Case Letter

Radial artery pseudoaneurysm diagnosed by point-of-care ultrasound five days after transradial catheterization: A case report

Stephen Alerhand, Donald Apakama, Adam Nevel, Bret P. Nelson

Emergency Medicine Department, Icahn School of Medicine at Mount Sinai, New York 10029, USA

Corresponding Author: Stephen Alerhand, Email: stephen.alerhand@gmail.com

World J Emerg Med 2018;9(3):223–226
DOI: 10.5847/wjem.j.1920–8642.2018.03.010

Dear editor,

Radial artery pseudoaneurysm from arterial wall disruption is an extremely rare complication of arterial cannulation. Most prior case reports describe this complication occurring from continuous blood pressure monitoring or serial blood-gas analysis requiring extended cannulation. The increasing use of radial artery access for coronary angiography and percutaneous coronary intervention (PCI) introduces another susceptible patient population.^[1–4] We report a case of a 57-year-old female with right radial artery pseudoaneurysm, diagnosed by bedside ultrasound (US) in the emergency department (ED) five days after transradial cardiac catheterization.

CASE

A 57-year-old female with atrial fibrillation reporting one month of dyspnea on exertion was found to have an NSTEMI and underwent non-emergent transradial coronary angiography. She re-presented to the ED five days later complaining of swelling to the volar surface of her right wrist. The patient reported having persistent, intermittent bleeding at the time of discharge and noted compliance to her prescribed anticoagulation (Apixaban 5 mg twice per day). She described the swelling as increasingly painful, with slight paresthesia to her right thumb. The patient denied any additional hand or finger sensory loss, motor deficits, or discoloration. She also denied trauma to this area.

The patient's vital signs were within normal limits on presentation. Examination revealed a nearly golf ball-sized 3×3 cm swelling at the radial volar surface

of her right wrist, without any overlying skin changes or temperature disparity compared to the left hand. The swelling was tense, non-pulsatile, non-fluctuant, and mildly tender. The patient reported slight numbness to pinprick sensation to the thumb, but otherwise retained complete sensory function to the fingers. Motor function was intact. The ulnar artery was easily palpated, and its occlusion did not lead to pale discoloration of the palm of the hand (negative Allen's test).

Using the linear ultrasound transducer in both the transverse (Figure 1) and longitudinal (Figure 2) planes in B-mode, the radial artery was found to have a small wall defect. B-mode also revealed a swirling pattern of blood flow, commonly seen with pseudoaneurysm. With each arterial pulsation on Color flow Doppler (Figure 3), a portion of the turbulent flow was redirected into a large adjacent hematoma showing no sign of thrombosis. A to-and-fro waveform ("ying-yang sign") within the arterial lesion was also visualized on spectral Doppler imaging.

Vascular Surgery consultants were notified. The pseudoaneurysm was deemed too large to treat with thrombin injection, and as such, the patient was admitted for operative repair the following morning. After successful brachial plexus block for regional anesthesia, a size-15 scalpel was used to make a 3-cm incision over the pseudoaneurysm to evacuate the hematoma. A 2-mm defect in the radial artery was visualized and subsequently repaired using 5-0 Prolene suture material. The wound was compressed to evacuate the remainder of the hematoma and hemostasis was obtained. The thromboembolic risk associated with atrial fibrillation was weighed against the bleeding risk from the hematoma and surgery. The patient was started

Figure 1. Transverse view in B-mode of the arterial wall defect connecting the radial artery and adjacent hematoma (187×176 mm, 72×72 DPI).

Figure 2. Longitudinal view in B-mode of the arterial wall defect connecting the radial artery and adjacent hematoma (190×186 mm, 72×72 DPI).

Figure 3. Transverse view in Color flow Doppler mode of an arterial pulsation redirecting blood flow from the radial artery into the adjacent hematoma (187×182 mm, 72×72 DPI).

on Aspirin, but the Eliquis was held until her follow-up appointment one week later. An ACE bandage was applied for compression, and when the patient presented one week later without complaints, her Eliquis was restarted.

DISCUSSION

A pseudoaneurysm is the formation of a hematoma outside the artery and within the surrounding parenchymal tissue. In contrast to an artery that is lined by its three inherent tissue layers (intima, media, and adventitia), a pseudoaneurysm is a false sac enclosed by fibrous scar tissue. Compared to a simple hematoma, a pseudoaneurysm is often pulsatile and may carry an audible bruit. Moreover, the release of pressure from a decompressed pseudoaneurysm leads to rapid refill of the hematoma. In the patient from this case report, the hematoma had become large enough that it would not compress with moderate palpation, nor was a pulsatile quality detected. Based on other case reports, there seems to be no definitive timeframe by which a pseudoaneurysm forms after radial artery cannulation. For our patient, the hematoma had enlarged to nearly the size of a golf ball by five days.

Pseudoaneurysm formation from transradial artery catheterization is extremely rare (incidence about 0.05%),^[5–7] and the radial artery itself is the most atypical arterial site for pseudoaneurysm formation.^[8] This complication has been associated with repeated arterial puncture attempts and catheter infection.^[7] Other predisposing factors include older age, longer catheterization duration, large sheath diameter, anticoagulant or antiplatelet use, coagulation disorder, and incomplete hemostasis. This 57-year-old patient had been prescribed Apixaban twice daily, and it is unclear for how long her pneumatic wristband was applied after cannulation. The standard compression time is 15–20 minutes, but some studies support longer application for 1–72 hours.^[9–11] This extended period may have proved beneficial for this patient who reported inadequate hemostasis on discharge, which should represent an ominous finding to interventional cardiologists performing catheterizations via radial artery access.

The symptoms of pseudoaneurysm generally arise from mass effect, digital ischemia, or nerve injury caused by the enlarging hematoma. Our patient had suffered pain due to the increasing swelling, as well as mild sensory changes perhaps suggestive of nerve compression. Further morbidity from pseudoaneurysms

may arise from venous compression or distal embolization from microemboli.^[12] Due to the thinner intimal layer and fibrotic wall with less vascularization, arterial pseudoaneurysms are also at risk for rupture.^[13] Conversely, with a very small hematoma, the mass may not be palpated or even visible, leaving the patient's subjective pain as the only presenting symptom.

Ultrasound is the most rapid and dynamic imaging modality with which to diagnose a pseudoaneurysm and its associated arterial wall defect. Within the hematoma itself, the variable echogenicity represents fluctuations of bleeding and rebleeding from the arterial wall lesion. Color flow Doppler further reveals a pulsatile, turbulent flow. The pathognomonic sign for pseudoaneurysm is a to-and-fro waveform within the arterial lesion on spectral Doppler imaging, often referred to as the "ying-yang" sign.^[14]

Other diagnoses can be differentiated from pseudoaneurysm using ultrasound. For instance, an abscess will often exhibit irregular borders, internal echoes, posterior acoustic enhancement, and a positive "squish sign" (movement of abscess debris) upon transducer compression. Furthermore, a cyst will often take the appearance of a well-circumscribed circular structure with anechoic contents. Neither of these two structures will demonstrate consistent flow with Color flow Doppler.

The management of a radial pseudoaneurysm aims to repair the wall lesion or discontinue the flow communication between the artery and the parenchymal hematoma. Treatment generally depends on the etiology, location, symptoms, presence of thrombi, and distal circulation and collateral formation. For instance, small (<3 cm), stable asymptomatic pseudoaneurysms may be monitored, as the majority will thrombose spontaneously within 4 weeks.^[15] Another technique uses US-guided compression for 10-minute intervals until occlusion is achieved. This approach would not have been useful (and been rather painful) for our patient's large, non-compressible hematoma. US guidance can also be used to inject thrombin, as its conversion of fibrinogen into fibrin leads to instantaneous formation of a clot. This method has been used more extensively in the treatment of femoral artery pseudoaneurysms,^[16–18] but fewer successful case reports exist for the radial artery.^[19–22]

Ultimately, surgical management is recommended in the subset of patients whose pseudoaneurysms may be large, symptomatic, expanding, infected, subacute, and/or have failed initial conservative management.^[23] These pseudoaneurysms are at greatest risk of rupture

and thromboembolism. Our patient fell in this surgical category due to the size of the hematoma (4×4 cm), and her worsening symptoms (pain and mild distal paresthesia). Fortunately, the patient's surgical operation was free of complications, and she presented without complaints at her follow-up visit.

CONCLUSIONS

The increasing use of radial artery catheterization for coronary angiography and percutaneous coronary intervention will likely lead to more procedural complications such as pseudoaneurysm formation. In addition to understanding the pathophysiology and risk factors for this condition, the emergency physician must be adept at using point-of-care ultrasound to both make the diagnosis and characterize its findings to determine management.

Funding: None.

Ethical approval: The study was approved by the Institutional Review Board.

Conflicts of interest: The authors declare there is no competing interest related to the study, authors, other individuals or organizations.

Contributors: SA proposed the study and wrote the first draft. All authors read and approved the final version of the paper.

REFERENCES

- 1 Otsuka M, Shiode N, Nakao Y, Ikegami Y, Kobayashi Y, Takeuchi A, et al. Comparison of radial, brachial, and femoral accesses using hemostatic devices for percutaneous coronary intervention. *Cardiovasc Interv Ther*. 2018;33(1):62-9.
- 2 Jolly SS, Yusuf S, Cairns J, Niemelä K, Xavier D, Widimsky P, et al. Radial versus femoral access for coronary angiography and intervention in patients with acute coronary syndromes (RIVAL): a randomised, parallel group, multicentre trial. *Lancet*. 2011;377(9775):1409-20.
- 3 Eichhöfer J, Horlick E, Ivanov J, Seidelin PH, Ross JR, Ing D, et al. Decreased complication rates using the transradial compared to the transfemoral approach in percutaneous coronary intervention in the era of routine stenting and glycoprotein platelet IIb/IIIa inhibitor use: a large single-center experience. *Am Heart J*. 2008;156(5):864-70.
- 4 Karrowni W, Vyas A, Giacomino B, Schweizer M, Blevins A, Girotra S, et al. Radial versus femoral access for primary percutaneous interventions in ST-segment elevation myocardial infarction patients. *Cardiovascular Interventions*. 2013;6(8):814-23.
- 5 Tatli E, Buturak A, Cakar A, Vatan BM, Degirmencioglu A, Agac TM, et al. Unusual vascular complications associated with transradial coronary procedures among 10,324 patients: case based experience and treatment options. *J Interv Cardiol*.

- 2015;28(3):305-12.
- 6 Tsai CC, Hsu CC, Chen KT. Infected aortic and iliac aneurysms: Clinical manifestations in the emergency departments of two hospitals in southern Taiwan, China. *World J Emerg Med.* 2017;8(2):121-5.
- 7 Llácer Pérez M, González Jiménez JM, Jiménez Ruiz A. Pseudoaneurysm in the radial artery after catheterization. *Rev Esp Anestesiol Reanim.* 2006;53(2):119-21.
- 8 Walton NP, Choudhary F. Idiopathic radial artery aneurysm in the anatomical snuff box. *Acta Orthop Belg.* 2002;68(3): 292-4.
- 9 Cauchi MP, Robb PM, Zemple RP, Ball TC. Radial artery pseudoaneurysm: a simplified treatment method. *J Ultrasound Med.* 2014;33(8):1505-9.
- 10 Nazer B, Boyle A. Treatment of recurrent radial artery pseudoaneurysms by prolonged mechanical compression. *J Invasive Cardiol.* 2013;25(7):358-9.
- 11 Ceccanti S, Frediani S, Andreoli GM, Giannini L, Ferro R, Cozzi DA. Effective compression bandage for repair of a complicated radial artery pseudoaneurysm. *Ann Vasc Surg.* 2014;28(5):1319.e9-12.
- 12 Rozen G, Samuels DR, Blank A. The to and fro sign: the hallmark of pseudoaneurysm. *Isr Med Assoc J.* 2001;3(10):781-2.
- 13 Pozniak MA, Mitchell C, Ledwidge M. Radial artery pseudoaneurysm: a maneuver to decrease the risk of thrombin therapy. *J Ultrasound Med.* 2005;24(1):119-22.
- 14 Law Y, Chan YC, Cheng SW. Endovascular repair of giant traumatic pseudo-aneurysm of the common carotid artery. *World J Emerg Med.* 2015;6(3):229-32.
- 15 Toursarkissian B, Allen BT, Petriner D, Thompson RW, Rubin BG, Reilly JM, et al. Spontaneous closure of selected iatrogenic pseudoaneurysms and arteriovenous fistulae. *J Vasc Surg.* 1997;25(5):803-8; discussion 808-9.
- 16 Olsen DM, Rodriguez JA, Vranic M, Ramaiah V, Ravi R, Diethrich EB. A prospective study of ultrasound scan-guided thrombin injection of femoral pseudoaneurysm: a trend toward minimal medication. *J Vasc Surg.* 2002;36(4):779-82.
- 17 Vlachou PA, Karkos CD, Bains S, McCarthy MJ, Fishwick G, Bolia A. Percutaneous ultrasound-guided thrombin injection for the treatment of iatrogenic femoral artery pseudoaneurysms. *Eur J Radiol.* 2011;77(1):172-4.
- 18 Kuma S, Morisaki K, Kodama A, Guntani A, Fukunaga R, Soga Y, et al. Ultrasound-guided percutaneous thrombin injection for post-catheterization pseudoaneurysm. *Circ J.* 2015;79(6):1277-81.
- 19 Komorowska-Timek E, Teruya TH, Abou-Zamzam AM Jr, Papa D, Ballard JL. Treatment of radial and ulnar artery pseudoaneurysms using percutaneous thrombin injection. *J Hand Surg Am.* 2004;29(5):936-42.
- 20 Kang SS, Labropoulos N, Mansour MA, Michelini M, Filliung D, Baubly MP, et al. Expanded indications for ultrasound-guided thrombin injection of pseudoaneurysms. *J Vasc Surg.* 2000;31(2): 289-98.
- 21 Kleczynski P, Rakowski T, Dziewierz A, Jakala J, Dudek D. Ultrasound-guided thrombin injection in the treatment of iatrogenic arterial pseudoaneurysms: single-center experience. *J Clin Ultrasound.* 2014;42(1):24-6.
- 22 Bauer P, Koshty A, Hamm CW, Gündüz D. Ultrasound guided percutaneous thrombin injection in a radial artery pseudoaneurysm following percutaneous coronary intervention. *Clin Res Cardiol.* 2014;103(12):1022-4.
- 23 Provencher MT, Maurer C, Thompson M, Hofmeister E. Operative grafting of a pseudoaneurysm of the radial artery after a pediatric both-bone forearm fracture. *Orthopedics.* 2007; 30(10): 874-5.

Received July 6, 2017

Accepted after revision March 1, 2018