Nitinol overdose—rescue of acute limb ischemia caused by stenting of the common iliac, external iliac, common femoral, superficial femoral, and popliteal arteries in an actively smoking patient with claudication

Khushi S. Patel, BA,[a] Charles A. Hamilton, MPhil, MD,[b] Lauren A. Huntress, MD,[b] Saum A. Rahimi, MD,[b] *and* William E. Beckerman, MD,[b] *Piscataway and New Brunswick, NJ*

ABSTRACT

Intermittent claudication (IC) from peripheral arterial disease is typically managed with pharmacologic interventions and lifestyle changes. However, despite societal guidelines, initial endovascular interventions are being used more frequently with an increased incidence of complications, resulting in rapid disease progression to critical and acute limb-threatening ischemia (ALI). The present report describes the case of a patient who developed ALI after treatment of IC at another facility, with malpositioned bilateral common iliac stents, continuous stent extension into the popliteal artery, and acute occlusion of the entirety of the right lower extremity vasculature. This case illustrates how extensive endovascular intervention for IC can result in ALI requiring urgent revascularization. (J Vasc Surg Cases Innov Tech 2023;9:101256.)

Keywords: Acute ischemia; Common femoral stenting; Endovascular complication; Intermittent claudication; Revascularization

Peripheral arterial disease (PAD) affects 8 to 12 million patients in the United States, with the most common presenting symptom being intermittent claudication (IC).[1,2] Treatment is generally initiated with medical management, including smoking cessation, pharmacologic therapy (eg, antiplatelet, anticoagulation, statin), and supervised exercise programs before any invasive treatment.[1] However, a recent and controversial increase has occurred in the use of early initial endovascular treatment of patients with IC. This has been shown to lead to rapid progression to critical and acute limb ischemia (ALI), subjecting patients to invasive revascularization procedures and possible amputation.[2,3] Our case highlights the complications of reintervention in a patient presenting with ALI after initial endovascular intervention of her IC symptoms.

CASE REPORT

A 75-year-old woman with a history of hypertension, hyperlipidemia, PAD, chronic kidney disease, and an active one-pack per day smoking history presented to the emergency department because of 8 hours of acute onset right lower extremity (LE) pain. Her recent surgical history was significant for bilateral endovascular interventions 9 months before for IC at an outside facility. The physical examination revealed sensory deficits of the right foot without audible Doppler signals in the femoral, popliteal, posterior tibial, or dorsalis pedis arteries, consistent with Rutherford class IIa ALI. The patient was systemically heparinized, and computed tomography angiography of the aortoiliac system and bilateral LEs was obtained, demonstrating occluded stents extending from the right common iliac artery to the popliteal artery without appreciable tibial runoff. The patient was taken to the hybrid suite for a diagnostic aortogram, which demonstrated extensive aortoiliac stenting with self-expanding stents that had been deployed into and across the common and deep femoral arteries (Fig 1, *A*). Consistent with the preoperative computed tomography angiographic findings, all the stents were thrombosed without visible reconstitution (Fig 1, *B*). The right-sided thrombosed stents were successfully crossed, and, given the lack of visible runoff to the foot, a Uni-Fuse thrombolytic catheter (AngioDynamics) was placed in the superficial femoral artery and popliteal arteries with direct tissue plasminogen activator infusion, with the knowledge that any progression toward Rutherford class IIb might require conversion to higher risk open surgery. The open surgical options would depend on which vessels, if any, had been opened via thrombolysis. After 24 hours of catheter-directed thrombolysis in an intensive care unit setting, a repeat angiogram was performed, revealing resolution of the acute thrombus burden within the

From the Rutgers Robert Wood Johnson Medical School, Piscataway,[a] and the Division of Vascular Surgery and Endovascular Therapy, Robert Wood Johnson Medical School, Rutgers University, New Brunswick.[b]

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Correspondence: William E. Beckerman, MD, Division of Vascular Surgery and Endovascular Therapy, Robert Wood Johnson Medical School, Rutgers Biomedical and Health Sciences, Rutgers University, Medical Education Bldg 541, One Robert Wood Johnson Pl, New Brunswick, NJ 08901 (e-mail: beckerwe@rwjms.rutgers.edu).

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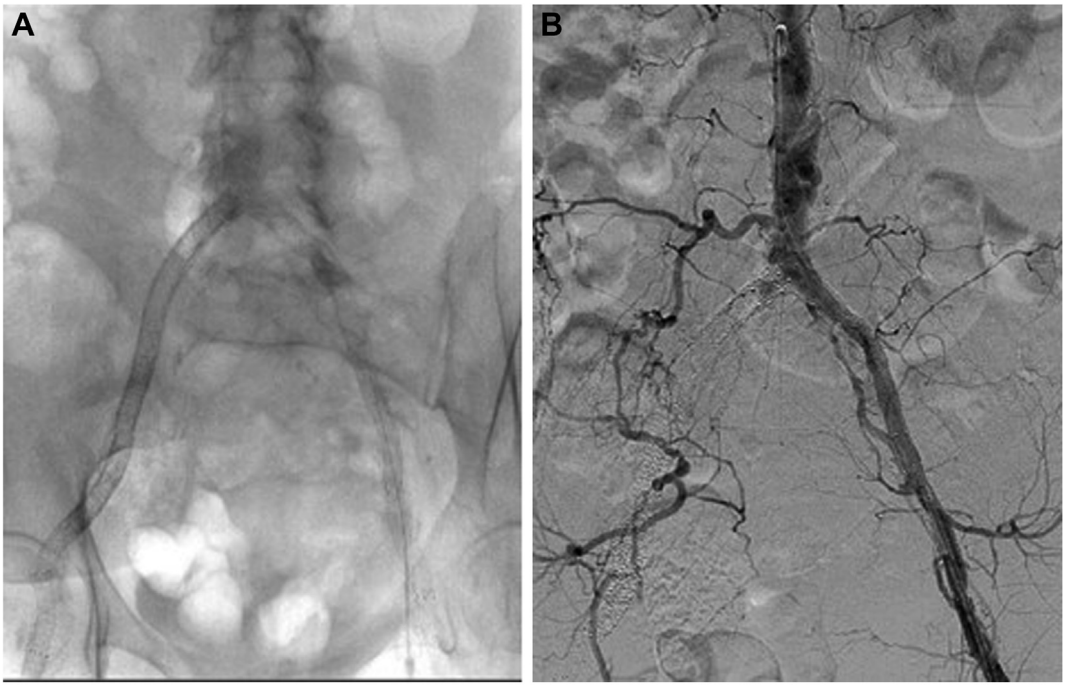

Fig 1. Angiogram showing continuous stent coverage from bilateral aortoiliac segment crossing common and deep femoral arteries **(A,B)** with occlusion of the right-sided stents **(B)**.

aortoiliac system. However, residual stenosis was still present in the below-knee popliteal artery, an occluded tibioperoneal trunk, and a diffusely diseased posterior tibial artery to the mid-calf, which reconstituted as the predominate runoff to the foot (Fig 2, *A*). The proximal posterior tibial artery lesion was treated with two overlapping 2.5 × 38-mm Resolute Onyx drug-eluting stents (Medtronic). The distal popliteal lesion was treated with rotational atherectomy, followed by 5-mm Lutonix drug-coated balloon angioplasty of the entire femoropopliteal segment (Fig 2, *B*). Completion angiography demonstrated successful restoration of inline flow to the foot (Figs 3 and 4).

Postoperatively, she experienced immediate symptomatic improvement. She was monitored closely for development of compartment syndrome. Her postoperative ankle brachial index was 0.85 on the right LE and 0.42 on the left LE. Bilateral LE arterial duplex ultrasound revealed residual >75% stenosis of the common femoral artery (CFA) and patent profunda, superficial femoral artery, and popliteal stents in the right LE (Fig 5). She was discharged with triple therapy (dual antiplatelet therapy and novel oral anticoagulation therapy) and atorvastatin, with counseling for smoking cessation. To maintain long-term treatment of the patient's symptoms, a definitive plan of elective open operative revascularization involving CFA stent removal and endarterectomy, with or without femoral-to-posterior tibial bypass, was planned after the initial postoperative outpatient visit with cardiac workup and carotid artery disease screening. The patient provided written informed consent for the report of her case details and imaging studies.

DISCUSSION

Early peripheral interventions have become a widely debated topic throughout the vascular surgery community. Further investigation by Hicks et al[4] revealed that 5.6% of physicians in the study were performing >14% of early peripheral vascular interventions, primarily at ambulatory surgery centers and office-based laboratories.

The treatment for IC has traditionally been nonoperative, and patients are often advised regarding lifestyle changes (ie, smoking cessation, exercise therapy) and pharmacologic interventions (eg, aspirin, cilostazol, statin). It is not until patients have developed lifestyle-limiting claudication, rest pain, or nonhealing wounds that operative intervention is considered. Despite the reported guidelines, some physicians have continued to perform early peripheral vascular interventions for IC,[4] with research showing a 62% increase in interventions for claudication during a 6-year period, as noted by Keeling et al[5] in a retrospective study of vascular surgery resident case logs.

Although many of these interventions offer temporary symptomatic relief, they can fail to provide long-term

Fig 2. Residual popliteal and infrapopliteal disease **(A)** successfully treated with overlapping drug-eluting stents and rotational atherectomy with subsequent drug-coated balloon angioplasty of the entire segment **(B)**.

benefits. The Society for Vascular Surgery (SVS) practice guidelines note that invasive therapy for IC should have a >50% likelihood of sustained clinical improvement for ≥2 years.[6] As seen with our present patient, the initial treatment, involving extensive stenting and maldeployment, was not durable in the long term, causing a worsening of her PAD. Although IC can negatively affect the quality of life of many patients, the risk of major amputation is <1% annually. However, for patients with minimal symptoms, invasive therapy as the first-line treatment can prove to be more harmful than beneficial.[1,7] George et al[3] demonstrated that patients within the Veterans Affairs Administration healthcare system who had received intervention for claudication had three to four times the risk of future amputation than those who did not undergo intervention. They also showed that earlier intervention of IC led to faster disease progression from IC to chronic limb-threatening ischemia compared with later interventions.[3] Furthermore, according to the SVS practice guidelines, when managing multisegment disease, the proximal disease should be treated first, because such treatment might improve symptoms without needing to treat the more distal vasculature.[6] For complex asymmetric complex aortoiliac bifurcation disease, such as in our patient, Suh et al[8] have shown the benefits of unilateral stenting in reducing the overall stent number and preservation of femoral access sites for future crossover interventions.

According to the discussion of Woo et al[9] of the SVS appropriate use criteria for the management of IC, the panel's opinion was that the endovascular revascularization of the CFA was deemed to have more risks than benefits. With very few exceptions, in almost all scenarios presented—current nicotine users, non-nicotine users, completion of exercise therapy, optimized medical therapy, and mild, moderate, and severe lifestyle

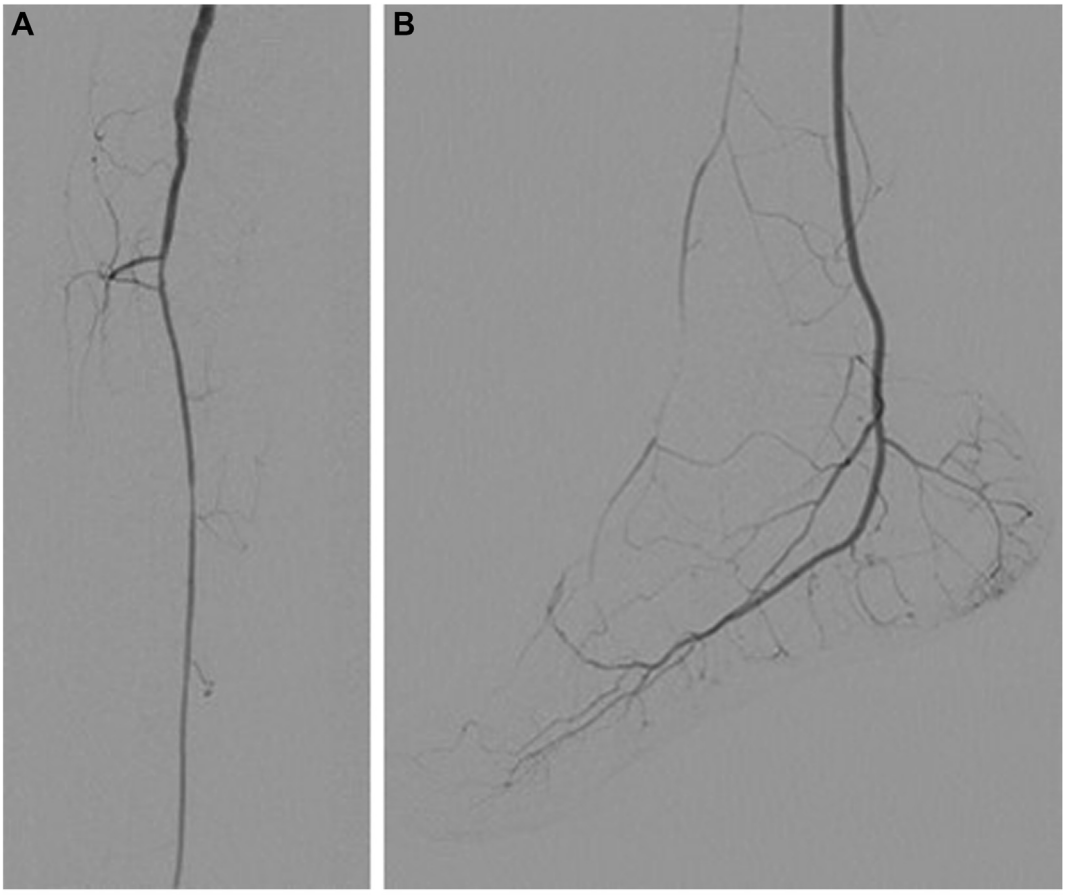

Fig 3. Completion angiogram showing in-line flow and single vessel runoff via the posterior tibial artery **(A)** that supplies the pedal arch **(B)**.

Fig 4. Completion angiogram of iliac system.

limitations—the panelists strongly agreed that endovascular intervention for IC in the CFA was not appropriate.[9] This was in congruence with the SVS clinical practice guidelines for IC that "common femoral artery disease should be treated surgically" and aligns with the idea that CFA endarterectomy remains a gold standard, with primary patency rates of 100% and 96% ± 3% at 1 and 5 years, respectively.[6,10] Comparatively, when evaluating the long-term efficacy of endovascular treatment of CFA occlusive disease, the primary patency rates were 73.4% at 1 year and 46.9% at 5 years.[11] When specifically considering stent-treated CFA lesions, the primary patency rates at 3 and 5 years were 76% and 72%, respectively, with stenting of the deep femoral artery presenting a significant risk factor for in-stent restenosis at 5 years ($P = .0007$).[12] Woo et al[9] further demonstrated panelist consensus that all infrapopliteal interventions were deemed to have risks outweighing the benefits for the treatment of IC, regardless of initial exercise therapies. Moreover, exercise therapy as the initial intervention for IC was endorsed, because it benefits the walking distance to the onset of claudication and maximum claudication pain, with some studies displaying clinical improvement in walking speed after 6 months of supervised exercise therapy.[9,13]

Right: Technically difficult study due to patient body habitus and shadowing artifact. Duplex imaging of the entire arterial tree of the leg was performed. The common femoral, SFA, popliteal, and tibial vessels were evaluated for plaque, patency, and flow abnormalities. There is evidence of a hemodynamically significant stenosis in the right common femoral artery (possible stent vs. irregular plaque in the native CFA). The profunda artery appears patent. There is an SFA stent visualized that appears patent with increased velocities at the distal stent consistent with mild in-stent stenosis (PSV 187 cm/s). There is a popliteal stent that appears patent, however there is evidence of mild-moderate residual stenosis at the distal stent edge (PSV is 339 cm/sec). The tibio-peroneal trunk and posterior tibial artery has increased velocities with significant turbulence consistent with mild stenosis. The peroneal artery is not well visualized.

Left: Technically difficult study due to patient body habitus and shadowing artifact. Duplex imaging of the entire arterial tree of the leg was performed. The common femoral, SFA, popliteal, and tibial vessels were evaluated for plaque, patency, and flow abnormalities. The common femoral and profunda arteries appear patent with normal flow velocities. The SFA appears to be completely occluded; there is absence of color flow and doppler signal within the SFA. Flow appears to reconstitute in the the left popliteal artery with normal flow velocities. The posterior tibial and anterior tibial arteries appear patent, however flow velocities are reduced. The peroneal artery is not well visualized.

Fig 5. Postoperative bilateral lower extremity (LE) arterial duplex ultrasound findings.

Stent placement in the CFA can further complicate the surgical options in the future if complications arise and reintervention is necessary.[9] This was noted in our patient, for whom the options for reintervention were limited, and added to the complexity of the emergent surgical intervention. Our case adds to the growing body of literature emphasizing the importance of understanding the potential complications and longevity of early endovascular interventions for IC.

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