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Radiofrequency Ablation of the Stellate Ganglion for Management of Acute Digital Ischemia: A Case Report

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The authors present a report of a pulsed radiofrequency ablation of the stellate ganglion performed on a patient with microemboli to the hand from a thrombosed abandoned arteriovenous fistula. The patient was initially managed using vasodilators and anticoagulation. However, the patient's skin mottling, pain, and decreased strength persisted. Ablation of the stellate ganglia increased perfusion to his hand and likely prevented amputation that has lasted for approximately 1 year. While radiofrequency ablation is more commonly used for pain syndromes, this is an example of its use in the treatment and potential treatment of acute ischemia. (A&A Practice. 2018;11:189–92.)

Radiofrequency ablation of neural tissue is a treatment modality commonly used for patients with chronic pain. When this therapy is used, the C and Aδ 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

Figure 1. Areas of ischemia and decreased perfusion before the stellate ganglion ablation seen throughout the left hand, with nitroglycerin paste on the palmar aspect of patient's hand.

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Accepted for publication July 9, 2018.

Funding: None.

The authors declare no conflicts of interest.

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DOI: 10.1213/XAA.0000000000000869

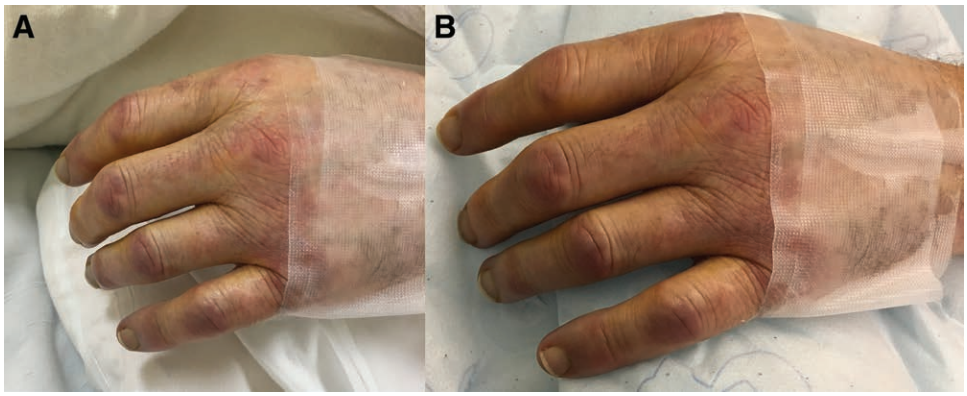

Figure 2. Comparison of affected hand before and after treatment. A, Picture of left hand before ablation of the stellate ganglion with livedo reticularis and nitroglycerin paste on the dorsum of the hand. B, Picture of left hand after ablation of the stellate ganglion with increased perfusion and near-normal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

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.

Figure 3. Ultrasound image of stellate ganglion ablation with white arrows pointing to ablation needle. Stars represent prevertebral fascia. LCo indicates longus colli muscle.

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

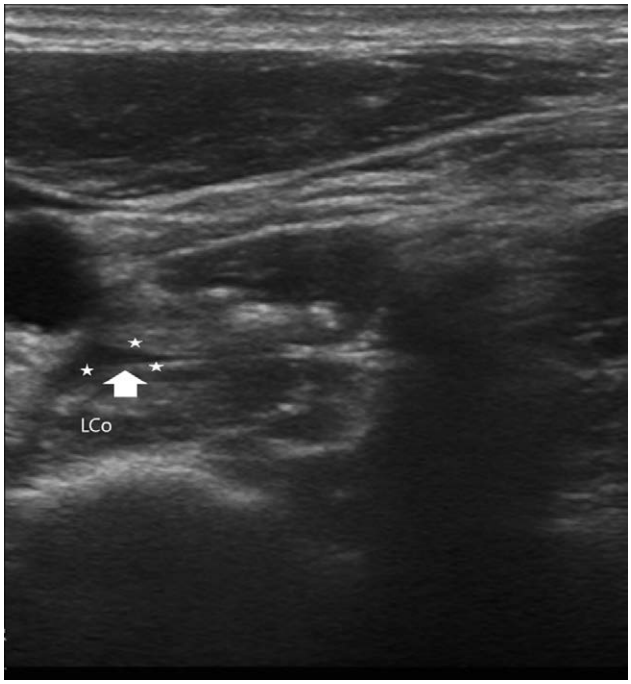

Figure 4. Ultrasound image of stellate ganglion ablation after local anesthetic is injected, with white arrow showing spread superficial to longus colli muscle but deep to prevertebral fascia. Stars represent prevertebral fascia. LCo indicates longus colli muscle.

was less likely given the thrombus found on preoperative ultrasonography and the intraoperative angiogram showing a filling defect in the palmar arch.

To achieve this desired increased distal perfusion, a stellate ganglion block and ablation was performed. The stellate, or cervicothoracic, ganglion is a cluster of sympathetic nerve cell bodies usually formed by the fusion of the inferior cervical ganglion with the first thoracic ganglion at the level of C6–7. Postganglionic axons may join the gray rami communicantes, which join the cervical nerve supply to cervical portion of the brachial plexus.[8] Stellate ganglion can be blocked with a local anesthetic to induce a sympatholytic effect in the ipsilateral upper extremity, thus, increased perfusion. PRF ablation of the stellate ganglion has been reported to be used for pain syndromes such as radiculopathies, complex regional pain syndrome, postherpetic neuralgia, and postmastectomy/sternotomy pain. It has also been reported to be used for nonpain syndromes such as posttraumatic stress disorder, Raynaud disease, and refractory ventricular arrhythmias.[9–12] The use of stellate PRF has rarely if ever used to help with limb salvage, as was done in this case.

The initial stellate ganglion block was performed to increase distal perfusion, limit the ongoing ischemia, and allow the anticoagulant to spread more distally due to the sympathetic blockade. Coagulopathy is generally considered a contraindication (as is infection and implantable cardiac devices), but the decision was made to attempt the procedures while on parenteral anticoagulation given the risk of further ischemia to the extremity and the compressible nature of the vessels in proximity to the stellate ganglion. Because the ischemia persisted, PRF ablation of the stellate ganglion was performed for longer lasting 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.[13] PRF ablation keeps tissue under the neurodestructive temperature threshold; thus, the risk of unwanted thermal disruption to the surrounding tissues is mitigated.[14] While the exact mechanism of action of PRF is uncertain, most explanations focus on the rapidly alternating electric fields generated and their neuromodulatory effects.[2,15] This creates microscopic damage to mitochondria and disorganization of microfilaments and microtubules of the axons.[1] 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.[2]

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.
Name: Shalvi Parikh, MBBS.
Contribution: This author helped write and edit the manuscript.
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Contribution: This author helped write and edit the manuscript.
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