

## Four patients with a clinically significant radial artery anomaly

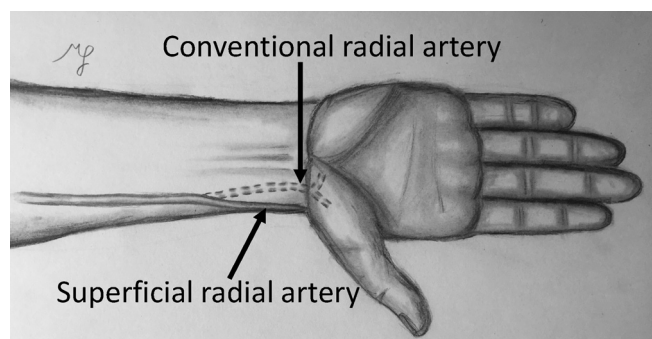
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### ABSTRACT

The superficial radial artery is an anatomic variant in which the radial artery passes superficial to the tendons of the anatomic snuffbox. Cadaver studies have shown its incidence to be 0.5% to 1%. Four patients with this anatomic variation were encountered in our practice, and their clinical courses and anatomy are described. One patient presented with digital ischemia after catheter placement in the anomalous radial artery. Three patients with end-stage renal disease were found to have a superficial radial artery incidentally, and this was used for inflow in the creation of hemodialysis fistulas. (*J Vasc Surg Cases and Innovative Techniques* 2019;5:104-6.)

**Keywords:** Superficial radial artery; Radial artery variant; Radial artery anomaly; Hemodialysis access; Arteriovenous fistula

The normal embryology of the radial artery involves division of the superficial brachial artery into superficial and deep branches in the distal third of the forearm. The superficial branch eventually regresses, and the deep branch remains as the conventional radial artery.<sup>1,2</sup> The normal course of the radial artery as it traverses the wrist is deep to the tendons of the anatomic snuffbox (Fig 1). A variant branch passing superficial to the lateral tendons was described in primates as far back as 1911 and has since been reported in humans.<sup>2-5</sup> It has been proposed that persistence of the superficial branch becomes this variation.<sup>2,6</sup> Cadaver studies have shown its incidence to be 0.5% to 1%.<sup>2,7</sup> In our PubMed search, fewer than 20 cases are reported in the literature. We describe a series of four patients with the superficial radial artery anomaly from which some clinical application can be learned. One patient presented with digital ischemia after catheter placement in the anomalous radial artery. Three patients were found to have a superficial radial artery incidentally after presenting for arteriovenous fistula creation for end-stage renal disease. All patients consented to the publication of their deidentified clinical information and photographs.



**Fig 1.** Superficial radial artery coursing dorsally compared with the conventional course of the radial artery.

### CASE REPORT

**Patient 1.** This patient is a 65-year-old woman presenting with critical ischemia of the first three digits of her right hand. Five days earlier, she presented with dyspepsia and underwent intravenous catheter insertion on her right dorsal hand in the area of the anatomic snuffbox. During the next 5 days, she developed pain, swelling, and discoloration of the first three digits.

On presentation, these first three digits were swollen with dusky discoloration and tender and cool to the touch (Fig 2, a). Radial and ulnar pulses were palpable at the wrist. The palmar arch signal was intact, but digital signal was absent at the base of the first digit, monophasic at the second digit, and biphasic at digits three through five. Sensory and motor function were present but diminished.

Because of acute kidney injury, computed tomography angiography was not performed. Ultrasound demonstrated an aberrant radial artery in which a large branch passed superficially onto the dorsum of the wrist and hand, with a calcified wall and thrombosis. Low-dose heparin infusion was started, and she was taken to the operating room for surgical thrombectomy. The conventional radial artery was small and diminutive compared with the superficial branch, from which a large

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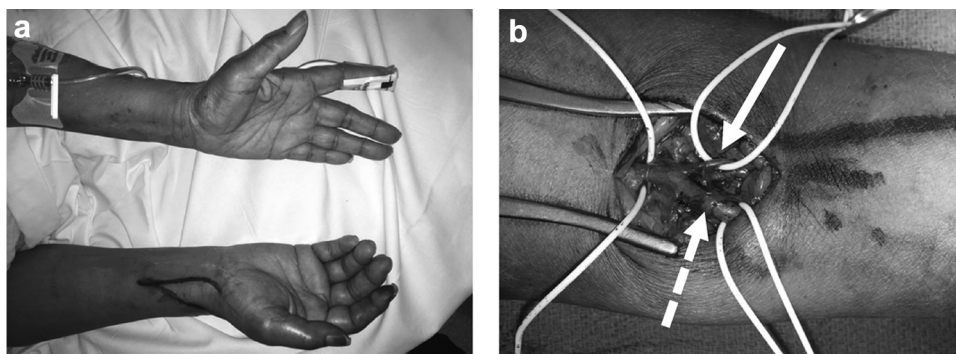
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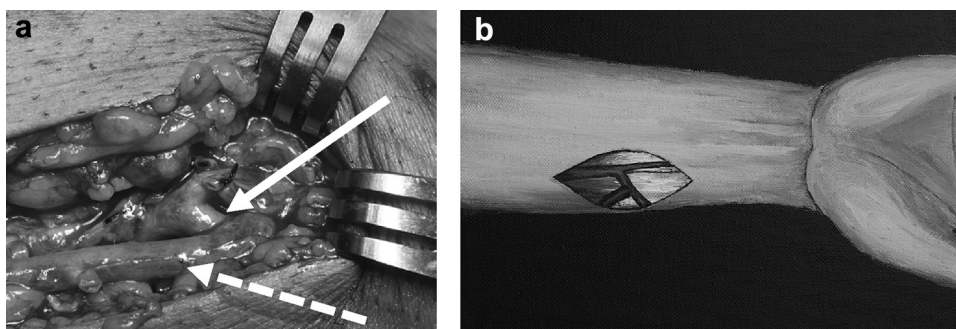
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**Fig 2.** **a**, Right hand with ischemic changes to digits one, two, and three. Course of radial artery and its branches outlined after ultrasound evaluation. **b**, Right wrist incision with large superficial radial artery branch (*dashed arrow*) and smaller conventional radial artery (*solid arrow*).



**Fig 3.** **a**, Radiocephalic fistula using superficial radial artery (*solid arrow*) as inflow to cephalic vein (*dotted arrow*). **b**, Illustration showing radiocephalic fistula using superficial radial artery.

amount of acute thrombus was retrieved (Fig 2, b). At completion of the case, there was a palpable pulse in the anomalous vessel, and Doppler signals were now present up to the proximal phalanx in the first three digits.

The patient remained on therapeutic anticoagulation with some improvement in her sensorimotor examination findings, but the distal aspects of her first and second digits developed dry gangrene. She was discharged with wound care and returned 1 month later with wet gangrene requiring amputation of her thumb and index fingers. The superficial radial artery pulse remained palpable with distal signals present, and her amputation wounds healed well. Although the relationship of the superficial radial artery to the palmar arch remains unknown in this patient without dedicated arterial imaging, it seems clear that this anomalous artery provided the dominant inflow to the first three digits.

**Patients 2 through 4.** Patients 2 through 4, all patients with chronic kidney disease, presented for planned radiocephalic fistula creation. At the time of operation, each was found to have a laterally coursing artery branching off of the radial artery in the distal forearm. Each had an appreciable pulse coursing distally over the area of the anatomic snuffbox. In all cases, the variant artery was a large branch off of the conventional deep radial artery, and it measured 3 mm in diameter in two of the three cases. In one case, it was not measured, but it still

appeared clearly larger than the deep radial artery. The superficial radial artery was used as inflow in radiocephalic fistula creation for all three patients (Fig 3).

In patient 2, the fistula had not yet matured 6 months postoperatively, and he underwent ligation of two draining venous branches to centralize flow to the main cephalic vein. Two months later, his fistula had matured and was successfully being used for hemodialysis. He experienced no steal symptoms.

Patient 3 did not return for a postoperative visit until 5 months after surgery, at which time he was noted to have a weak thrill and normal sensorimotor examination findings. Ultrasound showed stenosis of the peripheral aspect of the cephalic vein. He was scheduled for balloon angioplasty, although he was lost to follow-up.

Patient 4 had a soft thrill and no steal symptoms 6 weeks postoperatively. Ultrasound demonstrated outflow stenosis with a sharp turn of the vein. She underwent surgical ligation and proximalization, this time with anastomosis of the cephalic vein to the main radial artery proximal to the takeoff of the superficial radial artery. This arteriovenous fistula matured well and was used successfully for hemodialysis.

## DISCUSSION

The superficial radial artery anomaly has been described previously, and cadaver studies have shown its incidence to be 0.5% to 1%.<sup>2,7</sup> Previous publications

include two case reports of arterial puncture into a superficial radial artery without sequelae, suggesting that it was not the dominant inflow to any digits in these patients.<sup>1,8</sup> Another report describes two patients with accidental superficial radial artery catheterization who developed initial signs of ischemia that resolved after early recognition and removal of the catheters.<sup>9</sup> Finally, Beale and Behnam<sup>5</sup> reported a case of unintentional puncture with promethazine administration leading to thrombotic injury and eventually requiring amputation of necrotic first and second fingers. Similarly, our patient's ischemia developed after catheterization and thrombosis of the superficial radial artery, suggesting that sometimes this variant artery provides the dominant inflow to one or more fingers. Considering the mixed results after venipuncture into this variant artery, further insight into the relationship of this anomalous artery with the palmar arch is needed. Clinicians should at least be aware of this variant and check for a pulse before attempted venipuncture in this region of the dorsal hand.

Weyde et al<sup>10</sup> described five patients in whom radiocephalic fistulas were created using the superficial radial artery. Four of the five were successfully used for hemodialysis, whereas one failed to mature. Presence or absence of steal symptoms was not described. Among our three patients who had fistula creation using the anomalous artery, one was used successfully, one was lost to follow-up, and one needed revision to a more proximal fistula. As no steal symptoms occurred, we propose that it is reasonable to attempt fistula creation using this variant. However, careful assessment of digital perfusion while occluding this artery as well as consideration of artery diameter should be taken into account. This may help determine who is at risk of steal symptoms

from fistula creation using this artery. Further case reports or studies may help elucidate the long-term results of hemodialysis fistula creation using this variant artery.

## REFERENCES

1. Diz JC, Ares X, Tarrazo AM, Alvarez J, Meanos ER. Bilateral superficial radial artery at the wrist. *Acta Anaesthesiol Scand* 1998;42:1020.
2. Wood SJ, Abrahams PH, Sundo JR, Ferreira BJ. Bilateral superficial radial artery at the wrist associated with a radial origin of a unilateral median artery. *J Anat* 1996;189(Pt 3):691-3.
3. Manners-Smith MA. The limb arteries of primates. *J Anat* 1911;45:23-64.
4. Quain R. *The anatomy of the arteries of the human body*. London: Taylor and Walton; 1884. p. 333-5.
5. Beale EW, Behnam A. Injection injury of an aberrant superficial radial artery requiring surgical intervention. *J Hand Microsurg* 2012;4:39-42.
6. Singer E. Embryological pattern persisting in the arteries of the arm. *Anat Rec* 1933;55:403-9.
7. Sachs M. The arteria radialis superficialis. An unusual variation of the arteria radialis of man and its phylogenetic significance. [in German]. *Acta Anat (Basel)* 1987;128:110-23.
8. Lirk P, Keller C, Colvin J, Colvin H, Rieder J, Maurer H, et al. Unintentional arterial puncture during cephalic vein cannulation: case report and anatomical study. *Br J Anaesth* 2004;92:740-2.
9. Ghouri AF, Mading W, Prabaker K. Accidental intraarterial drug injections via intravascular catheters placed on the dorsum of the hand. *Anesth Analg* 2002;95:487-91.
10. Weyde W, Krajewska M, Zmonarski SC, Letachowicz W, Penar J, Watorek E, et al. The abnormal superficial radial artery does not restrict the successful creation of hemodialysis forearm arteriovenous fistula. *Clin Nephrol* 2009;71:584-7.

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