Digital Arteriovenous Fistula Formation Associated with Bone Fracture Induced Blunt Trauma

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Abstract

Keywords

- trauma
- arteriovenous fistula
- artery
- delayed presentation
- fistula

An arteriovenous fistula formation caused by a blunt trauma is a quite rare complication, especially in the hand. We report an extremely rare case of a traumatic arteriovenous formation in a finger that developed 5 years after the patient received a blunt trauma in conjunction with a phalangeal bone fracture. Successful management was achieved by direct surgical resection of the arteriovenous fistula without any complication.

A posttraumatic mass of the hand is mainly a true aneurysm or a pseudoaneurysm, whereas a traumatic arteriovenous fistula (AVF) is a rare cause. In previous reports, a posttraumatic aneurysm formation with a concomitant AVF is predominantly caused by a penetrating or a high-injury blunt trauma but rarely by a mild blunt trauma.^{1,2} A traumatic AVF in digital arteries is extremely rare due to the small caliber of a digital vessel. Small caliber would make a partial disruption of a vessel more difficult after a blunt trauma, and a penetrating injury would more likely sever the vessel rather than making AVF.³

This report presents an extremely rare case of a digital AVF formation caused by a blunt trauma from a phalangeal bone fracture.

Case Report

A 50-year-old male complained of a gradually enlarging mass on the ulnar side of the little finger of the left hand. Five years prior, the hand had received a blunt trauma from a fall. A physical examination found a soft pulsating mass, 1 cm in size, around the proximal interphalangeal joint (►Fig. 1). Computed tomography (CT) findings showed an AVF in conjunction with a healed fracture of the proximal phalanx (►Fig. 2).

A longitudinal incision was made along the bottom of the mass, and AVF was exposed. There were several small

arteries flowing into the fistula (►Fig. 3). In addition, there was one enlarged drainage vein. Even after ligation of all the vessels contributing to the fistula, and dissection of the bottom surface of the AVF, the AVF did not completely collapse, indicating retained blood flow. Complete dissection of the upper surface of the AVF from the dermis was difficult due to a thick adhesion; thus, we excised the AVF in a transverse manner, showing several capillary feeding vessels remaining from the dermis, which were undetectable in the preoperative CT. By cauterizing the capillary vessels flowing into the AVF, the AVF was successfully treated. The postoperative course was uneventful, and in 1 year of follow-up, there was no recurrence of the mass or any ischemic symptom. Patient consent was obtained prior to submitting this report.

Discussion

A traumatic AVF formation is a rare vascular complication. The most frequent locations of traumatic AVFs are extremities, head and neck, and visceral arteries.⁴ However, a traumatic AVF in distal extremities is quite rare. A posttraumatic mass appearing in the hand is generally considered to be a true aneurysm from a blunt trauma or a pseudoaneurysm from a penetrating trauma.⁵ After a penetrating trauma, an artery and a vein in close proximity are injured and develop

Fig. 1 Preoperative photograph showing a violaceous soft mass around the proximal interphalangeal joint on the ulnar side of the little finger.

Fig. 3 Intraoperative photograph showing small arteries (arrow) arising from the digital artery flowing into the arteriovenous fistula (AVF). The position of AVF is shown with an asterisk.

Fig. 2 Preoperative computed tomography (CT) showing an arteriovenous fistula in conjunction with a healed fracture of the proximal phalanx. The arrow indicates the drainage vein and the arrowhead indicates the feeding artery.

an intercommunication, but a blunt trauma rarely makes AVF. Especially in the hand, the frequency of AVF is quite low due to the small caliber of the vessels.³ In contrast, CT findings in our case showed an AVF in conjunction with a healed bone fracture. Though bone fractures are well reported causes of traumatic AVFs in various areas, a phalangeal bone fracture is not reported as a cause to the best of our knowledge. AVF formation occurs either immediately after a trauma or in a delayed manner.⁶ We speculated that vascular injury caused by mechanical stress from a fractured bone resulted in the formation of a small AVF. With time,

there was a slow but progressive dilation of AVF, with a relatively slow feeding flow, and finally the AVF became apparent after several years.

Direct surgical resection of a long-standing AVF is challenging due to venous hypertension and thick adhesion.⁷ Endovascular therapy with a covered stent or coil embolization is generally a less invasive and effective alternative for treating a traumatic AVF in relatively large arterial territories, including iliac, subclavian, carotid, and tibial arteries.^{8–11} However, endovascular therapy might not have been applicable in this case due to the small caliber of the digital artery and possible devastating complication of digital ischemia and subsequent necrosis. Also, simple ligation of feeding arteries may lead to distal gangrene because the collateral feeding arteries would continue to flow into the lower resistance fistula, causing insufficient perfusion to the distal tissues.⁶ To achieve an optimal outcome, a proper treatment strategy is important, with complete ligation of feeding vessels, resection of the AVF, and confirmation of the distal arterial perfusion.

In this context, intraoperative angiography would be quite helpful for surgical resection of long-standing AVF because detecting all of the feeding and drainage vessels is technically difficult in a small operative field, as in our case. In fact, in our case, there were residual small capillary feeding flows even after ligation of visible feeding vessels, which might have been created during the long-standing inflammation around the AVF. Intraoperative angiography will also help to confirm the peripheral tissue perfusion after ligation of the feeding vessels of the AVF, minimizing the risk of digital gangrene. We believe that surgical resection is the definitive therapy for long-standing AVF in a finger, but the intraoperative angiography should be performed to facilitate and secure the surgery.

Author Contributions

Keisuke Miyake contributed to the study conception and writing. All authors contributed to the critical review and revision, final approval of the article, and accountability for all aspects of the work.

Conflict of Interests

The authors have no conflicts of interest to declare with respect to authorship and/or publication of this article.

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