Angiosome-Guided Intervention in Critical Limb Ischemia

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KEYWORDS

• Critical limb ischemia • Angiosome • Revascularization • Limb reperfusion

KEY POINTS

- Successful revascularization for CLI involves knowledge of limb perfusion strategy, technical expertise in reperfusion therapies, and an approach of multidisciplinary care to address complex patient comorbidities.
- Broad conclusions about CLI reperfusion strategy are challenged by the heterogeneous and generally nonrandomized nature of available clinical studies.
- Although these observational analyses have limitations, they provide contemporary evidence of real-world limb revascularization that substantiate further clinical use and study of angiosome-directed limb reperfusion.

INTRODUCTION

Although accounting for a minority 1% to 3% of the more than 8 million Americans affected by peripheral artery disease (PAD), critical limb ischemia (CLI) is associated with substantial risks of limb loss, health care resource utilization, and high rates of fatal vascular and nonvascular events.[1–3] CLI represents the terminal consequences of severe PAD, including chronic ischemic rest pain, arterial ulceration, and gangrene. Revascularization is the optimal treatment of CLI to relieve ischemic limb pain, promote limb salvage, and to avoid major amputation.[2]

Effective arterial reperfusion is marked by improved hemodynamics to the distal extremity and at the wound bed. Evidence supports the use of either bypass surgery or endovascular therapy to that end.[4] Advances in technology that facilitate arterial revascularization, particularly endovascular techniques, have expanded treatment options for those with complex PAD and have been expertly reviewed elsewhere.[5] Several key factors should be considered in selecting a revascularization strategy, including the patient's operative risk, location of ischemia, and anatomic pattern of arterial disease. Evolution of limb reperfusion strategy also helps to shape how revascularization is applied to maximize opportunity for wound healing and limb salvage.

In recent years, angiosome-directed revascularization has developed into a popular theory of reperfusion, whereby anatomically directed arterial flow is restored to the wound bed. Clinical evidence continues to mount as to the efficacy of this strategy, although important limitations remain. This state-of-the-art review evaluates the development of the angiosome-directed model of revascularization for CLI, explores the current evidence supporting its use especially for infrapopliteal arterial revascularization, and

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considers future implications of the angiosome model that may guide endovascular reperfusion strategies.

THE ANGIOSOME MODEL

Achieving direct, in-line arterial flow to an area of ischemic tissue is the foundation of the angiosome approach. First described within the scope of reconstructive plastic surgery, the angiosome represents a territory of vascular cascade that corresponds to a specific three-dimensional dermal topography.[6] The foot and ankle have six distinct angiosomes supplied by the three major infrapopliteal arteries (Fig. 1).[7] The posterior tibial artery contributes to three angiosomes: the medial and lateral plantar surface of the foot, and the medial surface of the heel. The peroneal artery provides flow to the lateral forefoot, ankle, and heel. The anterior tibial artery provides supply to the dorsum of the forefoot, ankle, and leg. A watershed network of collateral arteries provides anastomotic connections between adjacent angiosomes. This system of collaterals allows tissue from a well-perfused angiosome to provide indirect flow via collaterals to an adjacent malperfused territory. Whereas the optimal revascularization result includes direct flow to the wound bed, indirect flow fed by collaterals of an adjacent angiosome may facilitate wound healing. The angiosome approach ensures that maximal arterial supply is directed to an affected region of ischemia, rather than simply improving global, nondirected limb flow.

REVASCULARIZATION STRATEGY IN THE GUIDELINES

The Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II) guidelines for CLI give preference to endovascular revascularization over surgery when equivalent short- and long-term clinical outcomes are anticipated, although they are further refined based on the severity classification of inflow lesions.[2] Guideline updates in 2011 from the American Heart Association/American College

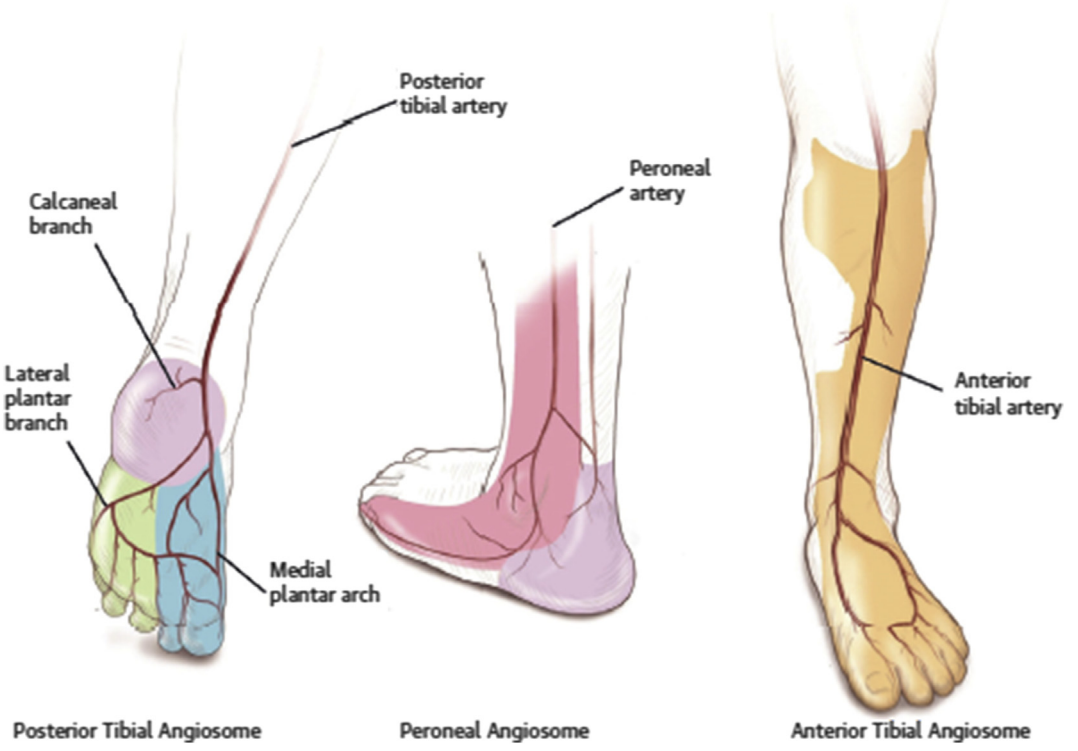

Fig. 1. The below-the-knee skin and tissue are supplied by three main arteries and six angiosomes. The anterior tibial artery supplies the anterior shin and dorsum of the foot, the posterior tibial artery supplies the medial heal and the medial and lateral plantar angiosomes, and the peroneal artery supplies the lateral aspect of the heel and the lateral border of the foot. (*From* Shishehbor MH, White CJ, Gray BH, et al. Critical limb ischemia: an expert statement. J Am Coll Cardiol 2016;68:2002–15; with permission.)