Radiofrequency ablation of neural tissue is a treatment modality commonly used for patients with chronic pain. When this therapy is used, the C and A δ nociceptive fibers are primarily targeted using either continuous thermal ablation at high frequency creating neurodestruction (conventional) or short high-voltage bursts of current that interrupt the nociceptive impulses (pulsed).1–3 The potential of radiofrequency ablation to impair the sympathetic nerve function at the level of stellate ganglion is not well explored, and we present a novel case in which digital ischemia due to microemboli was successfully reversed using radiofrequency of the stellate ganglion. The patient provided written permission for publication of this case report. This case report is waivered for institutional review board review and approval.

CASE DESCRIPTION

The pain management service was consulted for a 50-year-old man with numbness, weakness, and blue mottled skin (livedo reticularis) in his left hand after an arteriovenous fistula (AVF) resection. The patient had a left brachiocephalic AVF created 15 years before presentation and a history of renal transplant 10 years before due to end-stage renal disease from Alport syndrome. He presented to the authors’ medical center with weakness, livedo reticularis, and pain in his left hand (Figures 1 and 2A). On examination, he had a slightly palpable radial pulse and strong Doppler pulses in radial and ulnar arteries. The AVF had a palpable pulse with no thrill, and his left hand had a capillary refill time of 4 seconds. The left hand grip strength was 4/5 compared to 5/5 on the right side. Sensation of the left hand was intact to light touch and pin prick. Ultrasonography revealed a left brachial artery pseudoaneurysm with a large-volume internal thrombus along with an undetectable flow across the AVF. The patient was taken to the operating room, where resections of the AVF and venous aneurysm were performed along with a greater saphenous vein interposition graft. Completion angiogram demonstrated occlusion at the level of the palmar arch, either from vasospasm or microemboli. Postoperatively, nitroglycerin paste was applied topically to the palmar arch and convective temperature management system was placed continually to help with perfusion. However, the patient continued to have decreased sensation to the tips of the left second and third digits, with diminished grip strength and diffuse cold mottling of the hand (Figure 2A). The symptoms did not improve and in fact worsened, and after 3 days, the patient reported difficulty moving all his left digits. Radial pulse was palpable, and the palmar
arch had an identifiable Doppler pulse at the digital arteries except for the second digit that had no signal. Given refractory nature and clinical presentation, microembolization was then suspected and intravenous heparin infusion was initiated.

Pain management service was consulted for a possible intervention in hopes of digital reperfusion. After evaluation, a left stellate ganglion block was performed under ultrasound guidance with the intravenous heparin ongoing given the ongoing risk of ischemia. A 22-gauge spinal needle was used at the level of C6 vertebra anterolateral to longus colli muscle, and a total of 7 mL of 0.25% bupivacaine admixed with 2 mg of dexamethasone was used. Shortly after the block, the patient reported significant analgesia along with increased sensation, decreased mottling, and increased range of motion in his left fingers along with a pulse in the second digit found on Doppler. However, about 24 hours after the block, the mottling and other ischemic symptoms returned. The following day, a stellate ganglion pulsed radiofrequency (PRF) ablation and repeat block was performed. Under direct ultrasound guidance similar to previous block at the C6 level, a 20-gauge, 10-mm active tip needle was introduced in-plane from lateral to medial. Needle tip position was deep to internal jugular vein and common carotid artery, anterolateral to longus colli muscle, and deep to the prevertebral fascia (Figures 3 and 4). The probe was inserted and a sensory motor stimulation of 2 V was performed with no radicular or brachial plexus paresthesia. PRF was performed at 42°C for 120 seconds. The needle was then repositioned slightly more caudal to perform a second lesion after negative testing as above. A block was then performed using 8 mL of 0.25% bupivacaine admixed 2 mg of dexamethasone.

The patient was observed for about 20 minutes with development of Horner syndrome without issue with phonations. There was again a noticeably increased warmth and improved perfusion in the patient’s left hand (Figure 2B). He remained hospitalized for 5 days after ablation and reported continued improved strength to near baseline along with normal capillary refill and was transitioned from parenteral unfractionated heparin to oral warfarin with international normalized ratio monitoring. The patient has had close follow-up since the event, and at 11 months, showed no signs of ischemia along with normal muscle strength.

**DISCUSSION**

AVF created for hemodialysis in a patient with renal failure can be associated with thrombosis and proximal venous aneurysmal dilation adjacent to the anastomosis. This can cause distal arterial microembolization and present as a cold painful extremity with reduced capillary filling.4,5 Another diagnosis that was considered in this case was ischemic monomelic neuropathy (IMN),6 which falls under the spectrum of dialysis access–induced ischemic syndrome or a steal phenomenon. The ischemic insult to vasa nervorum from brachial artery manipulation can cause axonal loss mononeuropathies, leading to neuropathic pain along with sensory and motor loss of the extremity but with a palpable radial pulse. Distal peripheral embolization poses high risk of limb loss, while IMN can cause permanent functional loss, both of which can be prevented by increasing distal perfusion.7 However, in this case, it was thought that IMN

![Figure 2. Comparison of affected hand before and after treatment. A, Picture of left hand before ablation of the stellate ganglion with livedo reticularis and nitroglycerin paste on the dorsum of the hand. B, Picture of left hand after ablation of the stellate ganglion with increased perfusion and near-normal coloration.](image)

![Figure 3. Ultrasound image of stellate ganglion ablation with white arrows pointing to ablation needle. Stars represent prevertebral fascia. LCo indicates longus colli muscle.](image)
sympatholytic effects of increased perfusion to the patient’s hand and fingers.

PRF was used in this case given the unmyelinated, small diameter of the sympathetic nerve fibers along with the stellates’ close proximity to vital nervous tissue, such as the brachial plexus and recurrent laryngeal nerve. PRF ablation keeps tissue under the neurodestructive temperature threshold; thus, the risk of unwanted thermal disruption to the surrounding tissues is mitigated. While the exact mechanism of action of PRF is uncertain, most explanations focus on the rapidly alternating electric fields generated and their neuromodulatory effects. This creates microscopic damage to mitochondria and disorganization of microfilaments and microtubules of the axons. The duration of these effects of PRF is unknown, particularly on the sympathetic nerves. However, it has been reported to be clinically effective as long as 22 months for analgesia.

The ablation mitigated the acute pain, ischemia, and neurological impairment. This prevented tissue necrosis and likely amputation that has been long lasting for almost 1 year.

CONCLUSIONS

This case report highlights the role of radiofrequency ablation in possibly salvaging the loss of limb due to ischemia. While other cases have been reported of short-term reperfusion of digits after stellate ganglion blockade, the authors present what they believe is the first reported case of long-term reversal of embolic hand ischemia via ablation of the stellate ganglion. The ablation performed provided substantial, long-term increased perfusion that likely prevented amputation. Further research is needed to substantiate the efficacy of PRF ablation and promote its use in similar cases.

DISCLOSURES

Name: Nitin K. Sekhri, MD.

Contribution: This author helped conceive, write, and edit the manuscript.

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Contribution: This author helped write and edit the manuscript.

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