Scoring Angioplasty for Popliteal and Infrageniculate Stenosis

A limb salvage case using a scoring balloon device.

BY ERIN H. MURPHY, MD, AND FRANK R. ARKO, MD

Popliteal and infrageniculate arteriosclerosis are difficult conditions to treat and manage. In this case report, we discuss the use of popliteal and tibial angioplasty utilizing the AngioSculpt balloon (AngioScore, Inc., Fremont, CA).

CASE REPORT

A 68-year-old man presented with a 1-month history of worsening left lower extremity rest pain and nonhealing foot ulceration. The patient had an 8-month history of claudication symptoms before presentation. The patient's medical history was significant for hypertension, diabetes, and chronic renal insufficiency, with a baseline creatinine level of 1.6. His surgical history was significant for remote cholecystectomy in 1982. He currently uses tobacco and smokes one pack per day.

Pertinent physical examination revealed 2+ femoral pulses and diminished bilateral popliteal and absent pedal pulses. The patient had multiple areas of gangrene requiring debridement with the wound having adherent exudate and absent granulation tissue on the anterior surface of the lower shin as well as gangrene of the fourth and fifth digits.

There were no signs of local or systemic infection. Laboratory studies revealed a white blood cell count of 8.2 and a serum creatinine level of 1.6. All other laboratory values were within normal range. Noninvasive vascular laboratory testing revealed an ankle brachial index (ABI) on the left of 0.3 with a toe pressure of 10 and a severely dampened monophasic signal. The ABI on the right was 0.78 with a toe pressure of 55 with a biphasic signal.

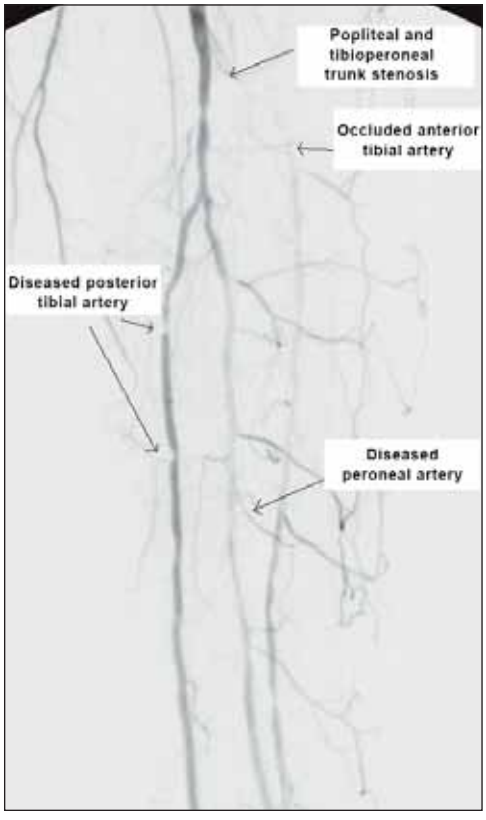

Figure 1. The preintervention arteriogram.

An arteriography was performed, which revealed a patent aorta without significant renal artery or aortoiliac disease. The superficial femoral artery and proximal popliteal artery were patent with minimal patchy non–flow-limiting stenosis. There was a 3-cm popliteal stenosis of the below-the-knee popliteal artery. The anterior tibial artery was occluded at the orifice with a short-segment stenosis of the posterior tibial artery with slow two-vessel runoff via the posterior tibial artery and a heavily diseased peroneal artery (Figure 1).

Procedure

The 5-F sheath was exchanged for a 6-F sheath, which was positioned in an up-and-over technique from the right common femoral artery into the left superficial femoral artery. The patient was pretreated with clopidogrel and aspirin and was anticoagulated to maintain an activated clotting time longer than 250 seconds. A .014-inch Choice PT guidewire (Boston Scientific Corporation, Natick, MA) was used to cross the popliteal stenosis and the occlusion of the anterior tibial artery. Balloon angioplasty of the infrageniculate popliteal artery was performed with a 5-mm X 2-cm AngioSculpt balloon, the anterior tibial artery was treated using a 3-mm X 2-cm AngioSculpt with multiple inflations in the area of the occlusions, the stenoses in the posterior tibial artery were treated with a 3-mm X 2-cm AngioSculpt, and a 2-mm X 2-cm AngioSculpt was used to treat lesions in the peroneal artery (Figure 2). An angiogram obtained after angioplasty revealed a widely patent popliteal artery without residual stenosis and brisk three-vessel runoff (Figure 3). Further wound debridement was performed.

Figure 2. Angioplasty with a 3-mm X 2-cm AngioSculpt balloon in the anterior tibial artery. The popliteal, anterior tibial, posterior tibial, and peroneal arteries were all treated.

Figure 3. Final angiogram with rapid flow in the popliteal artery and three-vessel runoff.

The patient was admitted overnight for observation. He was discharged home on postoperative day 1 with a biphasic left dorsalis pedis pulse and a palpable left posterior tibial pulse. He experienced immediate resolution of his left lower extremity rest pain. He was scheduled for wound care, including hydrotherapy, and was placed on our vascular surveillance protocol. Duplex ultrasound and ABIs were performed in our vascular laboratory at his 1-month postoperative visit, which revealed no evidence of restenosis and an ABI of 0.84 with biphasic signals in the left pedal vessels. The left foot ulceration had greatly improved, and there was excellent granulation tissue present, allowing skin grafting (Figure 4). The foot was completely healed in 4 weeks.

DISCUSSION: ENDOVASCULAR OPTIONS

The natural history of untreated critical limb ischemia is progression to major amputation. Because major amputation is associated with mortality rates of 25% to 50% at 1 year,[1] revascularization and limb salvage are critically important. Over time, distal bypass with an autologous conduit has remained the gold standard of treatment for limb-threatening ischemia in the setting of infrainguinal peripheral arterial disease. Surgical results after distal revascularization are excellent, with

Figure 4. Skin grafting was performed on the wounds 4 weeks after the intervention.

patency rates up to 70% and limb salvage rates of 80% to 90% at 3 years. Nonetheless, these patients face high morbidity and mortality rates up to 10% and 5%, respectively, proving this procedure is treacherous for the older, high-risk patient.[2-5]

Although popliteal and infrageniculate arterial lesions were once considered contraindications for endovascular interventions, accumulation of experience, technical advancements, and the development of lower-profile guidewires and balloon catheters have rekindled interest in the endovascular treatment of infrageniculate lesions. Although the reported results of distal endovascular interventions are variable and often contradictory, investigators generally agree that the endovascular approach is appealing because of its decreased morbidity and mortality rates, shorter hospital stays, quicker recovery times, faster postoperative ambulation, and improved patient satisfaction.[6-10] In addition, failed endovascular options do not necessarily interfere with the possibility of performing a future surgical bypass and, therefore, many surgeons now use these procedures as a first-line treatment, reserving open bypass for endovascular failures.

The most widely used endovascular options for distal disease include traditional angioplasty with adjunctive stenting for residual stenosis, endoluminal bypass with covered stents, and cryoplasty. Results after traditional angioplasty with adjunctive stenting are widely inconsistent when performed for critical limb ischemia. Reported limb salvage rates with this technique range from as low as 36% at 2 years to as high as 91% at 5 years.[6,7,11,12] Cryoplasty data are further mixed, with results comparable to the higher-end patency rates reported with traditional angioplasty.[6,7,13] Our personal experience with endoluminal bypass using covered stents has been modest but underwhelming. As patency rates are reported nearing 75% after 2 years, complications, including graft kinking and occlusion, have caused us to hesitate in employing this technology in our practice, and we rarely attempt this method of revascularization. Further, this treatment is not ideal in patients with severe calcification or disease in the proximal/distal arteries, limiting widespread application of this technique.

Cutting and Scoring Balloons

Balloons with cutting or scoring technology are currently available from two manufacturers: the AngioSculpt balloon (used in this patient) and the Peripheral Cutting Balloon, which is manufactured by Boston Scientific Corporation (Natick, MA). The Cutting Balloon has sharp microsurgical blades that are exposed during balloon inflation, and the AngioSculpt has nitinol scoring elements with rectangular edges, also exposed when the balloon is inflated. The Cutting Balloon's blades are positioned in a linear fashion, whereas the AngioSculpt has a nitinol scoring element that scores the plaque circumferentially. The Cutting Balloon's blades incise the plaque, and the scoring elements of the AngioSculpt score it, while their respective balloons compress the plaque against the arterial wall in a fashion similar to traditional angioplasty. Advantages include lower required balloon inflation pressures and reduced vessel distention and vessel trauma, resulting in lower dissection rates and vessel damage when compared to traditional angioplasty. These devices may be best designed for the diabetic patient with heavily calcified vessels that could lead to suboptimal results with conventional angioplasty, as seen in this case. Further, improved initial angioplasty results with this balloon ideally obviate the need for adjunctive stenting.

LITERATURE REVIEW

Cardon et al recently published a series of 53 extremities in 48 patients treated with scoring balloons with a procedural success rate of 96%. No

patients treated required adjunctive stenting, with less than 30% residual stenosis documented after angioplasty in all patients. The investigators demonstrated an 81% limb salvage rate at 1 year with this technique.[14] Ansel et al also reported on a series of patients treated with scoring balloons with a procedural success rate of 91% and a limb salvage rate of 84.4% at 1 year,[15] comparable to those results reported by Cardon et al. However, more than half of their patients in these studies underwent treatment of proximal lesions, making this group somewhat dissimilar for comparison. Results from both groups are promising and compare to the best results reported by traditional angioplasty with stenting and cryoplasty while avoiding complications of anticoagulation in this elderly population, which is required when adjunctive stenting is employed.

CONCLUSION

Performing angioplasty using the AngioSculpt balloon is an alternative approach to treating popliteal and infrapopliteal peripheral arterial disease that yields excellent procedural success rates and good short-term limb salvage rates. Results are at least comparable to those achieved with other endovascular options for this disease and may offer advantages, including less vessel trauma and dissection, improved results of angioplasty in calcified vessels, and reduced need for adjunctive stenting. This treatment should be further evaluated because the numbers that have been reported are still too low to provide conclusive evidence of possible clinical advantages over more traditional endovascular options. ■

Erin H. Murphy, MD, is a General Surgery Resident with the University of Texas Southwestern Medical Center in Dallas, Texas. She has disclosed that she holds no financial interest in any product or manufacturer mentioned herein. Dr. Murphy may be reached at (214) 645-0551; erinmurphy79@gmail.com.

Frank R. Arko, MD, is Associate Professor of Surgery, and Chief of Endovascular Surgery, at the University of Texas Southwestern Medical Center in Dallas, Texas. He has disclosed that he holds no financial interest in any product or manufacturer mentioned herein. Dr. Arko may be reached at (214) 645-0533; frank.arko@utsouthwestern.edu.

1. Nehler MR, Coll JR, Hiatt WR, et al. Functional outcome in a contemporary series of major lower extremity amputations. J Vasc Surg. 2003;38:7-14.
2. Pomposelli FB, Marcaccio EJ, Gibbons GW, et al. Dorsalis pedis arterial bypass: durable limb salvage for foot ischemia in patients with diabetes mellitus. J Vasc Surg. 1995;21:375-384.
3. Quinolones-Baldrich WJ, Colburn MD, Ahn SS, et al. Very distal bypass for salvage of the severely ischemic extremity. Am J Surg. 1993;166:117-123.
4. Taylor LM, Edwards JM, Porter JM, et al. Present status of reversed vein bypass grafting: five year results of a modern series. J Vasc Surg. 1990;11:193-205.
5. Pompeselli FB, Kansal N, Hamdan AD, et al. A decade of experience with dorsalis pedis artery bypass: analysis of outcome in more than 1000 cases. J Vasc Surg. 2003;37:307-315.
6. Ruef J, Hofman M, Haase J. Endovascular interventions in iliac and infrainguinal occlusive artery disease. J Interv Cardiol. 2004;17:427-435.
7. Zeller T. Current state of endovascular treatment of femoro-popliteal artery disease. Vasc Med. 2007;12:223-234.
8. Holm J, Arfvidsson B, Jivegard L, et al. Chronic lower extremity limb ischemia: a prospective randomized controlled study comparing the 1-year results of vascular surgery and percutaneous transluminal angioplasty (PTA). Eur J Vasc Surg. 1991;5:517-522.
9. Kudo T, Chandra FA, Ahn SS. The effectiveness of percutaneous transluminal angioplasty for the treatment of critical limb ischemia: a ten year experience. J Vasc Surg. 2005;41:423-435.
10. Tsetis D, Belli AM. The role of infrapopliteal angioplasty. Br J Radiol. 2004;77:1007-1015.
11. Soder H, Manninen HI, Jaakkola P, et al. Prospective trial of infrapopliteal artery balloon angioplasty for critical limb ischemia: angiographic and cinical results. J Vasc Interv Radiol. 2000;11:1021-1031.
12. Lofberg AM, Lorelius LE, Karacagil S, et al. The use of below-knee percutaneous transluminal angioplasty in arterial occlusive disease causing chronic critical limb ischemia. Cardiovasc Intervent Radiol. 1996;19:317-322.
13. Joye J. The clinical application of cryoplasty for infrainguinal peripheral arterial disease. Tech Vasc Interv Radiol. 2005;8:160-164.
14. Cardon JM, Jan F, Vasseur MA, et al. Value of cutting balloon angioplasty for limb salvage in patients with obstruction of popliteal and distal arteries. Ann Vasc Surg. 2008. In press.
15. Ansel GM, Sample NS, Botti III CF Jr, et al. Cutting balloon angioplasty of the popliteal and infrapopliteal vessels for symptomatic limb ischemia. Cathet Cardiovasc Interv. 2004;61:1-4.