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Case Report

A Case of Arterial Bypass for Extensive Stenosis of the Ulnar Artery and Superficial Palmar Arch due to Hypothenar Hammer Syndrome

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We present a case of arterial bypass for extensive stenosis of the ulnar artery and superficial palmar arch. The ulnar artery and the superficial palmar arch were bypassed using the great saphenous vein. Postoperatively, blood flow to the affected fingers gradually improved and the pain disappeared. Contrast-enhanced CT showed good visualization of the superficial palmar arch and more distal digital arteries. Considering the slow improvement in blood flow and the dilation of the stenotic finger artery postoperatively, it appeared that there was a significant effect of spasm in addition to organic stenosis preoperatively and that revascularization was an effective treatment.

Keywords: hypothenar hammer syndrome, revascularization, spasm

Introduction

Hypothenar hammer syndrome (HHS) is a disorder of the ulnar artery and its branches caused by repeated blunt trauma to the hypothenar. Surgical treatment for HHS involves revascularization; to the best of our knowledge, however, there have been no reports of cases requiring revascularization of the entire length of the ulnar artery. Although spasm is mentioned as the etiology of the disease, no literature clearly demonstrates this assertion. We present a case in which the ulnar artery was grafted with the great saphenous vein for revascularization of the entire ulnar artery after severe and extensive stenosis from the ulnar artery to the superficial palmar arch.

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Case Report

A 64-year-old man with complaints of pain and cyanosis in the right middle and ring fingers visited our hospital. He had been aware of transient cyanosis for more than 10 years, and gradually, the affected fingers became accompanied by a cold sensation, with increased pain in winter. He was an electrician by occupation, had no significant medical or traumatic history, and smoked 1 pack a day from age 20 to 45. Physical examination revealed pain, coldness, and delayed capillary refilling time (CRT) in the affected fingers, and thermography showed decreased heat patterns (**Fig. 1**). Allen test did not confirm blood flow in the ulnar artery, and the ankle-brachial index was 1.15 on the right and 1.14 on the left. Contrast-enhanced CT and angiography showed severe and extensive stenosis from the distal ulnar artery to the superficial palmar arch, and there was no development of the collateral blood vessels (**Figs. 2A and 2B**). Blood examination showed no inflammatory reactions, autoantibodies, or other noted abnormalities. Therefore, medical diseases such as collagen disease, vasculitis, and Buerger's disease were ruled out. Therefore, a diagnosis of HHS triggered by chronic mechanical stimulation associated with occupation was made. The patient was initially treated with prostaglandin E1 (PGE1) medication but without response. Because of the severe, extensive stenosis, revascularization using the reversed great saphenous vein was planned. The placement of the graft and the position of the vascular anastomosis were determined with the aim of anatomical reconstruction of the ulnar artery; if thrombus formation were to occur at the anastomosis site, the existing blood flow would not be disturbed. The graft was placed close to the body surface to avoid physical compression by the musculature and postoperative edema. The anastomosis site was selected

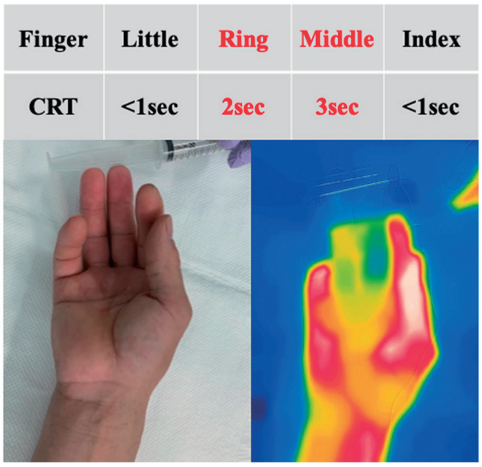

Fig. 1 CRT and thermography before operation. CRT: capillary refilling time

distally at the stenotic superficial palmar arch and proximally at the proximal forearm to preserve the branch of the ulnar artery. The great saphenous vein was harvested from the medial side of the knee to the medial condyle. Subcutaneous fibrosis was evident in the palmar region, and severe stenosis of the superficial palmar arch (OD 2.5 mm, ID 0.7 mm) was observed, confirming the effects of chronic stimulation. The inner diameter of the graft was 4 mm, and that of the ulnar artery at the planned anastomosis site was 5 mm. Considering caliber difference and blood flow, end-to-side anastomosis was performed. CRT and skin temperature of the affected fingers showed slight improvement with the postoperative course. Heparin was administered intravenously at 12000 units per day for 1 week postoperatively. In addition, PGE1 that had been taken orally before the operation was continued. At 12 months postoperatively, the graft was patent; however, stenosis was evident beyond the metacarpal artery (**Fig. 2C**). The patient also showed decreased skin temperature and CRT, and complained of severe pain upon cold stimulation (**Fig. 3A**). However, 14 months after surgery, when the cold stimulus had abated, these conditions improved and the pain disappeared (**Fig. 3B**).

Discussion

HHS, first reported by Cons,[1] is a condition in which the ulnar artery and its branches suffer from disturbance of blood flow and symptoms of inhibition due to spasm, occlusion, and aneurysm formation. Occupation-associated chronic stimulation and trauma are thought to be underlying causes of HHS, with the former reported to account for 90% of cases.[2] Treatment begins with conservative measures such as avoidance of stimulation and prostaglandin preparations. However, if not effective, surgical intervention, such as lesion excision and revascularization, is performed. If the lesion is short, vascular anastomosis of the resection margin is required; if long, bypass with a graft is required.

There have been reports of revascularization in this disease, including the great saphenous vein,[3] dorsal pedal vein,[3] subscapular artery,[4] and deep inferior epigastric artery.[5] The vein graft patency rate in revascularization is reported to be 84% at 2 years[6] and 57% at 4 years,[7] respectively. Endress et al. also reported a 22% patency rate at 10 years when the great saphenous vein and dorsal pedal vein were used.[3] These reports suggest that, after surgery, graft stenosis and occlusion occur over time. Endress et al. also studied the postoperative graft patency and stenosis groups for revascularization for this disease and reported that pain was low on the visual analogue scale (VAS) in both groups.[3] In other words, revascularization for this disease may be very useful for patients experiencing pain.[8]

In the present case, blood flow to the little finger was preserved, while blood flow to the middle and ring fingers was significantly reduced. There are two possible causes of decreased blood flow. First, stenosis of the superficial palmar arch results in reduced blood flow to the distal common palmar digital and proper digital arteries. In addition, the accompanying ulnar artery stenosis made blood flow to the fingers dependent on blood flow from the radial artery through the arterial network. Hence, the middle and ring fingers, located distal to the radial artery, appeared to have experienced an accelerated decrease in blood flow. Regarding the preserved blood flow to the little finger, we considered the following two possibilities. The first possibility is that it was directly dependent on the proper palmar digital artery, which branches from the superficial palmar arch to the ulnar side of the little finger. The second possibility is that branches of the ulnar artery, such as the anterior interosseous artery, contributed to the preservation of the blood flow. Although the patient had extensive ulnar artery stenosis, we could not rule out the possibility that this was the sole pathogenesis of HHS but rather a background of congenital hypoplasia of the ulnar artery.

Furthermore, the factor of reduced blood flow was considered to be largely due to spasms as well as arterial stenosis associated with chronic irritation. There are two possible reasons for this. The first is the transient cyanosis that occurred preoperatively, and the second is the slow improvement in blood flow after revascularization. Regarding the transient cyanosis, it was assumed that the stenotic ulnar artery was constricted, resulting in occlusion of the lumen of the vessel, which contributed to ischemia beyond the lesion. In the latter, the lack of refilling improvement and skin temperature increase in the affected fingers, despite increased blood flow after

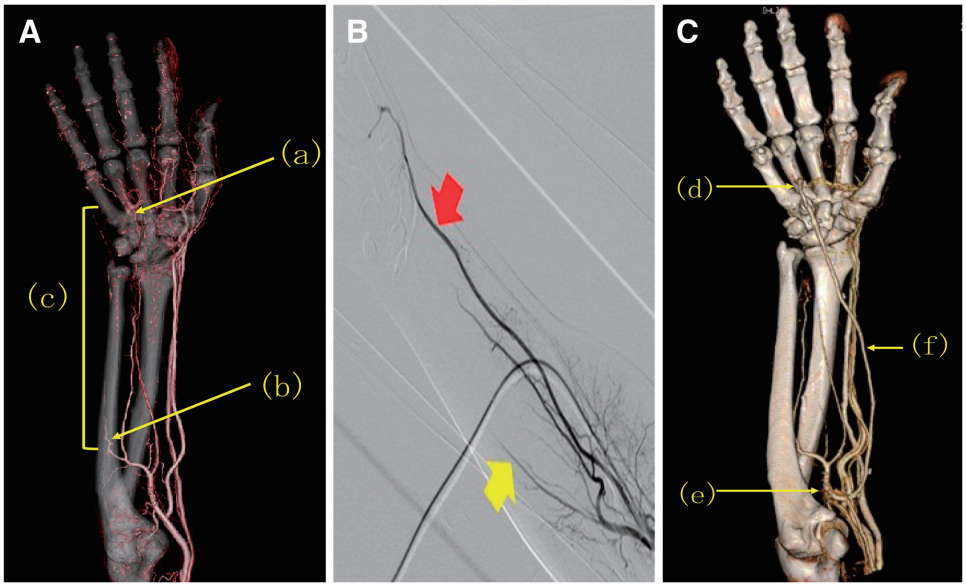

Fig. 2 (**A**) Preoperatively. (**a**) Distal end of ulnar artery stenosis (within superficial palmar arch), (**b**) proximal end of ulnar artery stenosis, (**c**) extent of ulnar artery stenosis, no collateral vessels. (**B**) Preoperatively angiogram. Red arrow: radial artery (patent distally), yellow arrow: proximal end of ulnar artery. (**C**) At 12 months postoperatively. (**d**) Anastomosis of the superficial palmar arch, (**e**) Anastomosis of the ulnar artery, and (**f**) reversed great saphenous vein.

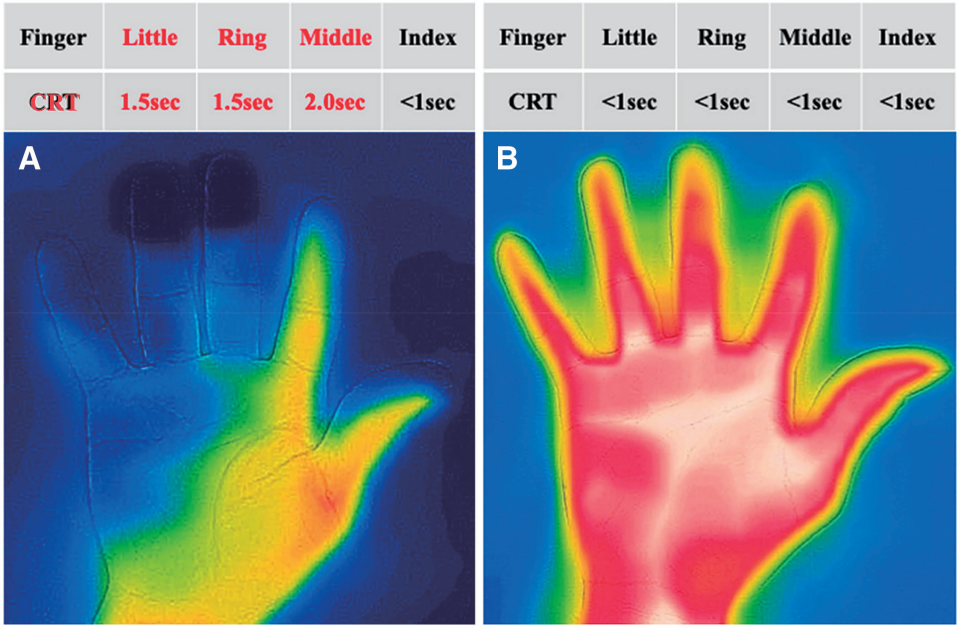

Fig. 3 Changes in thermography. (**A**) 12 months postoperatively: decreased blood flow in the middle to the little finger. (**B**) 14 months postoperatively: no decrease in blood flow. CRT: capillary refilling time

revascularization, seemed to indicate impaired blood flow in the digital artery. The poor delineation of the digital arteries on preoperative CT suggested that physical stimuli in daily life, especially cold, had similarly caused the spasm. This is supported by the postoperative findings at 12 and 14 months postoperatively. Despite graft patency, skin temperature and CRT decreased and pain was pronounced in winter when the cold stimulus was strong, but these symptoms improved as its stimulus abated. This result may indicate that ischemia in this disease is not only due to arterial stenosis but also to spasms caused by physical factors such as cold stimulation.

We are also concerned that prolonged postoperative spasm may lead to decreased blood flow and stenosis of the graft, which, in turn, may lead to occlusion. Although resection of the lesion may have a relative sympathectomy effect in HHS, in this case, the preservation of the lesion may have prevented the sympathectomy effect and may have prolonged the spasm postoperatively. In other words, if the spasm can be controlled, there is a possibility of maintaining graft patency after surgery; however, this hypothesis requires further case studies in the future.

Conclusion

In this study, we experienced a case of arterial bypass for highly extensive stenosis from the ulnar artery to the superficial palmar arch, which showed a good postoperative course. After revascularization, symptom-related ischemia disappeared and patient satisfaction was high, but improvement in postoperative blood flow was slow, indicating that the cause of the reduced blood flow was largely due to spasm in addition to stenosis. In cases with extensive stenosis, as in the present case, revascularization should be considered because of the susceptibility to ischemia associated with spasm and stenosis. Control of spasms may also contribute to postoperative graft patency.

Declarations

Informed consent

Informed consent was obtained for the publication of his photographs.

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Conflicts of interest

All authors have no conflict of interest.

Author contributions

- Study conception: FT and KS
- Data collection: FT
- Investigation: FT
- Manuscript preparation: FT
- Critical review and revision: all authors
- Final approval of the article: all authors
- Accountability for all aspects of the work: all authors

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