

# Severe radial artery spasm causing entrapment of the Terumo radial to peripheral destination slender sheath: a case report

Salik Nazir , Zeid Nesheiwat , Mubbasher Ameer Syed , and Rajesh Gupta \*

Department of Cardiology, University of Toledo Medical Center, 3000 Arlington Avenue, MS# 1118, Toledo, OH 43614, USA

Received 27 September 2019; first decision 11 November 2019; accepted 28 January 2020; online publish-ahead-of-print 20 February 2020

## Background

Radial access for lower-extremity peripheral vascular interventions (PVIs) has been limited due to inadequate equipment lengths. The Terumo R2P Destination Slender sheath is a relatively new sheath designed for these interventions. However, complications related to this sheath or access strategy for lower-extremity PVI have not been reported.

## Case summary

A 69-year-old woman presented with purple discoloration of her 1st and 5th toes of the left foot for approximately 1 month. Lower-extremity arterial duplex ultrasound showed mid left superficial femoral artery (SFA) greater than 90% stenosis. Peripheral angiogram was performed via the left radial artery and this confirmed the presence of severe left SFA stenosis. Intra-arterial vasodilators including verapamil and nitroglycerine were administered to prevent radial artery spasm. Next, we attempted to deliver the Terumo 6-Fr R2P Destination Slender 119 cm sheath for the interventional procedure. However, the sheath became stuck at the level of mid axillary artery due to severe radial artery spasm. Despite use of intra-arterial vasodilators, deep sedation with propofol, and gentle retraction, the sheath could not be removed and eventually broke requiring surgical removal.

## Discussion

This case demonstrates severe radial artery spasm causing sheath entrapment that required emergency surgery for sheath removal. Unfortunately, the sheath could not be removed despite typical manoeuvres for severe spasm including intra-arterial vasodilators and deep sedation with propofol. Physicians performing PVIs via radial access need to be aware of this potentially serious complication.

## Keywords

Peripheral vascular disease • Peripheral vascular interventions • Device failure • Device complication • Sheath • Radial artery spasm • Case report

## Learning points

- The Terumo R2P Destination Slender sheath is a relatively new sheath designed to facilitate radial access for peripheral vascular interventions (PVIs). It is available in 6-Fr size with a lengths of 119 cm and 149 cm, long enough to treat lower-extremity peripheral arterial disease via radial access.
- Severe radial artery spasm causing sheath entrapment is rare and occurs in approximately 0.8% of cases. This may require surgical removal in cases of refractory spasm.
- There is a trade-off between slender and flexible sheath design and risk of structural failure. Physicians performing PVIs via radial access need to be aware of this potentially serious complication and be familiar with equipment limitations.

\* Corresponding author. Tel: +1 419 383 6831, Fax: +1 419 383 3041, Email: [rajesh.gupta@utoledo.edu](mailto:rajesh.gupta@utoledo.edu)

Handling Editor: Marco De Carlo

Peer-reviewers: Helle Søholm, Alice Wood, and Rafal Wolny

Compliance Editor: Stefan Simovic

Supplementary Material Editor: Ross Thomson

© The Author(s) 2020. Published by Oxford University Press on behalf of the European Society of Cardiology.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact [journals.permissions@oup.com](mailto:journals.permissions@oup.com)

## Introduction

Transradial artery access (TRA) has gained increased popularity as the preferred mode for percutaneous coronary interventions (PCIs).<sup>1</sup> This is driven by decreased net adverse clinical events, early ambulation, improved quality of life after the procedure and reduced hospital cost compared with transfemoral access.<sup>2,3</sup> Prior to the introduction of the Terumo R2P Destination Slender sheath (Terumo Interventional System, Somerset, NJ, USA), radial access was infrequently utilized for lower-extremity peripheral vascular interventions (PVIs), due to lack of appropriate equipment length.<sup>4</sup> The R2P Destination Slender sheath is a relatively new device system available in 6-Fr size with a lengths of 119 cm and 149 cm, providing adequate length for treatment of lower-extremity peripheral arterial disease (PAD).<sup>4</sup> Given its limited experience, complications related to this sheath system have not been described. We report a case of severe radial artery spasm causing sheath entrapment and requiring surgical exploration to remove the Terumo Destination Slender sheath.

## Timeline

Initial presentation (7 June 2019)	<p>Patient noticed left foot discolouration and referred to cardiology.</p> <p>Patient underwent ankle brachial index revealing peripheral artery disease and arterial duplex revealing left superficial femoral artery stenosis.</p>
Two weeks later (21 June 2019)	<p>Patient underwent peripheral angiogram with attempted intervention.</p> <p>During the procedure, the Terumo 6-Fr R2P Destination Slender 119 cm sheath was advanced but became stuck at the level of the left axillary artery.</p> <p>Refractory radial artery spasm occurred and could not be relieved despite administration of multiple intra-arterial vasodilators.</p> <p>Inability to remove the sheath despite multiple attempts at manual retraction.</p> <p>Sheath lost its structural integrity and fragmented requiring surgical removal.</p>

## Case presentation

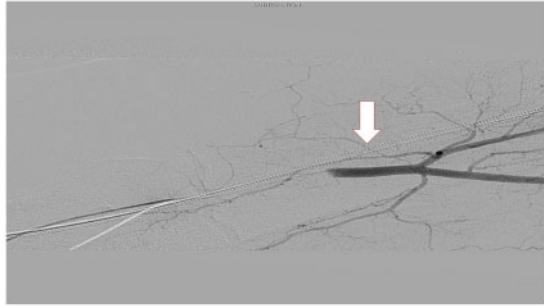
A 69-year-old woman presented with a chief complaint of purple discolouration of her 1st and 5th toes of the left foot for approximately 1 month. She had a past medical history of coronary artery disease, coronary artery bypass grafting in 2010, PCI of the left circumflex coronary artery in 2019, history of ischaemic stroke with no permanent disability, paroxysmal atrial fibrillation, essential hypertension, insulin-dependent Type 2 diabetes mellitus, and morbid obesity (body



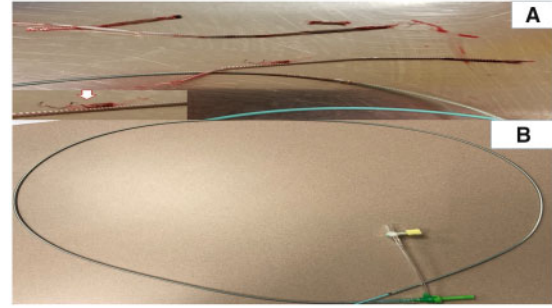
**Figure 1** Digital subtraction angiography demonstrates a 90% stenosis in the mid segment of the left superficial femoral artery (arrow).

mass index 37 kg/m<sup>2</sup>). Initial physical exam was unremarkable except peripheral vascular exam which revealed cyanosis of the left 1st and 5th toes with diminished left dorsalis pedis and posterior tibial pulses. Laboratory testing was unrevealing with a creatinine 0.66 mg/dL (normal 0.60–1.20 mg/dL), haemoglobin 12.3 g/dL (normal 12–15 g/dL), and platelet count 190 000/μL (normal 150 000–400 000/μL). Her electrocardiogram showed normal sinus rhythm with no significant ST-T changes. Non-invasive vascular testing showed an ankle brachial index of 0.88 on the right and 0.50 on the left. Lower-extremity arterial duplex ultrasound revealed a severe left superficial femoral artery (SFA) stenosis. Patient was diagnosed with PAD (Rutherford Grade 5) and planned for peripheral angiogram and possible intervention.

The prior PCI procedure via femoral access was complicated by severe bleeding requiring transfusion. Given obesity and prior femoral access site bleeding, the decision was made to pursue left radial approach for the PVI to reduce the risk of bleeding. Midazolam and



**Figure 2** R2P Terumo Destination Slender guiding sheath entrapment. Antegrade contrast injection via catheter in the brachial artery. The ulnar artery is visualized, but the sheath is occlusive in the radial artery (arrow).



**Figure 3** (A) Fragmented Terumo Destination Slender guiding sheath after surgical removal. Inset demonstrates magnified image of unraveled stainless steel braided wire (arrow). (B) Image of a normal Terumo Destination Slender guiding sheath for comparison.

fentanyl were used for conscious sedation as needed throughout the procedure and 1% lidocaine for local infiltration over the left radial artery. A 6-Fr Terumo Guiding Sheath Slender was placed in the left radial artery followed by verapamil 2.5 mg and nitroglycerine 200 µg intravenous through the sheath. A Magic torque wire was manipulated to the descending aorta. Heparin anticoagulation was used for this procedure. A 5-Fr pigtail catheter was placed in the descending aorta and aortogram was performed. Next, a Terumo 4-Fr PV multipurpose catheter (150 cm) was advanced to the left iliac artery and left lower-extremity angiogram was performed using digital subtraction angiography. A 90% stenosis in the left mid SFA was noted (Figure 1). The Terumo 6-Fr R2P Destination Slender 119 cm sheath was then advanced over the Magic Torque guidewire after the previous catheter was removed. Unfortunately, the sheath became stuck with the tip of the sheath at the level of the left axillary artery (Figure 2, Supplementary material online, Video S1). The sheath was unable to be advanced nor removed. Multiple doses of intra-arterial verapamil and nitroglycerine were given without success. Following this, right femoral artery was accessed, and a 6-Fr sheath was placed. Then, a NaviCross catheter and a Magic Torque guidewire were advanced to the left brachial artery and further intra-arterial doses of verapamil as well as nitroglycerine were delivered without success. The patient was then intubated and started intravenous propofol for deep sedation with the assistance of anaesthesia. The sheath was still unable to be removed. Subcutaneous injection of verapamil, nitroglycerine, and lidocaine using ultrasound guidance along the course of the radial artery were then attempted. Unfortunately, despite all conventional measures and steady retraction we could not remove the sheath. Due to severe radial spasm, further attempts at removal resulted in structural failure of the sheath. Vascular surgery was consulted, and surgical approach in the operating room to remove the sheath was recommended. The sheath was removed by arteriotomy and was noted to be very thin, friable, and broken into multiple pieces. The stainless steel braided wire that is part of the sheath construction had unraveled and the plastic polymer had separated (Figure 3). Fortunately, the patient recovered well from the surgery

and was discharged a week later. She recovered over the next month and has no residual deficits. The left SFA was successfully treated with a second procedure using right common femoral artery access.

## Discussion

The most common complication of TRA is radial artery spasm with the reported incidence of 4–20% in the literature.<sup>5–7</sup> The vasospastic potential of the radial artery is due to its highly muscular media along with high density of alpha receptors. Refractory severe spasm is rare and occurs in about 0.8% of cases causing entrapment of the inserted sheath.<sup>8</sup> All conventional measures to treat radial artery spasm including midazolam, fentanyl, lidocaine, verapamil, nitroglycerine, and lastly intubation and deep sedation with propofol were unsuccessful.<sup>9,10</sup> The R2P Terumo Destination Slender sheath is a relatively new device used for radial access for PVLs. It has specific construction designed to increase flexibility and tracking. It also has a thin-walled design which allows for a smaller arteriotomy and this product line has been identified with the ‘slender’ designation. This case demonstrates severe radial artery spasm and sheath entrapment with structural failure of the sheath requiring emergency surgery for sheath removal. There is a trade-off between slender and flexible sheath design and risk of structural failure. Physicians performing PVLs via radial access need to be aware of this potentially serious complication. The device manufacturer as well as the US Food and Drug Administration (FDA) were informed about this complication.

## Conclusion

This case demonstrates severe radial artery spasm causing sheath entrapment that required emergency surgery for sheath removal. Unfortunately, the sheath could not be removed despite typical manoeuvres for severe spasm including intra-arterial vasodilators and deep sedation with propofol. Physicians performing PVLs via radial access need to be aware of this potentially serious complication.

## Lead author biography



Dr Salik Nazir completed his internal medicine residency from Reading Hospital, West Reading, PA, USA. Currently, he is a first-year cardiology fellow at the University of Toledo Medical Center, Toledo, OH, USA. His research focus includes acute coronary syndrome, transcatheter aortic valve replacement, takotsubo cardiomyopathy, and peripheral vascular interventions.

## Supplementary material

[Supplementary material](#) is available at *European Heart Journal - Case Reports* online.

**Slide sets:** A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

**Consent:** The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

**Conflict of interest:** none declared.

## References

1. Mason PJ, Shah B, Tamis-Holland JE, Bittl JA, Cohen MG, Safirstein J, Drachman DE, Valle JA, Rhodes D, Gilchrist IC; American Heart Association Interventional Cardiovascular Care Committee of the Council on Clinical Cardiology; Council on Cardiovascular and Stroke Nursing; Council on Peripheral Vascular Disease; and Council on Genomic and Precision Medicine. An update on radial artery 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**:e000035.
2. Cooper CJ, El-Shiekh RA, Cohen DJ, Blaesing L, Burket MW, Basu A, Moore JA. Effect of transradial access on quality of life and cost of cardiac catheterization: a randomized comparison. *Am Heart J* 1999;**138**:430–436.
3. Romagnoli E, Biondi-Zoccai G, Sciahbasi A, Politi L, Rigattieri S, Pendenza G, Summaria F, Patrizi R, Borghi A, Di Russo C, Moretti C, Agostoni P, Loschiavo P, Lioy E, Sheiban I, Sangiorgi G. 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**:2481–2489.
4. O'Connor DJ, Nielsen S, Patel P, Cook K, Ratnathicam A, Wilderman M, Simonian G, Napolitano M. Initial experience with the Terumo radial to peripheral catheter system for peripheral arterial intervention. *J Vasc Surg* 2019;**70**:e24.
5. Coppola J, Patel T, Kwan T, Sanghvi K, Srivastava S, Shah S, Staniloae C. Nitroglycerin, nitroprusside, or both, in preventing radial artery spasm during transradial artery catheterization. *J Invasive Cardiol* 2006;**18**:155–158.
6. Chen Z, Ng F, Nageh T. An unusual case of infective endocarditis presenting as acute myocardial infarction. *Emerg Med J* 2007;**24**:442–443.
7. Varenne O, Jégou A, Cohen R, Empana JP, Salengro E, Ohanessian A, Gaultier C, Allouch P, Walspurger S, Margot O, El Hallack A, Jouven X, Weber S, Spaulding C. Prevention of arterial spasm during percutaneous coronary interventions through radial artery: the SPASM study. *Catheter Cardiovasc Interv* 2006;**68**:231–235.
8. Zencirci E, Değirmencioglu A. Catheter entrapment due to severe radial artery spasm during transradial approach. *Cardiol J* 2016;**23**:324–332.
9. Kiemeneij F, Vajifdar BU, Eccleshall SC, Laarman G, Slagboom T, Wieken R. V D. Evaluation of a spasmolytic cocktail to prevent radial artery spasm during coronary procedures. *Catheter Cardiovasc Interv* 2003;**58**:281–284.
10. Raut M, Mantri RR, Sharma M, Maheshwari A. Propofol to relieve radial artery spasm. *Indian Heart J* 2016;**68**:364–365.