Current Endovascular Management of Acute Limb Ischemia

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KEYWORDS

• Peripheral artery disease • Peripheral vascular intervention • Acute limb ischemia • Limb salvage

KEY POINTS

- Acute limb ischemia is a vascular emergency, with a variable presentation that can limit and hinder diagnostic certainty.
- Prompt diagnosis and treatment are critical given the morbidity and mortality associated with the condition.
- Multiple approaches exist to manage acute limb ischemia, with emerging and evolving endovascular approaches showing promise and efficacy.
- There is an ongoing need to determine the optimal long-term management of patients with acute limb ischemia after initial reperfusion.

INTRODUCTION

The incidence of acute limb ischemia (ALI) has decreased over time to 26 cases per 100,000 in the United States.[1] However, ALI remains a vascular emergency, and persistent delays in the recognition and management of this condition continue to place patients at risk for limb loss and subsequent adverse events.[2] Accordingly, this report describes and reviews the current understanding and management of ALI, with a focus on endovascular intervention for limb salvage.

DIAGNOSIS

ALI is defined as the rapid development of decreased limb perfusion, resulting in a new or worsening threat to the viability of a limb.[3] The classic symptoms suggestive of ALI are commonly known as the six "Ps": paresthesias, pain, pallor, pulselessness, poikilothermia, and paralysis. However, the presentation of ALI is markedly variable and can include severe rest pain to decrements in sensation. Physical examination findings consistent with this diagnosis include absent pulses in the distal limb with cool temperature and pale or mottled skin. There can be a clear demarcation in skin color and temperature below the occluded artery, although the absence of this finding does not exclude the diagnosis.

The subtlety in historical and clinical features and the presence of confounding comorbidities can contribute to the difficulty in diagnostic precision for ALI. More specifically, patients may present with concomitant claudication and diabetic peripheral neuropathy that may mimic several of the symptoms and signs outlined above. However, the acuity of symptom onset should suggest the presence of an acute thrombosis within the peripheral vasculature. The sudden decrement in limb perfusion results in acute symptoms, as there has not been sufficient time for collateral vasculature to mature and circumvent the culprit lesion. Traditionally, the development of decreased limb perfusion occurs within 2 weeks, distinguishing it from the natural progression of critical limb ischemia or diabetic peripheral neuropathy.

Disclosures/Conflicts of Interest: S.W. Waldo receives investigator initiated research support from Merck Pharmaceuticals and Cardiovascular Systems Inc.

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Intervent Cardiol Clin ■ (2016) ■–■

http://dx.doi.org/10.1016/j.iccl.2016.12.003

2211-7458/16/Published by Elsevier Inc.

Early diagnosis of this condition is critical to reduce the damage to the affected extremity and improve the rates of limb salvage.[4] Once the diagnosis is suspected, the severity of limb ischemia should be determined using the Rutherford classification (Table 1) to ensure clarity in communication and influence the urgency of revascularization.[5] Classification is determined using physical examination and Doppler pulse evaluation of the affected limb. Patients with class I or IIa limb ischemia may be appropriate for adjunctive diagnostic testing, focused first on delineating anatomy and procedural planning. Duplex ultrasonography, computed tomographic angiography, or magnetic resonance angiography (Fig. 1) can be useful. Echocardiography can also be useful in determining possible embolic sources for ALI but is not as useful in planning revascularization. Ultimately, the gold standard for anatomic evaluation is catheter-based contrast angiography allowing for both diagnostic imaging and direct therapeutic intervention. In patients with class IIb limb ischemia, the limb is acutely threatened, and there is an urgent need for revascularization to maintain tissue viability. In these patients, progression directly to catheter-based angiography is recommended.

ETIOLOGIES

The potential etiologies of ALI are divided into 3 broad categories: (1) thrombosis, (2) trauma/dissection, and (3) embolism. Thrombosis may present suddenly but is also most likely to occur in patients with significant comorbidities (eg, elderly, presence of atherosclerotic cardiovascular disease) at the site of already existing atherosclerotic plaques and may mimic more chronic conditions resulting in delayed presentations. Thrombosis resulting in ALI may also occur in arterial aneurysms, bypass grafts, or endovascular stents. Although thrombotic events in grafts or stents can be related to anatomic or mechanical processes impacting graft or stent function (ie, "kinking" or anastomotic issues in grafts, underexpansion or fracture in stents), they can also occur spontaneously without obvious mechanical issue. In rare cases, hematologic conditions, such as antiphospholipid antibody syndrome or heparin-induced thrombocytopenia, can predispose patients to spontaneous arterial thrombosis in the native vasculature. Trauma can result in severing of the inflow vasculature to the affected limb and is often suggested by history or presentation. Dissection can be spontaneous or trauma-induced and again can be suggested by history and presentation (ie, accidental: gunshot wound, or iatrogenic: recent femoral arterial access). Finally, embolic events can occur from a variety of sources: cardioembolic (left ventricular thrombus, left atrial thrombus in atrial fibrillation, valvular thrombus or pannus), paradoxic emboli, and atheroembolic from more proximal arterial aneurysms with associated thrombus or aortic mural thrombus. Embolic events tend to lodge at bifurcations, such as the common femoral bifurcation or the brachial artery bifurcation in the upper extremity (Fig. 2).

INITIAL MANAGEMENT

After identifying a patient with an acute limb, the initial management focuses on preventing the propagation of thrombus and planning for

Table 1
Rutherford classification of acute limb ischemia

Class	Assessment of Limb Viability	Physical Findings	Pulses
I	Limb viable, no immediate threat	Motor: intact strength Sensory: intact sensation	Arterial: + Doppler Venous: + Doppler
II	Limb threatened		
IIa	Threatened, but salvageable if urgent revascularization	Motor: intact strength Sensory: minimal (end digits) or no deficits	Venous: + Doppler Arterial: +/− Doppler
IIb	Threatened, salvageable if immediate revascularization	Motor: Mild/moderate deficit Sensory: +/++ deficits (beyond end digits), rest pain	Venous: + Doppler Arterial: − Doppler
III	Limb irreversibly damaged: tissue loss, permanent nervous damage	Motor: paralysis Sensory: profound deficits	Venous: − Doppler Arterial: − Doppler

Adapted from Rutherford RB, Baker JD, Ernst C, et al. Recommended standards for reports dealing with lower extremity ischemia: revised version. J Vasc Surg 1997;26:518; with permission.