Reconstruction of the Ischemic Hand

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• Hand ischemia • Reconstruction • Arterial perfusion
• Vascular trauma • Raynaud's

Ischemia of the hand remains an uncommon condition, but problems with arterial perfusion of the hand can arise from trauma (open and closed), thrombosis, or as a result of arteriovascular disease. Certain identifiable patterns are seen with hand ischemia, usually discernable according to which one of the major arteries (radial or ulnar) are involved. This article discusses the origin and management of ischemic hand conditions, with an emphasis on recognizing the patterns of ischemia that are commonly seen.

ARTERIAL ANATOMY OF THE HAND

The vascularity of the hand is primarily provided by the radial and ulnar arteries, with secondary contribution through the anterior and posterior interosseous vessels that arborize at the wrist. Although these interosseous vessels do not supply the dominant blood supply to the hand, they may become important in some ischemic conditions involving the major two vessels. The arterial anatomy in the palm has traditionally been considered as having a deep and a superficial arch, whose names describe their positions in the palm. The deep arch is typically fed by the radial artery as it comes around the hand at the base of the thumb in the anatomic snuffbox, and then enters the palm as it pierces the dorsal interosseous muscle in the first web space. This artery then connects with the deep component of the palmar arch. The ulnar artery runs into the palm from the forearm along the radial aspect of the pisiform bone with the ulnar nerve on its ulnar side. This artery continues on to become the superficial arch and supplies the proper digital vessels in the palm. Since the early work of Coleman and Anson[1] on the anatomy of the arch, much discussion has surrounded the potential for ischemia from an incomplete arch if one of the major vessels of the hand becomes occluded. Traditional teaching is that most hand ischemia is caused by this incomplete arch, and the fingers become ischemic from lack of crossover blood flow from the nonthrombosed vessel. In the authors' experience with close to 150 cases of arterial thrombosis of the radial or ulnar arteries, ischemia of the fingers or hand is not generally from a lack of connection between the two portions of the arch, but rather from embolization of clots from the site of original thrombosis (in the radial or ulnar artery) into the downstream digital vessels, leading to ischemia of the fingers fed by these digital arteries (**Fig. 1**). Thus, the authors question the long-held concern about the lack of a complete palmar arch in its contribution to digital ischemia with thrombosis of the radial or ulnar arteries. Some patients unquestionably have an incomplete arch and would experience partial hand ischemia if the radial or ulnar arteries were harvested for a bypass or flap, but in the authors' experience, these patients are significantly few and far between.

Numerous causes of ischemia of the upper extremity have been reported (**Box 1**). The treatment should be individualized depending on the cause and expected outcomes.

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Fig. 1. View of digital vessel with small thrombus from ulnar artery thrombosis.

Box 1
Causes of ischemia of the upper extremity

Occlusive arterial disease
Atherosclerosis
Embolic disorders
Vasculitis
Thromboangiitis obliterans
Thoracic outlet syndrome
Takayasu disease
Traumatic aneurysm
Canalization
Ulnar hammer
Arteriovenous steal/shunt
Arteriovenous malformation
Vasospastic disorders

Cutaneous small-vessel disease
Vasculitis
Waldenström's hypergammaglobulinemic purpura
Henoch-Schönlein purpura
Collagen vascular–associated
Acute hemorrhagic edema of infancy
Rheumatoid nodules with vasculitis
Urticarial vasculitis
Hyperimmunoglobulinemia D syndrome
Essential mixed cryoglobulinemia
Familiar Mediterranean fever
Connective tissue disorders
Myeloproliferative disorders

IATROGENIC HAND ISCHEMIA

Accidental blunt or sharp injury to the radial, ulnar, palmer, or digital vessels may result in vascular insufficiency to the hand or digits. The vascular system could also be disrupted from surgical intervention through flap harvesting. Ischemia from harvesting of the radial artery for coronary artery bypass grafting or flap transfer is fortunately uncommon. Although cases of digital ischemia have been reported after this,[2,3] most studies have shown no significant morbidity from harvest of the radial artery, either for coronary bypass or transfer of a radial forearm flap. Several studies in patients undergoing coronary artery bypass with the radial artery have actually shown improved perfusion of the radial digits after harvest, presumably because of a compensatory mechanism to increase flow to the fingers supplied primarily by the radial artery.[4] Although ischemia of the digits after radial artery harvest has an estimated incidence of 10%,[5] some investigators have found no clinical evidence (hand claudication or ischemic symptoms) after harvest.[6] If the hand is noted to be ischemic after harvest of the radial artery for either a flap or coronary bypass, performing a vein bypass graft at that time is probably prudent rather than waiting for symptoms to develop.

Another potential iatrogenic cause of hand ischemia is radial artery catheterization for blood pressure monitoring. Large studies have shown the overall safety of radial artery catheterization, with one study quoting a "permanent ischemic complications" rate of only 0.09%.[7] Nonetheless, other large studies have shown flow abnormalities or thrombosis of the radial artery in approximately 26% of patients who have an arterial line.[8,9] Ischemia significant enough to lead to digital amputation is rare but is certainly reported. In their review of eight patients who experienced ischemia of the fingers after radial artery catheterization,