

CASE REPORT Hand

Distal Bypass to the Deep Palmar Arch for Treatment of a Unique Presentation of Digital Ischemia

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Summary: Radial artery occlusion leading to hand ischemia is a serious problem that may require prompt surgical intervention. Due to the rarity of these events, consensus on the most effective surgical approach has not yet been reached. There is even scarce literature on appropriate management of symptomatic radial occlusion in patients with a congenital variation in hand vasculature. We report on a case of a 38-year-old woman with radial artery occlusion who underwent a successful distal radial artery bypass to the deep palmar arch due to a diminutive ulnar artery and the absence of a superficial palmar arch. Radial artery bypass to the deep palmar arch using a reversed vein graft is a viable treatment option for preventing further digital ischemia or necrosis in patients with a compromised vasculature of the hand. (*Plast Reconstr Surg Glob Open 2023; 11:e5121; doi: 10.1097/GOX.00000000005121; Published online 17 July 2023.*)

Symptomatic radial artery occlusion (RAO) is rare due to the extensive network of circulation that provides collateral blood flow to the hands. In cases where there is insufficient collateral flow, hand ischemia may occur. Untreated hypoperfusion can lead to tissue necrosis and subsequent amputation leading to significant morbidity.¹

When conservative measures, such as nitroglycerin paste and calcium channel blockers, fail to relieve symptoms of digital ischemia, perfusion to the hand may be restored with intravenous tissue plasminogen activator or botulinum toxin injections.^{2,3} If all measures fail, surgical intervention is recommended. Historically, primary treatment involves resection of the occluded segment with endto-end anastomosis, though success is also demonstrated with microsurgical vein graft reconstruction.^{1,4,5} The purpose of this case report is to highlight the effectiveness of upper extremity distal radial artery bypass to palmar arch for the treatment of acute digit ischemia in patients with vascular variations of the hand.

CASE REPORT

A 38-year old right-hand-dominant female patient presented with idiopathic RAO 1 week after receiving a rituximab infusion to treat idiopathic thrombocytopenic

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Received for publication December 7, 2022; accepted June 1, 2023. Copyright © 2023 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of The American Society of Plastic Surgeons. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal. DOI: 10.1097/GOX.00000000005121 purpura. The patient had received routine rituximab infusions since 2014 and denied previous ischemic events. On examination, her right hand had apparent progressive mottling and cyanosis, most notably on the long (LF), ring (RF), and small fingers (SF) extending from the distal interphalangeal joint (DIPJ) distally. The patient was otherwise healthy and an intermittent smoker for 20 years.

The patient was first treated conservatively with warming measures, calcium channel blockers (amlodipine), antiplatelet therapy (clopidogrel), and nitroglycerin paste for 2 weeks, without improvement symptoms. Administration of tissue plasminogen activator during arteriogram also resulted in minimal improvement in patency of the radial artery. Over the subsequent 7 days, the right hand demonstrated hyperalgesia; worsening cyanosis of the LF, RF, and SF; and mottling on the thumb and index finger (IF) (Fig. 1). Arteriography of the right upper extremity demonstrated near complete occlusion of the radial artery proximal to the scaphoid with a diminutive ulnar artery and minimal collateral flow (Fig. 2). The palmar arch was intact, with adequate perfusion of the thumb, IF, and radial aspect of the RF, but less pronounced perfusion to the RF and SF. Given the failure of conservative measures and worsening ischemia, the decision was made to proceed with a bypass procedure.

Methods

A Bruner incision was made over the radial artery to the mid-palm, revealing the deep palmar arch and the absence of a superficial palmar arch. The thrombus was located proximal to the scaphoid in the radial artery and resected. A 10-cm cephalic vein was harvested in the distal forearm, reversed, and anastomosed end-to-end to the radial artery and the deep palmar arch using 9-0 nylon

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Fig. 1. Preoperative photograph showing cyanosis and mottling in the fingertips, resulting from RAO.

with the operative microscope (Fig. 3). At the end of the procedure, a pencil Doppler confirmed pulsatile flow through the vein graft and distal past the deep palmar arch to all digits. The operative site was irrigated, sutured, closed with 4-0 nylon suture, and wrapped in sterile dressings with a dorsal splint.

Results

After surgery, the patient continued to have a strong Doppler pulse along the vein graft to the palmar arch with a two-second capillary refill time in the thumb, IF, and LF tips. Digital arteries of the SF and RF had soft Doppler pulses with absence of a pulse just distal to the PIPJ. Two days later, the patient's SF and RF showed signs of early mummification demarcating at the DIPJ. At 3 weeks postoperatively, the patient reported moderate pain localized to the SF area of necrosis with marked overall improvement in her hand pain. At 8–12 weeks postoperatively, the patient's pain was isolated to the area of demarcation on the SF (Fig. 4), from the DIPJ distally and along the volar tip of the RF.

DISCUSSION

Symptomatic vaso-occlusion of the radial artery is uncommon due to the robust arterial blood supply to the hand. In patients with deviations in normal hand



Fig. 2. Right hand angiogram demonstrating occlusion of the radial artery with diminished ulnar artery.

vasculature, however, collateral blood flow is compromised. Due to its rarity, optimal management of RAO in the upper extremity remains controversial, and treatment is based on the etiology of the thrombus.⁶

The ulnar artery generally forms the superficial palmar arch to supply blood to the three ulnar digits of the hand.⁷ The patient in our case had a diminutive ulnar artery with minimal collateral flow, as well as the absence of the superficial palmar arch. This could explain why the patient presented with more prominent ischemic changes in the LF, RF, and SF. In 1984, Richards et al documented two cases of RAO wherein both patients presented with ischemic symptoms of the thumb and IF. The three ulnar



Fig. 3. Intraoperative photograph illustrating microsurgical bypass of the radial artery to the deep palmar arch using a reversed cephalic vein graft.

digits were unaffected, as perfusion was maintained by the ulnar artery in contrast to the case at hand.

In refractory cases of symptomatic RAO, arterial reconstruction is recommended to increase digital perfusion and restore blood flow.5,8 Appropriate timing from onset of symptoms to surgery is unclear; however, surgical intervention is usually explored after failure of 2- to 4-week trial of conservative measures.¹ Historically, the standard protocol for RAO in the upper extremity was ligation and resection of the diseased segment. This method posed a problem for patients with greater areas of occlusion. More recently, a few case series studied interpositional vein grafting with resection of the thrombosed section to minimize tension and support maximum flexion and extension at the wrist.^{1,5} In other studies, a single bypass vein graft was used to minimize operation time and disruption of collateral circulation by avoiding resection of the diseased segment.9,10

CONCLUSIONS

Venous bypass graft as a treatment option for symptomatic RAO shows promising results, with improvement in symptoms and successful graft patency. However, optimal management for patients with underlying variations in vascular structure is limited. This group is more prone to hand ischemic symptoms from RAO due to poor collateral circulation and abnormalities of vessels. Further investigation of upper extremity bypass surgery should be considered for patients with vascular anomalies. In this case report, we demonstrated that microsurgical revascularization is possible in patients with symptomatic RAO and other underlying vascular anomalies in the hand. We also demonstrated the feasibility of bypassing to the deep arch palmar arch.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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Fig. 4. Ten weeks postoperative presentation shows improvement of digital mottling and demarcation at the level of the distal interphalangeal joint of the small finger.

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