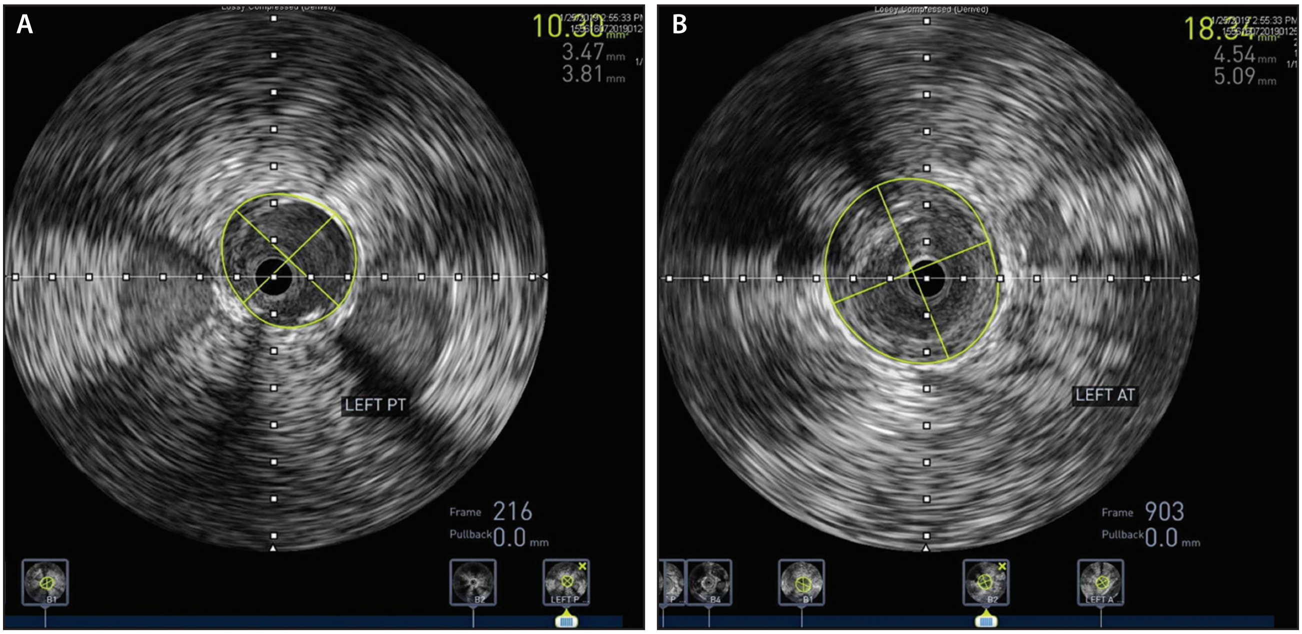

Figure 4. IVUS interrogation of the posterior tibial (A) and anterior tibial (B) arteries demonstrating a larger than expected diameter, influencing device size selection for PTA.

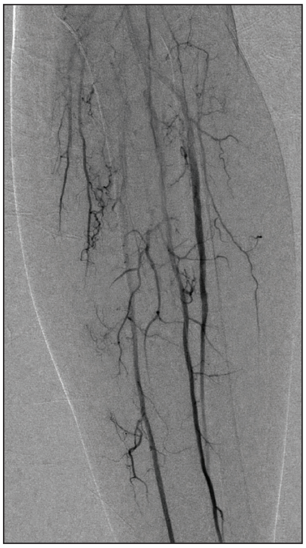

Figure 5. Completion angiography with contrast demonstrating restoration of robust three-vessel tibiopedal flow.

Figure 6. Three-vessel runoff into the ankle and foot.

scrutiny available to optimize outcomes. Unfortunately, concern over reimbursement has discouraged the widespread use of IVUS. This has been recently addressed with the addition of two new bundled codes (as of 2016) for noncoronary IVUS (37252, 37253). In the case presented here, a typical treatment regimen based on an average tibial size of 2 to 3 mm from angiographic assessment alone would have led to significant undersizing and inferior outcomes. Vascular specialists should consider this imaging modality as an important and effective adjunct to help plan complex interventions more precisely in this challenging patient population. ■

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