Transradial renal salvage after complex endovascular aneurysm repair complicated by left renal artery thrombosis

Justin M. George, MD, Lucyna Z. Price, MD, Adam H. Korayem, MD, PhD, Michael L. Marin, MD, Peter L. Faries, MD, *and* Rami O. Tadros, MD, *New York, NY*

ABSTRACT

Transradial access has been used for percutaneous coronary interventions with success; however, there is limited literature on its use for visceral stenting in the setting of complex endovascular aneurysm repair. We present a case of transradial left renal salvage after renal artery thrombosis in the setting of complex endovascular aneurysm repair. (J Vasc Surg Cases and Innovative Techniques 2019;5:239-42.)

Keywords: Transradial; Endovascular; Aortic; Renal

CASE REPORT

A 74-year-old man with history of morbid obesity, hypertension, obstructive sleep apnea, and prior endovascular aneurysm repair (EVAR) for infrarenal abdominal aortic aneurysm was found on surveillance imaging to have juxtarenal aneurysmal growth to 10.6 × 10.8 cm. A thoracoabdominal endovascular aortic repair with four-vessel parallel stent grafting to the celiac artery, superior mesenteric artery, and bilateral renal arteries (6-mm × 10-cm Viabahn endoprosthesis; W. L. Gore & Associates, Flagstaff, Ariz) was performed using Gore Excluder and Gore TAG thoracic endoprosthesis devices. Completion aortography demonstrated patent visceral, renal, and iliac vessels with no evidence of endoleak (Fig 1).

On postoperative week 2, the patient was noted to be hypertensive and gaining weight. Routine laboratory test results revealed a rise in creatinine concentration from 1.08 mg/dL preoperatively to 2.40 mg/dL. Routine postoperative duplex ultrasound examination failed to visualize flow in the left renal artery, prompting computed tomography angiography (CTA), which demonstrated left renal artery thrombosis (Fig 2). The patient was taken to the operating room emergently for renal salvage.

The left radial artery was accessed after a Barbeau test demonstrated an intact palmar arch. A 6F sheath was placed, and a Glidewire (Terumo Interventional Systems, Somerset, NJ) was inserted and tracked down the aorta. A 6F destination sheath was then placed from the left radial artery to the thoracic aorta (119-cm R2P Destination Slender Guiding Sheath; Terumo). A Glidewire was then used to access the left renal artery. A vertebral catheter was used to cannulate the left renal artery (Fig 3). The AngioJet Ultra system (Boston Scientific, Marlborough, Mass) was introduced, and pharmacomechanical thrombolysis was performed. A self-expanding stent (6- ×80-mm EverFlex; Medtronic, Santa Rosa, Calif) was placed across the origin of the left renal artery to an area of tortuosity. An additional self-expanding stent (6- ×60-mm EverFlex) was placed with overlap to cross this tortuous segment. The system was then dilated with an EverCross 6-mm balloon (Medtronic), and arteriography demonstrated patency (Fig 4). Wires and sheaths were removed, and a TR Band (Terumo) was placed on the patient's left forearm to maintain hemostasis. The patient was discharged on postoperative day 2 with rapidly improving renal function and suffered no access site complications. The patient consented to publication of all case details and images.

Follow-up. The patient has been seen in clinic 2 months after reintervention. His creatinine concentration has downtrended to 1.8 mg/dL, and duplex ultrasound examination demonstrated bilateral renal stent patency. He is maintained on aspirin and clopidogrel (Plavix), with a plan to follow up at the 6-month mark.

DISCUSSION

EVAR has become the first-line treatment modality for anatomically suitable aneurysms.[1] Although more centers have adopted EVAR, nearly 40% of patients have complex anatomy unsuitable for conventional EVAR.[2,3] The snorkel-chimney technique is an endovascular therapeutic modality for branch revascularization in complex aortic disease that has gained increasing popularity.[4,5] Snorkel techniques, fenestrated devices, and branched stent grafts have expanded the range of cases that can be treated endovascularly. These complex techniques often require an anterograde approach for visceral or renal artery stenting.

Traditionally, anterograde access had been achieved through the axillary or brachial artery. Renal artery stenting techniques had previously required 8F sheaths and

From the Division of Vascular Surgery, Department of Surgery, The Icahn School of Medicine at Mount Sinai.

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Correspondence: Rami O. Tadros, MD, FACS, RPVI, Associate Program Director of Vascular Surgery, Associate Professor of Surgery and Radiology, Director, Off-site Vascular Lab Division of Vascular Surgery, Icahn School of Medicine at Mount Sinai, The Mount Sinai Medical Center, 1425 Madison Ave, 4th Fl, New York, NY 10029 (e-mail: rami.tadros@mountsinai.org).

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Fig 1. Completion aortogram after complex endovascular aneurysm repair (EVAR) demonstrating patent bilateral renal artery, superior mesenteric artery, and celiac artery stents with no evidence of endoleak.

Fig 2. Computed tomography angiography (CTA) image 2 weeks after complex endovascular aneurysm repair (EVAR) with four-vessel stenting demonstrating left renal artery thrombosis (the *arrow* indicates the left renal artery).

stent systems over 0.035-inch wires, necessitating larger arterial access sites. Contemporary systems now allow placement of devices through a 6F sheath over 0.014-inch wires.[6] This has allowed an increase in the number of transradial interventions. A transradial approach has long been used for coronary angiography and intervention[7]; however, data on transradial renal or visceral interventions, particularly in the setting of complex aortic disease, are scarce.[8-10] This is one of the first cases of transradial renal salvage after complex EVAR in the literature.

Our standard protocol after complex EVAR with parallel stent grafting involves duplex ultrasound at postoperative week 2, followed by CTA at 1 month, 6 months, and 12 months. Early CTA was obtained in this patient, given clinical findings and inability to visualize left renal arterial flow on ultrasound. Left renal artery thrombosis with rising creatinine concentration was concerning for ischemia; however, the presence of renal enhancement on CTA indicated some perfusion through collateral flow as well as viability. In instances in which viability of the kidney is unclear, functional imaging techniques, such as renal scintigraphy, can be employed. Although the patient's renal function has not returned to baseline, there was significant improvement immediately after the reintervention, indicating that a considerable volume of the left kidney was salvaged.

A transradial approach has demonstrated a favorable safety profile compared with a transbrachial approach. Transradial access has also been associated with lower postoperative hemorrhage rates and increased comfort for the patient.[8,11,12] Furthermore, the risk of proximal access site complication, including hematoma and subsequent brachial plexus injury, is obviated with a transradial approach.[13]

Transradial access site complications are limited. Radial artery occlusion after cannulation occurs in 1% to 10% of cases but is often clinically silent, given the dual blood supply to the hand.[14,15] Other infrequent complications of transradial access include pseudoaneurysm formation (<0.1%) and hemorrhage (<1%).[13]

Transradial access does have its own set of challenges. There is often an operator learning curve. The artery may not be large enough to accommodate the necessary sheath sizes, particularly when a sheath >6F is required. Furthermore, it is crucial to ensure that the patient has a patent ulnar artery and intact palmar arch by a Barbeau test. Difficulty can also be encountered if there is significant radial artery calcification or tortuosity and in tall patients, in whom device length may be limited.[10,16] Assessment of the patient's height and torso length as well as tortuosity of thoracic and abdominal aorta on preoperative imaging may aid the operator in selecting cases appropriate for transradial

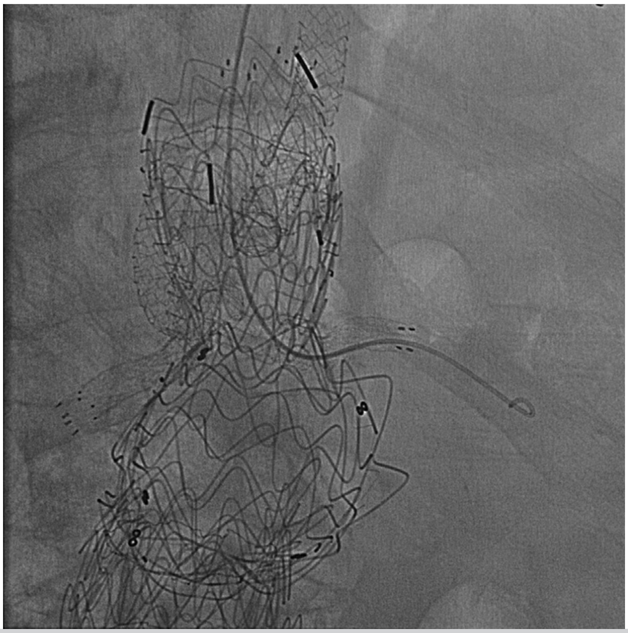

Fig 3. Anterograde access of left renal artery achieved through a transradial approach.

Fig 4. Left renal arteriogram after pharmacomechanical thrombolysis and stenting demonstrating patency (the *arrow* demonstrates the left renal artery).

access. Bilateral groins should be routinely prepared for transradial visceral interventions in case difficult anatomy is encountered and transfemoral access is needed. This patient's anatomy was favorable with regard to acceptable radial artery size and no tortuosity of the radial artery or aorta. We had no difficulties in regard to reach or maneuverability. Issues with maneuverability can be somewhat curtailed using longer sheath sizes. We used a Terumo 119-cm sheath in this case. Although wire access to the external iliac artery could be achieved, transradial peripheral interventions are limited by device delivery systems. Current stenting devices have a maximal device delivery system of 135 cm, whereas certain percutaneous transluminal angioplasty systems have a delivery system of up to 200 cm.

Self-expanding stents were selected for the reintervention, given their high, additive radial force. This force is necessary to overcome renal artery kinking resulting from aneurysmal sac thrombosis. Advancements in stent technology have closed the gap between self-expanding and balloon-expandable stents; however, self-expanding stents continue to be preferable for reinforcement of the renal artery after parallel stent graft complication. Balloon-expandable stents exhibit a plastic deformation curve and are susceptible to being crushed with further aneurysmal sac remodeling. Self-expanding stents have shape memory and are more kink resistant. We do not routinely use prophylactic reinforcement stents within parallel stent grafts. Reinforcement stents are placed only when completion angiography demonstrates suboptimal angulation or kinking of the parallel stent graft.

In this particular case, transradial access allowed adequate anterograde access, delivery of the AngioJet Ultra system, and stenting of the left renal artery with no access site complications.

CONCLUSIONS

This case demonstrates the feasibility of transradial renal artery thrombolysis and stenting after complex EVAR. This approach may be preferable, given the limited complication profile.

REFERENCES

1. United Kingdom EVAR Trial Investigators, Greenhalgh RM, Brown LC, Powell JT, Thompson SG, Epstein D, et al. Endovascular versus open repair of abdominal aortic aneurysm. N Engl J Med 2010;362:1863-71.
2. Sternbergh WC 3rd, Carter G, York JW, Yoselevitz M, Money SR. Aortic neck angulation predicts adverse outcome with endovascular abdominal aortic aneurysm repair. J Vasc Surg 2002;35:482-6.
3. Ullery BW, Chandra V, Dalman RL, Lee JT. Impact of renal artery angulation on procedure efficiency during fenestrated and snorkel/chimney endovascular aneurysm repair. J Endovasc Ther 2015;22:594-602.
4. Greenberg RK, Clair D, Srivastava S, Bhandari G, Turc A, Hampton J, et al. Should patients with challenging anatomy be offered endovascular aneurysm repair? J Vasc Surg 2003;38:990-6.
5. Donas KP, Lee JT, Lachat M, Torsello G, Veith FJ; PERICLES investigators. Collected world experience about the performance of the snorkel/chimney endovascular technique in the treatment of complex aortic pathologies: the PERICLES registry. Ann Surg 2015;262:546-53; discussion: 552-3.

6. Zeller T. Renal artery stenosis: epidemiology, clinical manifestation, and percutaneous endovascular therapy. J Interv Cardiol 2005;18:497-506.
7. Kiemeneij F, Laarman GJ. Percutaneous transradial artery approach for coronary stent implantation. Cathet Cardiovasc Diagn 1993;30:173-8.
8. Trani C, Tommasino A, Burzotta F. Transradial renal stenting: why and how. Catheter Cardiovasc Interv 2009;74:951-6.
9. Schiattarella GG, Magliulo F, Laurino FI, Bottino R, Bruno AG, De Paulis M, et al. Transradial approach for the endovascular treatment of type I endoleak after aortic aneurysm repair: a case report. BMC Surg 2013;13(Suppl 2):S47.
10. Stern JR, Ellozy SH. Transradial delivery of a renal snorkel during complex endovascular aortic aneurysm repair. Vasc Endovascular Surg 2017;51:513-6.
11. Cortese B, Rigattieri S, Aranzulla TC, Russo F, Latib A, Burzotta F, et al. Transradial versus transfemoral ancillary approach in complex structural, coronary, and peripheral interventions. Results from the multicenter ancillary registry: a study of the Italian Radial Club. Catheter Cardiovasc Interv 2018;91:97-102.
12. Pristipino C, Trani C, Nazzaro MS, Berni A, Patti G, Patrizi R, et al. Major improvement of percutaneous cardiovascular procedure outcomes with radial artery catheterisation: results from the PREVAIL study. Heart 2009;95:476-82.
13. Kanei Y, Kwan T, Nakra NC, Liou M, Huang Y, Vales LL, et al. Transradial cardiac catheterization: a review of access site complications. Catheter Cardiovasc Interv 2011;78:840-6.
14. Zhou YJ, Zhao YX, Cao Z, Fu XH, Nie B, Liu YY, et al. [Incidence and risk factors of acute radial artery occlusion following transradial percutaneous coronary intervention]. Zhonghua Yi Xue Za Zhi 2007;87:1531-4.
15. Gilchrist IC. Laissez-faire hemostasis and transradial injuries. Catheter Cardiovasc Interv 2009;73:473-4.
16. Valsecchi O, Vassileva A, Musumeci G, Rossini R, Tespili M, Guagliumi G, et al. Failure of transradial approach during coronary interventions: anatomic considerations. Catheter Cardiovasc Interv 2006;67:870-8.

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