Prevention and Management of CLI Complications

Interventionists must be aware of and prepared to treat complications that can occur during endovascular treatment of high-risk lesions.

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All endovascular interventions carry the risk of complications. This is even more relevant in the patient with critical limb ischemia (CLI), in whom a complication during intervention may result in suboptimal results, limb loss, and even death. Knowledge of the pathologies and procedures that carry increased risk of complications is very important, as is the prompt recognition and management of complications when they occur.

PROTECTING TIBIAL ARTERIES DURING PROXIMAL INTERVENTIONS

Certain pathologies that occur predominantly in the femoropopliteal arteries can be considered "at-risk" lesions for distal embolism to the tibial arteries (see *Femoropopliteal Lesions at Risk for Tibial Embolism* sidebar). Lesions associated with acute thrombus can be identified either by patient history or imaging. Patients who have a history of recent onset or worsening of symptoms are likely to have acute thrombus within the lesion and may have acutely thrombosed an underlying stenosis. On duplex ultrasound, an occlusion containing hypoechoic thrombus is suspicious, and on CT angiography and (especially) magnetic resonance angiography (MRA), periarterial enhancement is an important sign of acute or subacute thrombus (Figure 1). Recently occluded arterial bypass grafts are likely to contain a significant volume of thrombus, especially synthetic grafts.[1] Lesion morphology may indicate a high risk for distal embolism (Figure 2). In particular, crossing and treating lesions with ulcerated plaque or free-floating thrombus are associated with increased embolic risk.[1-3] Certain endovascular procedures carry a higher risk of distal embolism, including atherectomy, thrombolysis, and mechanical thrombectomy.[3,4] Most importantly,

Figure 1. Acute thrombosis in a 78-year-old man who presented with a 10-day history of severe left leg pain. MRA demonstrated an occluded left above-knee popliteal artery (A). An individual image partition demonstrated the occlusion containing hypointense thrombus with periarterial enhancement (arrows) (B).

Figure 2. A lesion at high embolic risk in the right popliteal artery in a patient with short-distance claudication. Note the intraluminal filling defects suggesting free-floating thrombus.

FEMOROPOPLITEAL LESIONS AT RISK FOR TIBIAL EMBOLISM

- Recent onset or worsening of symptoms
- Periarterial enhancement of a chronic total occlusion on CT angiography/MRA
- Occluded femoropopliteal bypass grafts
- Ulcerated plaque or free-floating thrombus within the lesion
- Revascularization techniques in the setting of high embolic risk (eg, atherectomy, mechanical thrombectomy)
- Compromised distal runoff

patients with compromised tibial artery anatomy are more likely to suffer severe clinical consequences of distal embolism because they lack anatomic arterial reserve.

When treating at-risk lesions in the femoropopliteal arteries, attention to technique is important in order to prevent embolic complications. This includes close attention to adequate anticoagulation, preferably maintaining an activated clotting time > 250 seconds. The use of primary stenting and covered stents should be considered in order to constrain any unstable thrombus or plaque (Figure 3). Finally, the use of distal embolic protection devices can be vital when treating high-risk proximal lesions (Figure 4), as they may prevent severe complications.[5,6]

TREATING TIBIAL ARTERY EMBOLI DURING PROXIMAL INTERVENTIONS

The two main treatment strategies to manage tibial arterial emboli are aspiration thrombectomy and thrombolysis.[7,8] Aspiration thrombectomy has the advantage of being able to quickly restore flow and

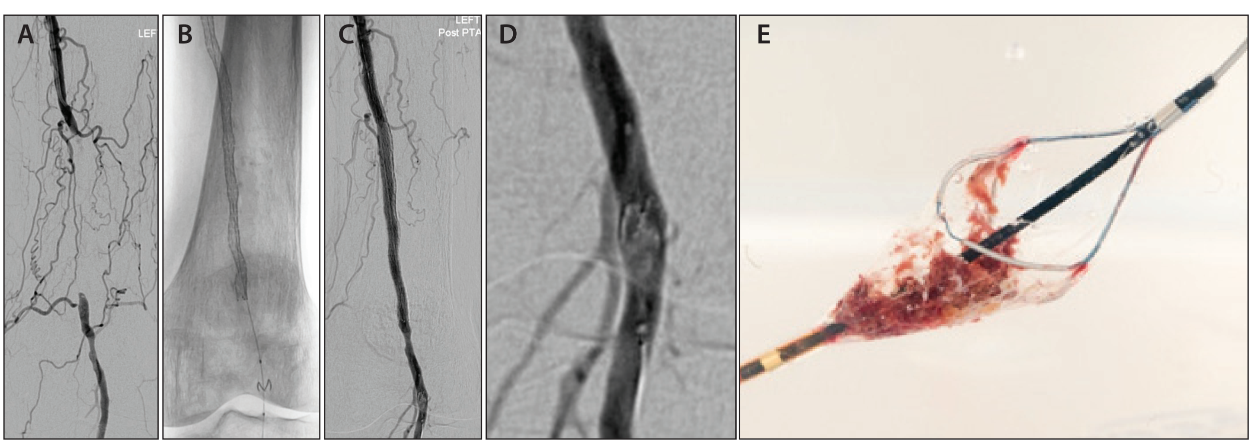

Figure 3. A high-risk lesion treated with primary stenting and embolic protection. An 84-year-old man presented with 5 days of severe rest pain. The patient gave a history of long-standing left leg claudication. This suggests recent thrombosis of an underlying stenosis. A 12-cm-long occlusion of the distal left superficial femoral artery and proximal popliteal artery (A). A primary drug-eluting stent with a distal embolic filter (B). Note the stent was still constrained by the underlying disease. Angiography following stent dilatation (C). Magnified view of the embolic filter, showing embolic debris within it (D). Embolic filter containing thrombus and minor atheromatous debris (E).

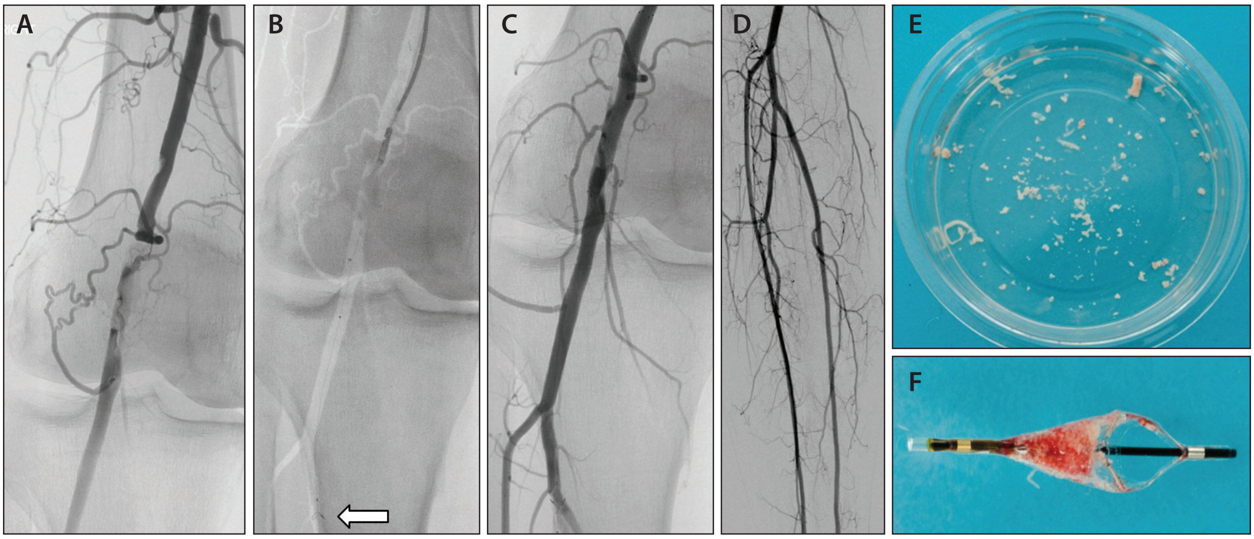

Figure 4. Directional atherectomy with embolic protection of a mid-popliteal artery lesion. Near-total chronic occlusion of the mid-popliteal artery (A). Directional atherectomy with a distal filter in place (arrow) (B). Completion angiography with the filter in place (C). Tibial artery anatomy following filter removal (D). Atheromatous debris obtained from the atherectomy device (E). Embolic filter full of debris (F).

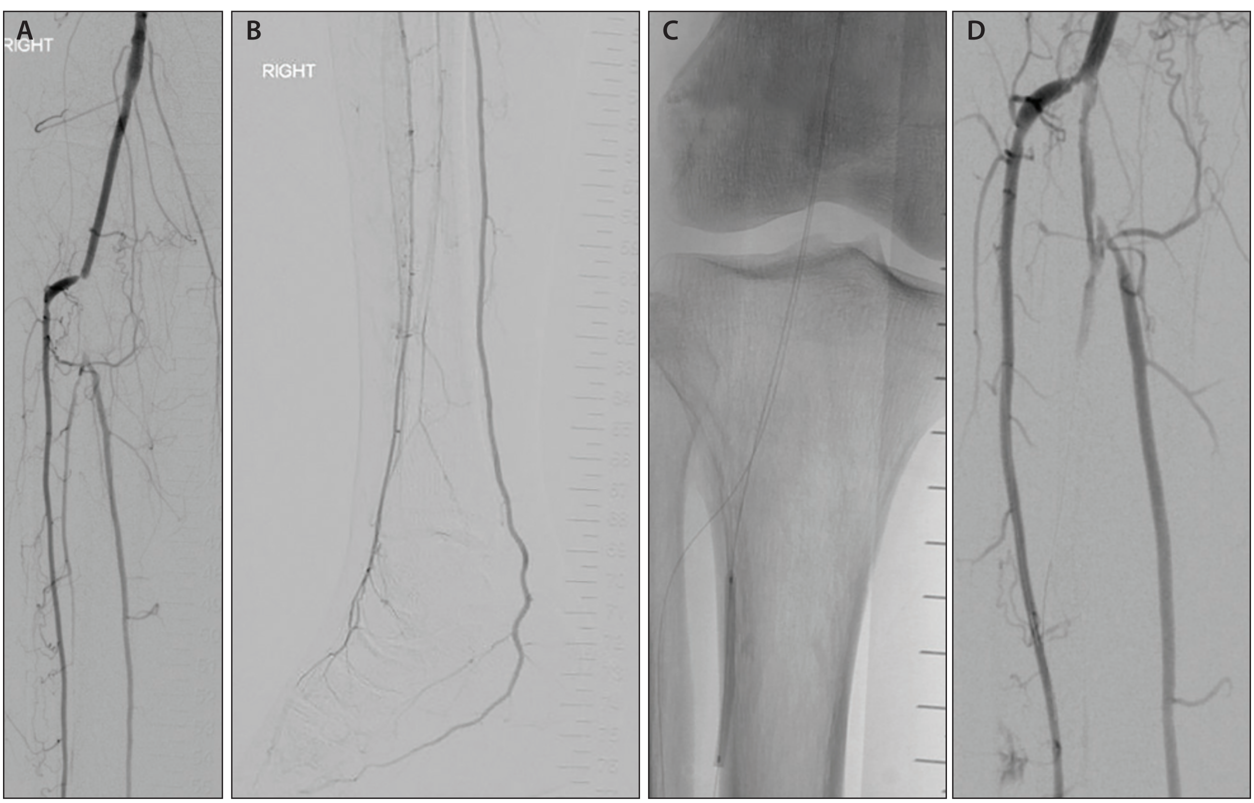

Figure 5. Poor planning during a tibial artery intervention resulting in complications in a 79-year-old man with a nonhealing right heel ulcer. The posterior tibial artery was clearly the wound-related artery. Initial angiography showing a tibioperoneal trunk occlusion and an anterior tibial artery ostial stenosis (A). Angiography of the lower calf and foot demonstrated a good-quality posterior tibial artery supplying the heel ulcer region (B). Guidewires placed in the peroneal and anterior tibial arteries with angioplasty of the tibioperoneal trunk (C). A guidewire was not placed in the target posterior tibial artery. A dissection that occurred after angioplasty, with loss of the peroneal artery and difficult access to the posterior tibial artery (D).

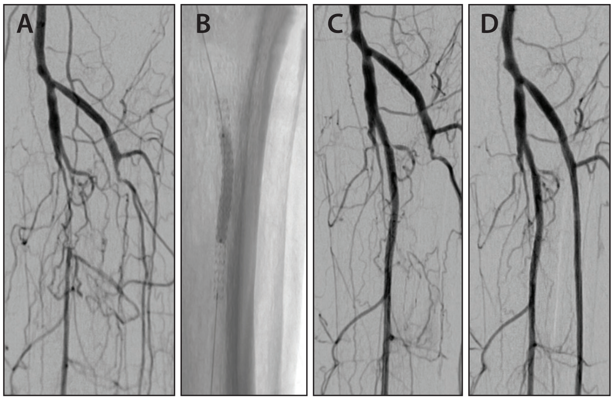

Figure 6. Multiple artery revascularization in an 82-year-old man with a cold left foot and heel ulcer. Preliminary angiography showed localized occlusions of the proximal peroneal artery and the anterior tibial artery (A). The posterior tibial artery was completely occluded. Angioplasty and a drug-eluting stent were used to treat the peroneal artery lesion (B). The peroneal artery was revascularized (C). The anterior tibial artery was treated with angioplasty to improve cold foot symptoms (D).

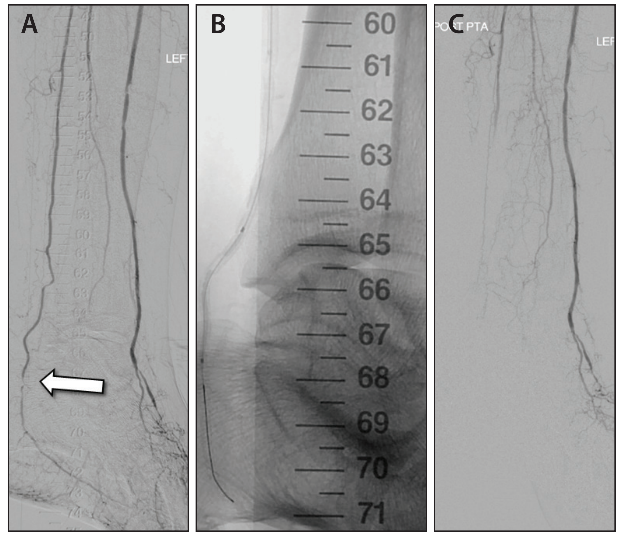

Figure 7. An iatrogenic tibial artery occlusion in an 86-year-old woman with a plantar ulcer. Preliminary angiography showed a distal posterior tibial artery stenosis (arrow) (A). Overly aggressive angioplasty with a 3-mm diameter balloon catheter (B). Complete posterior tibial artery occlusion that was unable to be revascularized (C).

manage atheroembolic debris that do not respond to thrombolysis. For this reason, aspiration thrombectomy is usually the first treatment approach.

PREVENTING COMPLICATIONS DURING TIBIAL INTERVENTIONS

The key to minimizing the risk of complications during tibial artery interventions is to have a carefully planned approach. Although there is considerable debate about the relative merits of direct (angiosome related) versus indirect revascularization,[9-11] it is important to clearly identify the most appropriate target artery and make sure it is protected during the intervention. The use of buddy wires achieves this when treating an arterial bifurcation (Figure 5). If target artery revascularization is unsuccessful, indirect revascularization should be performed in an attempt to improve the patient's outcome.[9-11] Revascularization of multiple arteries should also be considered to minimize the clinical consequences of vessel closure (Figure 6).

Important intraprocedural techniques include close attention to adequate anticoagulation and the liberal use of vasodilators. Factors that clearly affect procedural outcomes include operator experience, the appropriate use of low-profile crossing and chronic total occlusion wires, catheters, and angioplasty balloons. Prolonged angioplasty balloon inflation times and low-pressure inflations appear to be associated with reduced arterial dissection after angioplasty.[12] It is important to appropriately size angioplasty balloons. A common approach is to be initially conservative with balloon sizing. It is easy to upsize the balloon if a lesion has been undertreated. However, if arterial rupture, perforation, or occlusion occur as a result of balloon oversizing, this is more difficult to deal with (Figure 7).

TREATING COMPLICATIONS DURING TIBIAL INTERVENTIONS

CLI patients are a challenging group to treat. In a large Medicare audit of CLI patients in the United States, a 30-day amputation rate of 23.8% and mortality rate of 7.7% were noted.[13] However, most of the mortality was not limb related, with renal, respiratory, and cardiac causes dominating.

The most common complications encountered during endovascular tibial artery intervention include unsuccessful antegrade guidewire crossing, subintimal entrapment, arterial dissection, and vessel perforation.[14] The incidence of unsuccessful antegrade guidewire crossing has dramatically reduced with the appropriate use of a range of hydrophilic, low-profile crossing guidewires, as well as weighted-tip chronic total occlusion wires offered by a number of manufacturers. Operator experience with when and how to use these wires clearly affects outcomes.

In cases of unsuccessful antegrade crossing or subintimal entrapment, a retrograde tibial or pedal artery

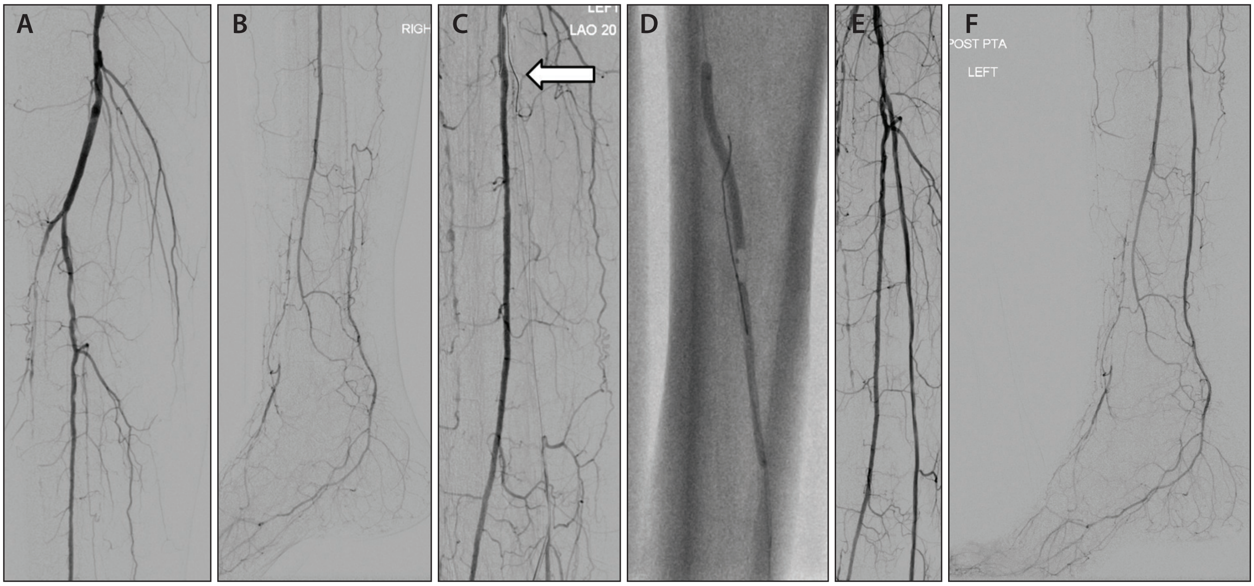

Figure 8. Subintimal entrapment treated by retrograde tibial access and the double-balloon technique in a 74-year-old man with a right heel ulcer. Preliminary angiography showed a long posterior tibial artery occlusion (A, B). The posterior tibial artery was the wound-related artery. An antegrade guidewire was trapped in the subintimal space (arrow) (C). The double-balloon technique from antegrade and retrograde approaches (D). Completion angiography after angioplasty (E, F).

approach is often the next step (Figure 8). In this setting, a retrograde approach facilitates successful revascularization in approximately 90% of cases.[15,16] Ancillary techniques such as "double-balloon" angioplasty (retrograde and antegrade balloons in different subintimal spaces) are important to master and have available. Most reentry devices are too bulky for use in the tibial arteries, although several low-profile devices including Enteer (Medtronic) and Ocelot (Avinger, Inc.) are now available.

Tibial artery dissection is initially managed with prolonged, low-pressure balloon angioplasty. If there is a persistent dissection of hemodynamic significance, the use of a stent is required. For focal lesions, a coronary drug-eluting, balloon-expandable stent is usually used (Figure 9). For more diffuse lesions, nitinol self-expanding

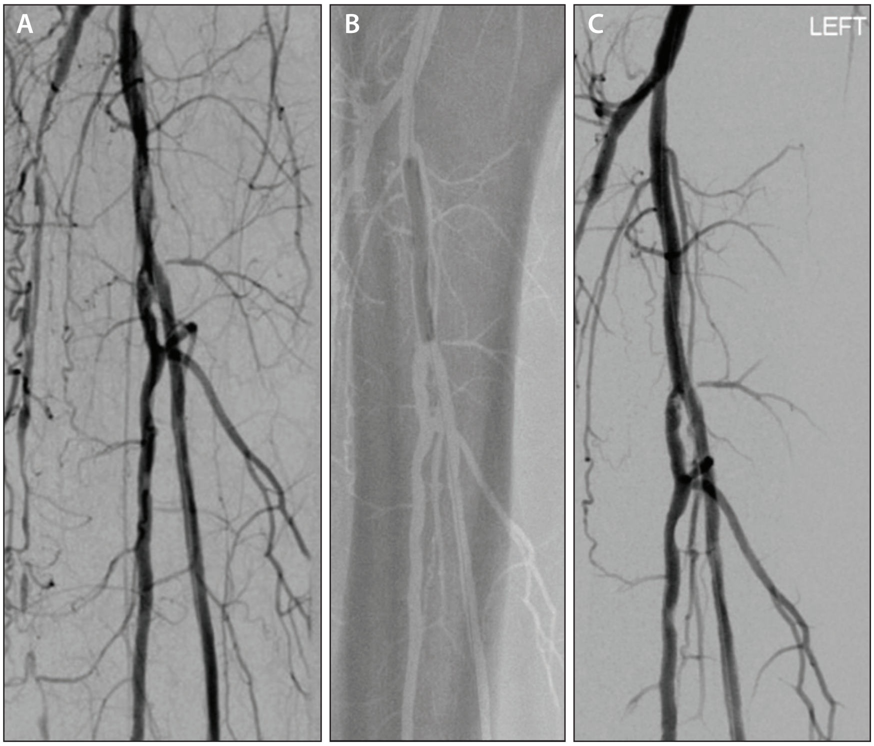

Figure 9. A tibioperoneal artery dissection managed with a drug-eluting stent in a 68-year-old diabetic man with severe rest pain. Dissection following angioplasty of the tibioperoneal artery (A). Deployment of a drug-eluting, balloon-expandable stent (B). Angiography following stent deployment (C).

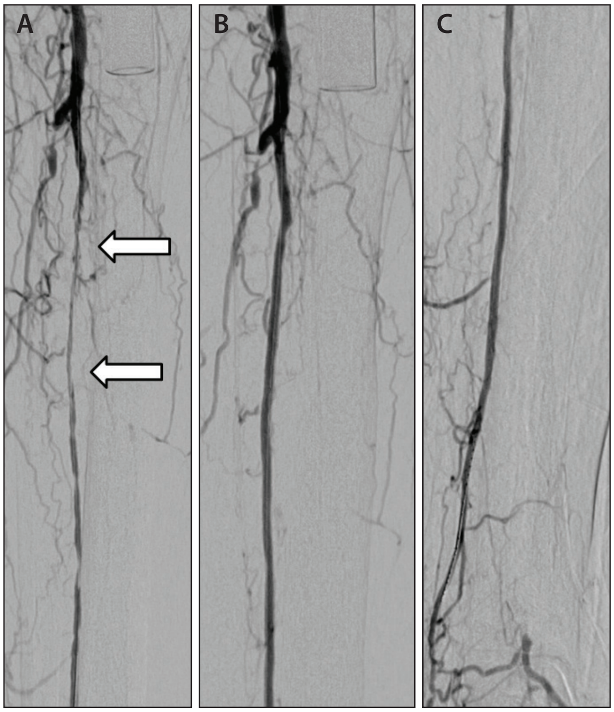

Figure 10. Long residual stenosis and dissection following prolonged balloon angioplasty managed with a nitinol self-expanding stent. Long residual stenosis (arrows) involving the peroneal artery (A). Angiography following deployment of nitinol self-expanding stents (B, C).

stents may be required, sometimes in association with a drug-coated balloon (Figure 10). There are new devices being assessed in this setting, including the use of miniaturized self-expanding stents or Tacks (Intact Vascular, Inc.).[17]

Arterial perforation during tibial artery intervention is an uncommon but potentially serious complication. Perforation was reported at an incidence of 5% in the BASIL trial.[18] Initial management includes prolonged balloon angioplasty and reversal of anticoagulation. Additional strategies include external compression, proximal arterial occlusion, or the use of a covered stent. Assessment of compartment syndrome and early surgical consultation is important, as decompression via fasciotomy may be required.

CONCLUSION

Knowledge of potential complications and their management is very important when undertaking tibial artery interventions. Swift action must be taken once a complication is recognized in order to provide an optimal outcome and possibly even save the patient's life. ■

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Disclosures: None.