Radial Artery Pseudoaneurysm with Aberrant Radial Artery Anatomy: An Unusual Presentation of Flexor Tenosynovitis

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Abstract

Purpose Radial artery pseudoaneurysm is uncommon and mainly associated with radial artery cannulization for cardiac intervention or invasive hemodynamic monitoring. It is rarely seen as a result of intra-arterial recreational drug injection.

Methods We present the case of a 35-year-old man with a 12-year history of intravenous drug use and 1-year history of intra-arterial drug use who developed radial artery pseudoaneurysm with a right long finger suppurative flexor tenosynovitis and subsequent acute radial-sided hand ischemia. Computed tomography (CT) angiography with three-dimensional reconstructions was used in diagnosis. We treated him with parenteral antibiotics followed by surgical debridement of his infection and removal of the infected pseudoaneurysm.

Results Examination of the three-dimensional CT angiogram showed an unusual anatomical variant that likely predisposed him to isolated long finger flexor tenosynovitis.

Conclusion Prompt diagnosis and treatment of pseudoaneurysm in this context is crucial to avoiding sepsis, hemorrhage, and irreversible ischemia. In rare cases, imaging can demonstrate an underlying anatomical variant that may be a predisposing factor.

Keywords

- anatomical variant
- injection drug abuse
- radial artery pseudoaneurysm
- suppurative flexor tenosynovitis

Introduction

Common complications of injection drug abuse (IDA) include abscesses, cellulitis, endocarditis, and bacteremia. Less common are vascular complications such as vessel perforation, phlebitis, arteritis, pseudoaneurysm, arteriovenous fistulization, and acute organ/limb ischemia. In one study, the authors estimated that these sequelae represent less than 1% of IDA complications.¹

Infectious arterial pseudoaneurysms, or mycotic aneurysms, are relatively uncommon. They typically arise as secondary infections from endocarditis or as complications of percutaneous coronary revascularization and long-term

arterial line monitoring. Primary arterial pseudoaneurysms from IDA are uncommon because drug users prefer venous access. However, as venous access becomes increasingly difficult, arterial injections become more common. Chronic injections disrupt the arterial wall and, over time, weaken the integrity of the adventitia, resulting in pseudoaneurysm and increased risk of concomitant infection. Arterial pseudoaneurysms secondary to IDA have been reported to mainly occur in the femoral artery,² with only a few involving the radial artery.³ One study estimated the annual incidence of primarily infected pseudoaneurysms from IDA to be 0.03%, with radial artery cases being a small subset of this number.⁴

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Fig. 1 (A) The erythematous, mildly tender, pulsatile swelling over the radial artery near the site of injection at the wrist, as seen on initial clinical examination. (B) The swollen, erythematous long finger before the first surgical debridement.

We report the case of a 35-year-old man presenting with suppurative flexor tenosynovitis secondary to septic emboli from an IDA-induced radial artery pseudoaneurysm. Subsequent imaging studies showed an underlying anatomical abnormality that likely contributed to the pathogenesis of his unusual presentation.

Case Report

A 35-year-old, left-hand-dominant man presented to the emergency department reporting radiating pain and swelling in his right wrist, palm, and long finger for 4 days. He had a history of radial artery injections over the last year and reported a recent injection of heroin into his right radial artery at the wrist 4 days before. He reported no numbness and tingling. His hand was warm and well-perfused. There was a pulsatile swelling (2.5 cm in diameter) over the radial artery at the distal wrist that was minimally tender with mild hyperemia (► **Fig. 1A**). His right long finger had fusiform swelling and was held in flexion (► **Fig. 1B**). He had excruciating pain on palpation over the path of the flexor tendon and with passive extension of the long finger. His

temperature was 38.1°C. His white blood cell count was 8,200 cells/ μ L, erythrocyte sedimentation rate was 34 mm/hour, and C-reactive protein level was 4.0 mg/L. Ultrasonography of the wrist showed a patent radial artery. Computed tomography (CT) of the upper extremity with intravenous contrast showed a radial artery pseudoaneurysm without abscess formation (► **Fig. 2**). His examination was consistent with suppurative flexor tenosynovitis, and he underwent surgical debridement for the infection. Wound cultures grew methicillin-resistant *Staphylococcus aureus* (MRSA). Inpatient echocardiographic studies showed no masses or vegetations. CT of the chest, abdomen, and pelvis with intravenous contrast was similarly unremarkable for infectious sources. He was treated with intravenous vancomycin and was discharged 3 days later with a prescription for oral linezolid. We proposed reconstruction of the radial artery on an elective basis after he had recovered from his suppurative tenosynovitis.

Three days after discharge, the patient presented to our emergency department reporting increased right long finger pain and swelling with purulence. He was afebrile, and laboratory studies showed a white blood cell count of 5,800

Fig. 2 Computed tomography scan of the upper extremity with intravenous contrast showing a pseudoaneurysm without abscess formation.

cells/ μ L. The finger and the hand were well perfused. There were no interval changes to the radial artery. There was poor healing of the wound and a slight drainage. The patient admitted to poor compliance with antibiotics. He underwent operative debridement. Wound cultures again grew MRSA. We discharged him in stable condition 2 days later on oral linezolid, ciprofloxacin, and instructions for local wound care.

Five days after his second discharge, the patient presented to our emergency department with a painful, swollen right hand, mainly involving the thumb, index finger, and long finger. He reported injecting heroin into his right radial artery earlier in the day, and while under the influence, he had hit his wrist quite hard on the door frame while reaching for the light switch. He had immediate onset of pain and numbness with skin color changes, initially dark red then dusky blue-purple. Notably, he indicated compliance with antibiotic therapy since his most recent discharge. On examination, his radial-sided hand and three digits were cold and mottled (**Fig. 3**). There was no apparent pus or discharge from the long finger wound. The palmar finger incision line appeared dark. We administered intravenous heparin, ciprofloxacin, and vancomycin. Over 24 hours, there was a progressive decrease in the mottling and increased perfusion and warmth to the radial three fingers and hand. Given the high probability of recurrence if left untreated, we felt that the radial artery pseudoaneurysm could no longer be treated electively. Because there was an unresolved infected wound in the right long finger, we felt that arterial reconstruction with a graft would not be ideal. A preoperative Allen's test confirmed ulnar artery hand perfusion. After 48 hours of intravenous heparin and antibiotics, we took the patient to surgery, ligated the radial artery, and removed the pseudoaneurysm. The pseudoaneurysm was encased in substantial dense scar and the vessel appeared inflamed. Cultures grew *Bacillus* (non-*anthracis*) species, considered to be a likely contaminant. Postoperatively, the hand remained well perfused. Eight days later, he underwent reconstruction of his right long

finger wound with a cross-finger flap from the ring finger. At 10 months, the wrist incision and the flap healed.

Discussion

Radial artery pseudoaneurysm is a rare complication of IDA.⁴ In contrast to true aneurysms, which are a distention of the full thickness of the arterial wall, a pseudoaneurysm does not contain all three layers. It is an outpouching of mostly arterial adventitia and fibrous tissue, which contains a collection of blood that communicates with the arterial lumen. Repeated arterial cannulization and incidental bacterial infection are risk factors for pseudoaneurysm formation because they impair the artery's ability to regenerate.⁵ This patient had a 12-year history of IDA and a 1-year history of radial artery injections, compromising arterial wall integrity and likely introducing MRSA, resulting in the noted sequelae.

The classic presentation of radial artery pseudoaneurysm includes signs of local inflammation and a mass over the artery that can be tender or pulsatile. Diagnosis can be confirmed with color-flow Doppler ultrasonography or CT with intravenous contrast. Ultrasonography may produce false positives and negatives.⁶ Complications of untreated pseudoaneurysms include rupture, hemorrhage, and septic shock. Less severe complications include septic embolization to the hand, transient fingertip ischemia, tissue loss, and diminished hand function.

Treatment options for this lesion are diverse but all focus on preventing serious morbidity. Some authors have discussed the use of thrombin, though most often in the context of femoral artery pseudoaneurysm.⁷ Major drawbacks of this approach are the lack of standardized dosing for various vessel sizes and the risk of arterial thrombosis. Another option is ultrasonography-guided compression.⁸ Data suggest a high degree of success with this approach,⁸ but the technique requires a substantial amount of time on the part of the provider. Open surgical removal, with or without reconstruction, is appropriate for acute ischemia or infected pseudoaneurysms. An Allen's test to determine adequate ulnar artery hand perfusion is important in determining surgical options.

Finally, antibiotic treatment is mandatory. Initial treatment with broad-spectrum agents followed by narrow-spectrum, culture-driven therapy is the standard of care. At the time of our patient's pseudoaneurysm excision, he had received long courses of outpatient antibiotic treatment and several days of inpatient antibiotic treatment with drugs active against MRSA. Although previous wound cultures from the right long finger grew MRSA, it is unsurprising that the pseudoaneurysmal tissue did not culture MRSA in the setting of this extensive antibiotic exposure. The isolated *Bacillus* (non-*anthracis*) species from the pseudoaneurysm is widely described as a frequent contaminant.⁹ Given that the vessel demonstrated signs of infection and inflammation intraoperatively, it is most probable that the inpatient antibiotic therapy sterilized the lesion before surgical cultures were obtained. Moreover, previous authors have shown MRSA to be the predominant organism causing IDA-associated pseudoaneurysms.

Fig. 3 The patient's hand on his third presentation, after intravenous heparin administration but before surgery. Acute ischemic changes include duskeness and purple discoloration visible throughout the hand but most pronounced in the radial most three fingers and the thenar eminence. The site of the previous long finger surgeries has become necrotic because of the ischemia.

The development of suppurative flexor tenosynovitis as a result of septic microembolization from an infected pseudoaneurysm is exceedingly uncommon and largely the focus of our case report. We could identify only one case of this complication in the literature.¹⁰ Flexor sheath infection can be a result of direct inoculation, secondary local extension of an infectious nidus, hematogenous spread, or lymphatic spread. Local spread is unlikely because there was no evidence of local abscess on CT or intraoperatively. Similarly, lack of puncture sites over the tendons on physical examination makes direct

exposure unlikely. Hematogenous spread is the most likely route of infection, secondary to ejection of infected microemboli from the infected pseudoaneurysm. The absence of other infectious sources on inpatient work-up further supports this explanation.

Three-dimensional reconstruction of the CT angiogram shows an anatomical variant in this patient, which may explain the preferential infection of the long finger (►Fig. 4). The aberrant arterial supply to the long finger stems from the radial artery just distal to the

Fig. 4 Three-dimensional reconstructions of the upper extremity computed tomographic angiogram. (A) An overall view of the vasculature of the hand. Single arrows show the superficial palmar arch originating from the ulnar artery, double arrows show the deep palmar arch originating from the radial artery, and stars show the aberrant arterial supply to the long finger. (B) The take-off of the aberrant artery to the long finger, just distal to the pseudoaneurysm. Arrows highlight the path of the artery. (C) The aberrant artery joining a branch from the ulnar artery (arrow with star) to form the digital artery of the long finger.

pseudoaneurysm but proximal to the take-off of the princeps pollicis artery. Over time, septic microemboli from the pseudoaneurysm consistently entered this aberrant circulation. With close examination of ►Fig. 4B, it appears that the branches to the thumb and index finger are very small and anastomose with the anomalous vessel at near right angles. As such, both angle and vessel size were protective against septic emboli to the thumb and index finger. Conversely, the aberrant vessel terminates at the long finger common digital artery, making it most susceptible to repeated septic embolization. Thus, the long finger tendon alone was consistently bombarded with septic emboli, ultimately manifesting as the clinical infection. This pattern of embolization, from an infected radial artery pseudoaneurysm to a solitary digital artery, has been previously reported in the context of radial artery catheterization.¹¹

Radial artery pseudoaneurysm is a serious complication of IDA. Several sequelae, including suppurative tenosynovitis and acute hand ischemia, are possible and pose high risks for morbidity and mortality. Imaging studies are important in diagnosing and planning treatment for these lesions; current imaging technology provides insights into the specific pathophysiology of each case of pseudoaneurysm. As shown here, this knowledge can explain otherwise perplexing findings.

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Conflict of Interest

None.

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