Intraoperative rescue of a dislodged renal stent during fenestrated endovascular aortic repair for treatment of type 1A endoleak

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ABSTRACT

In the past 15 years, fenestrated-branched endovascular aortic repair (F-BEVAR) has progressively become the first-line option for management of most complex abdominal aortic aneurysms (AAAs); with increasing experience, as well as persistent technological refinements, F-BEVAR indications have been expanded to include rescue of failures after prior EVAR. Despite the feasibility and effectiveness, F-BEVAR procedures in the presence of prior infrarenal endografts may come with higher technical complexity that should be properly anticipated, and several anatomical challenges can be expected. Among these, presence of suprarenal bare stents from prior EVAR device are certainly a frequent scenario and may sometimes make target vessel cannulation more difficult because of encroachment on the target vessel origins. In this manuscript, we report a case intraoperative rescue of a dislodged renal stent during FEVAR for treatment of type 1 endoleak with the aim of showing the culprit of the complication, how to recognize it, and the off-label solution that was devised to solve it. (J Vasc Surg Cases Innov Tech 2025;11:101688.)

Keywords: Bridging stent; Complications; Endoleak; Fenestrated endovascular aortic repair

The failure of endovascular aortic repair (EVAR) for management of infrarenal abdominal aortic aneurysm (AAA) repair is not uncommon and may depend on both the original treatment modality as well as on disease progression. In the past, failure of proximal sealing leading to type 1A endoleak (T1aEL) and/or endograft migration could only be treated with open surgical conversion. Although this remains a feasible alternative when needed (eg, in case of endograft infection), open surgery after EVAR is technically demanding, owing to often reduced physiological status of patients, as well as to the additional technical challenges that are imposed by the presence of the prior endograft.

Several recent reports have highlighted highly satisfactory results when using fenestrated EVAR (FEVAR) in patients with failure of proximal sealing zones.[1,2] However, these procedures may be technically complex and lead to intraoperative adverse events that may hinder technical success as well as clinical outcomes.[3,4] In this manuscript, we report a case intraoperative rescue of a dislodged renal stent during FEVAR for treatment of T1EL with the aim of showing the culprit of the complication, how to recognize it, and the off-label solution that was devised to solve it. The patient provided written informed consent for publication of the case-report and related anonymized images.

CASE REPORT

A 82-year-old male with type 2 diabetes mellitus on insulin therapy, medically treated hyperlipidemia and hypertension, and moderate chronic kidney disease (estimated glomular filtration rate, 40 ml/min/1.73 m^2) had undergone EVAR with a Medtronic Endurant IIS stent graft at an outside institution in 2018, which was reported to be technically successful. After 3 years of uneventful follow-up, the patient was diagnosed on computed tomography angiography with a T1aEL without endograft migration (Fig 1), associated with sac increase to 68 mm, and wasreferred to our attention for evaluation of secondary repair.

The patient was physically active and fully autonomous and lived home with his wife. After discussion with the patient and his family, it was decided to proceed with a commercially manufactured custom-made four-fenestrated FEVAR. The device was planned to land proximally in the healthy para-visceral aorta with a 20% oversizing (as compared with the aortic diameter), whereas distally the device would land in the main body of the previous endograft, providing a 2-mm diameter interference (Fig 2).

On the day of the procedure, the patient underwent general orotracheal anesthesia, and bilateral percutaneous femoral access was gained. The FEVAR device was placed and partially deployed in the intended position, and the reno-visceral target vessels (TVs) were each selected and catheterized as per

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Fig 1. Computed tomography angiography showing a type 1a endoleak (*T1aEL*) without endograft migration after prior endovascular aortic repair (*EVAR*).

standard routine. After releasing the stent graft to its nominal diameter and post-ballooning the proximal and distal landing zones, we proceeded to sequential stenting of the TV starting with the lowest (right) renal artery. However, we were unable to advance a 6F introducer sheath past the fenestration, likely owing to encroachment from the bare metal stent of the prior EVAR device. Although we did not try to balloon the bare metal stent of the EVAR device (owing to concerns that this could potentially lead to dissection of the renal artery ostium), we attempted several maneuvers to try and advance a sheath. These included changing different sheaths as well as escalating from a softer guidewire to a stiffer guidewire. Therefore, we attempted to introduce a "bare" BeGraft 6 × 27 mm stent (Bentley Innomed GmBH, Germany) into the renal artery, with significant friction upon passing through the fenestration. At this point, it was noted that the stent had dislodged from the supporting ballon; therefore, upon inflation, this resulted in the opening of only the most proximal one-half of the stent, whereas the most distal portion remained closed (Fig 3). The balloon was deflated, and, while keeping the .035 Rosen wire (Cook Medical) in place, several attempts were made at passing a standard 4F angiographic catheter through the distal portion of the stent. At this point, we were able to gain access to the distal portion of the stent using a Navicross .035 catheter (Terumo Interventional Systems); subsequently, we exchanged for a .018 Advantage glidewire (Terumo Interventional Systems), over which we were able to navigate a non-compliant 6-mm Sterling balloon (Boston Scientific). By inflating the balloon, we were able to dilate the distal one-half of the stent and exchange for a .035 Rosen wire. We then successfully navigated a 6F introducer sheath past the previously placed stent with countertraction upon deflation of the balloon, and deployed a second BeGraft 6 × 27 mm stent with 1 cm overlap over the previous one (Fig 4). The most proximal portion of the first stent was eventually flared within the fenestration, as per standard routine (Fig 5). The remainder of the operation proceeded without additional issues, and final angiography showed successful resolution of the T1aEL with widely patent reno-visceral TV.

The patient spent one night in the intensive care unit before being admitted to the surgical ward and was discharged without sustaining any major adverse events on postoperative day 3 on dual antiplatelet therapy for 6 months, followed by lifelong single antiplatelet therapy.[5] The patient is currently alive, and computed tomography angiography at 36 months shows sustained clinical success with no signs of recurrent endoleaks and maintained patency of all bridging stents without any associated complications (Fig 6).

DISCUSSION

In the past 15 years, F-BEVAR has progressively become the first-line option for management of most complex AAAs, mainly owing to its reduced invasiveness, thereby extending potential treatment also to patients who would have otherwise been deemed unfit for open surgical repair.[6] With increasing experience, as well as persistent technological refinements, F-BEVAR indications have been expanded to include rescue of failures after prior EVAR,[7] thereby becoming a suitable alternative to secondary open surgical repair, which remains a major operation for the surgeon as well as for the patient.[8]

Despite the feasibility and effectiveness, F-BEVAR procedures in the presence of prior infrarenal endografts may come with higher technical complexity that should be properly anticipated, and several anatomical challenges can be expected. Among these, presence of suprarenal bare stents from prior EVAR devices are

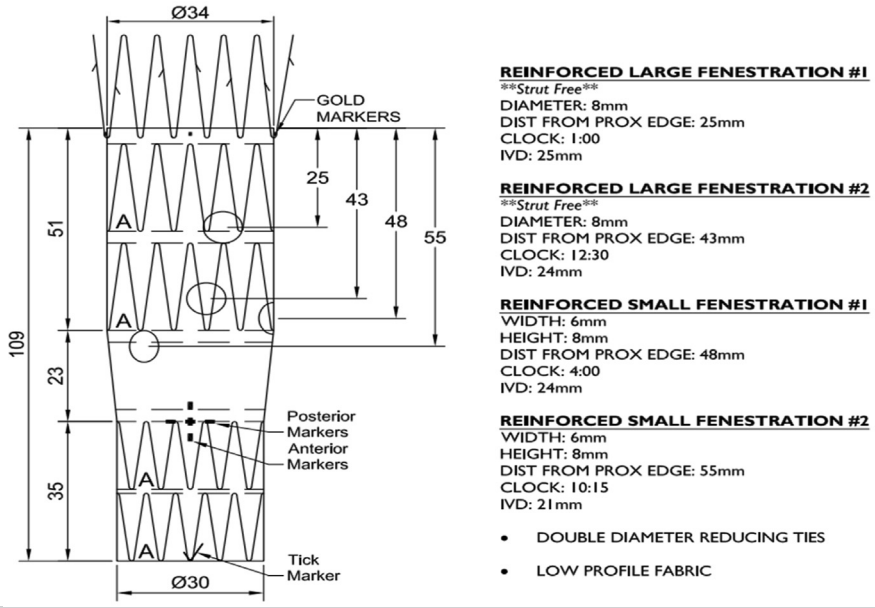

Fig 2. Technical drawing of the four-fenestrated custom-made device ("fenestrated cuff") that was designed to treat the type 1a endoleak (*T1aEL*).

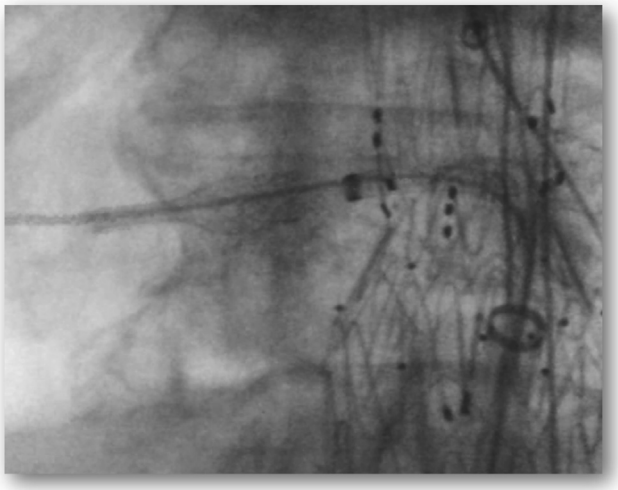

Fig 3. Dislocation of the stent from the supporting balloon, resulting in the opening of only the most proximal one-half of the stent, while the most distal portion remained closed.

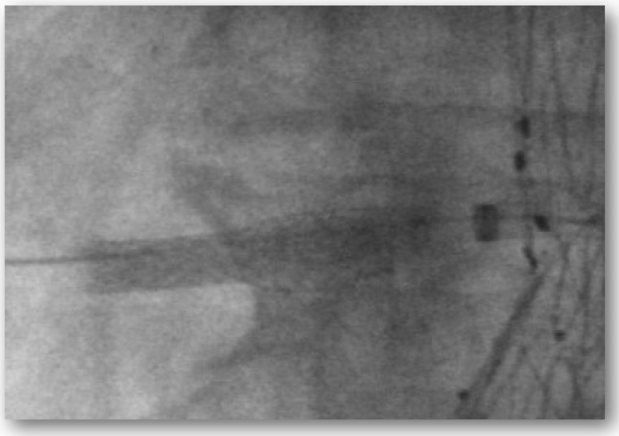

Fig 4. After rescuing the distal one-half of the closed stent with .018 wire and balloon, a second stent was deployed with 1-cm overlap with the previous one.

certainly a frequent scenario and may sometimes make TV cannulation more difficult because of encroachment on the TV origins. In such cases, one may try to advance a bridging stent graft in a "bare" configuration (ie, without the support of an introducer sheath) although this maneuver (which remains outside the recommended instructions for use) may lead to stent dislocation as in the presented case.

In our experience, we use the Bentley BeGraft as first-line for FEVAR procedures because it offers the main

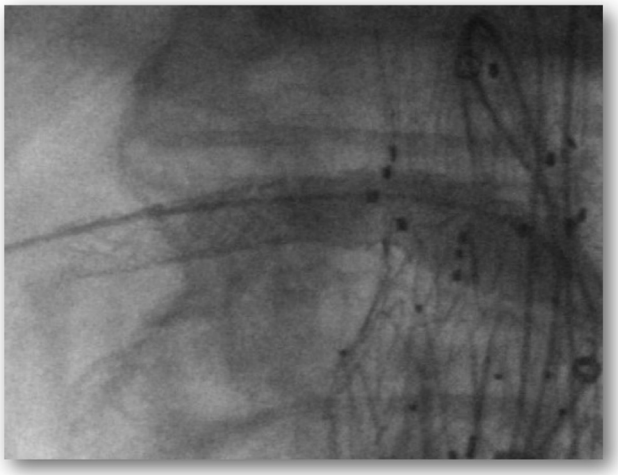

Fig 5. Final flaring of the proximal stent within the fenestration and aortic lumen.

advantages of lower profiles available (6F for most stent diameters may indeed represent a significant technical benefit). Recent studies have indeed proven satisfactory mid-term results with this device in FEVAR interventions, with no instances of fractures up to 2 years of follow-up, despite the low-profile fabric.[9] However, in cases of significant friction with the vessel wall, the stent may be dislodged from the supporting balloon, and particular caution must therefore be taken to always visualize the stent and the balloon during the procedure.

In this report, we were able to successfully rescue a potentially serious intraoperative complication (that may otherwise have resulted in loss of the renal artery or need for laparotomy and retrograde stenting) by leveraging tools and techniques from peripheral interventions. In our opinion, this case shows that, although a dedicated learning curve is required for reducing complication rates and achieving excellent results with complex EVAR interventions,[10-12] endovascular operators should also be able to leverage a wide range of interventional skills and devices from other fields to be able to manage unexpected intraoperative occurrences.

Fig 6. Follow-up computed tomography angiography at 36 months shows sustained clinical success with no signs of recurrent endoleaks and maintained patency of all bridging stents without any associated complications.

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REFERENCES
1. D'Oria M, Budtz-Lilly J, Lindstrom D, et al. Comparison of early and mid-term outcomes after fenestrated-branched endovascular aortic repair in patients with or without prior infrarenal repair. *J Endovasc Ther.* 2022;29:544–554.

2. Budtz-Lilly J, D'Oria M, Gallitto E, et al. EUropean multicentric experience with Fenestrated-Branched ENDOvascular stent-grafting after previous FAILed infrarenal aortic repair: the EU-FBENDO-FAIL registry. *Ann Surg*. 2023;278:e389–e395.
3. Tenorio ER, Balachandran PW, Marcondes GB, et al. Incidence, predictive factors, and outcomes of intraprocedure adverse events during fenestrated-branched endovascular aortic repair of complex abdominal and thoracoabdominal aortic aneurysms. *J Vasc Surg*. 2022;75:783–793.e4.
4. Sulzer T, Tenorio ER, Mesnard T, et al. Intraoperative complications during standard and complex endovascular aortic repair. *Semin Vasc Surg*. 2023;36:189–201.
5. D'Oria M, Bertoglio L, Bignamini AA, et al. PRINciples of optimal antithrombotiC therapy and coagulation managEment during elective fenestrated and branched EndovaScular aortic repairS (PRINCE^{2}SS): an international expert-based Delphi consensus study. *Eur J Vasc Endovasc Surg*. 2022;63:838–850.
6. Wanhainen A, Van Herzeele I, Bastos Goncalves F, et al. European society for vascular surgery (ESVS) 2024 clinical practice guidelines on the management of abdominal aorto-iliac artery aneurysms. *Eur J Vasc Endovasc Surg*. 2024;67:192–331.
7. Nana P, Spanos K, Apostolidis G, Haulon S, Kolbel T. Systematic review and meta-analysis of fenestrated or branched devices after previous open surgical aortic aneurysm repair. *J Vasc Surg*. 2024;79:1251–1261.
8. Xodo A, D'Oria M, Squizzato F, et al. Early and mid-term outcomes following open surgical conversion after failed endovascular aneurysm repair from the "Italian North-easT RegIstry of surgical Conversion AfTer Evar" (INTRICATE). *J Vasc Surg*. 2022;75:153–161.
9. D'Oria M, Mezzetto L, Silingardi R, et al. Two-year outcomes with Bentley BeGraft as bridging stent-grafts for reno-visceral target vessels during fenestrated endovascular aortic repair. *J Endovasc Ther*. 2023;15266028231175621.
10. Mirza AK, Tenorio ER, Karkkainen JM, et al. Learning curve of fenestrated and branched endovascular aortic repair for pararenal and thoracoabdominal aneurysms. *J Vasc Surg*. 2020;72:423–434.
11. Hawkins A, Jin R, Clouse WD, Tracci M, Weaver ML, Farivar BS. Center-level outcomes following elective fenestrated endovascular aortic aneurysm repair in the Vascular Quality Initiative database. *J Vasc Surg*. 2024;80:311–322.
12. Tenorio ER, Mirza AK, Karkkainen JM, Oderich GS. J Lessons learned and learning curve of fenestrated and branched endografts. *J Cardiovasc Surg*. 2019;60:23–34.

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