*Case Reports*

# Acute Hand Ischemia and Digital Amputation

## After Transradial Coronary Intervention in a Patient With CREST Syndrome

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*The radial artery approach for coronary angiography and intervention is rapidly replacing the femoral artery approach, largely because it reduces bleeding and vascular access site complications. However, complications associated with transradial access warrant attention, notably radial artery occlusion. This report focuses on a case of radial artery occlusion after percutaneous coronary intervention in a 46-year-old woman with CREST (calcinosis, Raynaud phenomenon, esophageal dysfunction, sclerodactyly, and telangiectasia) syndrome, which ultimately led to acute hand ischemia necessitating amputation of her middle and index fingers.* ***(Tex Heart Inst J 2020;47(4):319-21)***

The radial artery approach for coronary angiography and intervention procedures is rapidly replacing the femoral artery approach, largely because it reduces bleeding and vascular access site complications.[1-3] The transradial approach is especially advantageous in treating acute coronary syndromes and ST-segment-elevation myocardial infarction.[1,4] Although complications associated with transradial access are rare, they are distinct and warrant attention, as do strategies aimed at reducing them.[5] One particular complication, radial artery occlusion (RAO) with acute hand and digital ischemia, occurred in a woman who underwent transradial percutaneous coronary intervention (PCI) and whose case emphasizes the need for close monitoring.

## Case Report

A 46-year-old woman presented with a non-ST-segment-elevation myocardial infarction. Her medical history included CREST (calcinosis, Raynaud phenomenon, esophageal dysfunction, sclerodactyly, and telangiectasia) syndrome and tobacco use. The patient underwent heart catheterization through the radial approach via a 6F sheath. An Allen test was not performed before the procedure. Verapamil and nitroglycerin were administered through the sheath to alleviate radial artery vasospasm. Unfractionated heparin (5,000 IU) was given intravenously after sheath insertion. Coronary angiograms showed stenoses in the right coronary artery and obtuse marginal branch; both were successfully treated with drug-eluting stents. An additional dose of unfractionated heparin (3,000 IU) was given before percutaneous coronary intervention, although her activated clotting time (ACT) remained low, peaking at 160 seconds. To improve her ACT, tirofiban (0.15 μg/kg/min) was given intravenously for several hours after PCI. Aspirin and clopidogrel were also prescribed postoperatively. Patent hemostasis was achieved with use of a compression band; as part of our protocol, a reverse Barbeau test was performed after sheath removal. Next, serial deflation of the compression device was started 10 minutes after the procedure was completed and continued for 2 hours. The patient recovered well and was discharged home the next day.

Two weeks later, the patient returned to the hospital with a painful and discolored right hand. A duplex ultrasonogram showed total occlusion of the radial artery and the absence of flow on pulsed-wave Doppler (Fig. 1). A subsequent selective angiogram of the right arm showed distal RAO (Fig. 2). The occlusion was successfully treated by means of mechanical thrombectomy, catheter-assisted thrombolysis, and balloon angioplasty (Fig. 3). Afterward, the patient was prescribed amlodipine to alleviate arterial vasospasm. Although her postprocedural course was unremarkable, she had

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recurrent episodes of hand ischemia; 3 months later, dry gangrene necessitated amputation of the patient's middle and index fingers at the proximal phalanges.

## Discussion

Transradial arterial access for cardiac catheterization procedures has been increasingly adopted worldwide.[6] Radial artery occlusion is among the most common complications of transradial catheterization, occurring in up to 10% of cases.[7,8] However, a substantial proportion of occluded radial arteries recanalize spontaneously during the postoperative follow-up period.[9] The presumed mechanism of RAO is endothelial injury and vascular stasis leading to thrombus formation; distal embolization and in situ thrombosis of collateral vessels have also been implicated.[9] Multiple risk factors for RAO have been identified including age, female sex, low body weight, tobacco abuse, increased sheath-to-artery size ratio, lack of intraprocedural anticoagulation, and absence of patent hemostasis after the procedure.[9-12] Hahalis and colleagues[13] reported the superiority of high-dose heparin (100 IU/kg body weight) over standard low-dose heparin (50 IU/kg body weight) in reducing RAO after transradial catheterization for coronary angiography, suggesting that aggressive anticoagulation strategies help to preserve radial artery patency.

Few authors have reported RAO that led to digital ischemia.[14-16] Our patient's risk factors were female sex, low body weight, and tobacco use; moreover, a potential compounding factor was her underlying CREST syndrome, which is characterized in part by endothelial dysfunction and vasculopathy. Moreover, the low ACT after heparin administration in this patient, suggesting heparin resistance, may have further increased the risk of ischemic complications. Hand ischemia in a patient with CREST syndrome and dry gangrene in a patient with possible Raynaud phenomenon have been reported.[17,18]

The transradial approach has been shown to improve outcomes across a wide spectrum of patients; however, several important precautions should be taken in selecting patients. Specifically, conditions associated with severe vaso-occlusion, such as Raynaud phenomenon, have been described as relative contraindications.[12,13] Such patient-specific variables must be carefully considered when evaluating the risks and benefits of transradial

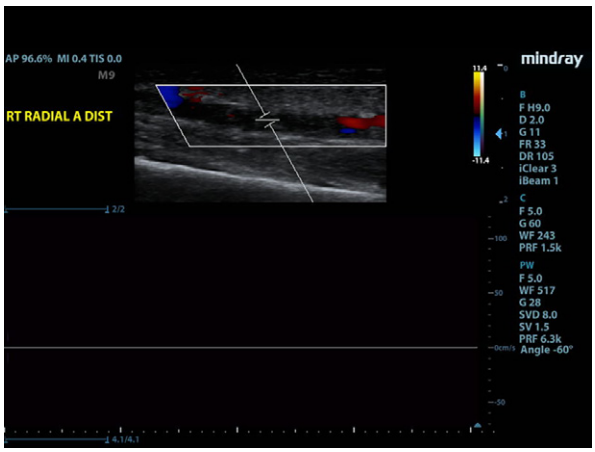


***Fig. 1*** *Duplex ultrasonogram shows thrombotic occlusion of the right radial artery (top), and no flow on pulsed-wave Doppler (bottom).*

***Fig. 2*** *Selective angiogram shows a totally occluded right radial artery.*

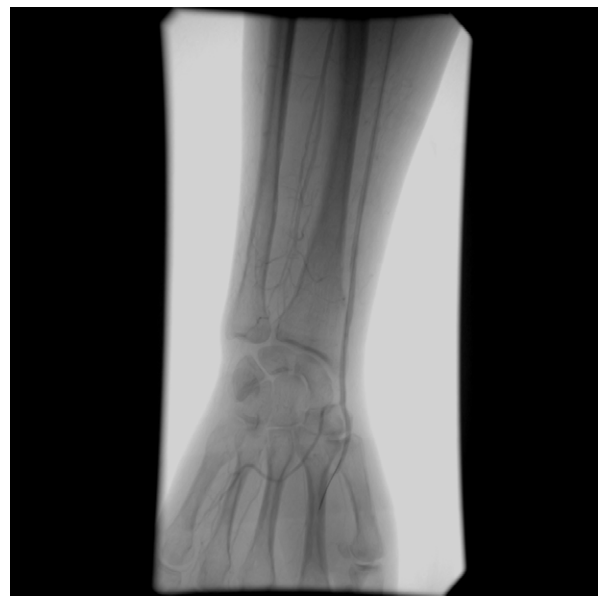

***Fig. 3*** *Follow-up angiogram shows successful recanalization of the right radial artery.*

access and integrated into the preprocedural assessment of all patients.

## Conclusion

Transradial access can have serious, although rare, complications, and operators must evaluate each patient's individual risk. Strategies to reduce RAO, such as smaller sheath size (4F or 5F), adequate intraprocedural anticoagulation, and liberal use of local vasodilators, as well as use of alternative access sites, should be considered. More data from registries including patients with vasoocclusive disease who undergo transradial access are needed to define the safety and overall complication rates of this approach.

## References


1. Jolly SS, Yusuf S, Cairns J, Niemela 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 [published errata appear in Lancet 2011;377(9775):1408 and Lancet 2011;378(9785):30]. Lancet 2011;377(9775): 1409-20.
2. Ferrante G, Rao SV, Juni P, Da Costa BR, Reimers B, Condorelli G, et al. Radial versus femoral access for coronary interventions across the entire spectrum of patients with coronary artery disease: a meta-analysis of randomized trials. JACC Cardiovasc Interv 2016;9(14):1419-34.
3. Brener MI, Bush A, Miller JM, Hasan RK. Influence of radial versus femoral access site on coronary angiography and intervention outcomes: a systematic review and meta-analysis. Catheter Cardiovasc Interv 2017;90(7):1093-104.
4. Romagnoli E, Biondi-Zoccai G, Sciahbasi A, Politi L, Rigattieri S, Pendenza G, et al. Radial versus femoral randomized investigation in ST-segment elevation acute coronary syndrome: the RIFLE-STEACS (Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Syndrome) study. J Am Coll Cardiol 2012;60(24):2481-9.
5. Sanmartin M, Cuevas D, Goicolea J, Ruiz-Salmeron R, Gomez M, Argibay V. Vascular complications associated with radial artery access for cardiac catheterization [in Spanish]. Rev Esp Cardiol 2004;57(6):581-4.
6. Masoudi FA, Ponirakis A, de Lemos JA, Jollis JG, Kremers M, Messenger JC, et al. Trends in U.S. cardiovascular care: 2016 report from 4 ACC national cardiovascular data registries. J Am Coll Cardiol 2017;69(11):1427-50.
7. Stella PR, Kiemeneij F, Laarman GJ, Odekerken D, Slagboom T, van der Wieken R. Incidence and outcome of radial artery occlusion following transradial artery coronary angioplasty. Cathet Cardiovas Diagn 1997;40(2):156-8.
8. Zankl AR, Andrassy M, Volz C, Ivandic B, Krumsdorf U, Katus HA, Blessing E. Radial artery thrombosis following transradial coronary angiography: incidence and rationale for treatment of symptomatic patients with low-molecular-weight heparins. Clin Res Cardiol 2010;99(12):841-7.
9. Garg N, Madan BK, Khanna R, Sinha A, Kapoor A, Tewari S, et al. Incidence and predictors of radial artery occlusion after transradial coronary angioplasty: Doppler-guided follow-up study. J Invasive Cardiol 2015;27(2):106-12.
10. Pancholy S, Coppola J, Patel T, Roke-Thomas M. Prevention of radial artery occlusion–patent hemostasis evaluation trial (PROPHET study): a randomized comparison of traditional versus patency documented hemostasis after transradial catheterization. Catheter Cardiovasc Interv 2008;72(3): 335-40.
11. Rhyne D, Mann T. Hand ischemia resulting from a transradial intervention: successful management with radial artery angioplasty. Catheter Cardiovasc Interv 2010;76(3):383-6.
12. Mason PJ, Shah B, Tamis-Holland JE, Bittl JA, Cohen MG, Safirstein J, et al. An update on radial access and best practices for transradial coronary angiography and intervention in acute coronary syndrome: a scientific statement from the American Heart Association. Circ Cardiovasc Interv 2018;11(9):e000035.
13. Hahalis GN, Leopoulou M, Tsigkas G, Xanthopoulou I, Patsilinakos S, Patsourakos NG, et al. Multicenter randomized evaluation of high versus standard heparin dose on incident radial arterial occlusion after transradial coronary angiography: the SPIRIT OF ARTEMIS Study. JACC Cardiovasc Interv 2018;11(22):2241-50.
14. Bojakowski K, Zawadzki M, Mruk B, Andziak P, Walecki J. Critical hand ischemia after radial access for coronary angiography – case report. Pol J Radiol 2017;82:19-23.
15. Valentine RJ, Modrall JG, Claggett GP. Hand ischemia after radial artery cannulation. J Am Coll Surg 2005;201(1): 18-22.
16. Rademakers LM, Laarman GJ. Critical hand ischemia after transradial cardiac catheterisation: an uncommon complication of a common procedure. Neth Heart J 2012;20(9):372-5.
17. Taglieri N, Galie N, Marzocchi A. Acute hand ischemia after radial intervention in patient with CREST-associated pulmonary hypertension: successful treatment with manual thromboaspiration. J Invasive Cardiol 2013;25(2):89-91.
18. Singh K, Abunassar J, So DY. Digital gangrene following transradial coronary angiogram. JACC Cardiovasc Interv 2016;9(2):e21-2.