Endovascular Management of Endograft Migration and Aneurysm Rupture

Why a percutaneous approach with redo endografting should be considered for patients with distal endograft migration and acute abdominal aortic aneurysm rupture.

BY ZVONIMIR KRAJCER, MD, FACC

Distal endograft migration and type I endoleak are serious complications of endovascular aneurysm repair (EVAR) that can significantly increase the incidence of a ruptured abdominal aortic aneurysm (RAAA).[1-3] RAAA is a surgical emergency that is associated with high mortality and morbidity rates. The overall operative mortality rate for patients with RAAAs after open repair has been reported in meta-analysis to be up to 48%.[4,5]

Since the first successful EVAR of an RAAA by the Nottingham group in 1994, several other investigators have reported lower mortality and morbidity rates with this technique than with open repair.[4,5] Endograft rescue and EVAR of RAAAs are feasible procedures when proper preprocedural planning and innovative techniques are used.

PRESENTATION

In 2006, a 61-year-old man was sent via air ambulance from another hospital to our institution. Three years before this admission, the patient underwent successful EVAR in our center. His past medical history was pertinent, including a heart transplant 5 years earlier.

A physical examination upon arrival revealed an acutely ill man complaining of severe abdominal and back pain with a blood pressure of 98/60 mm Hg and a heart rate of 110 beats per minute. His abdomen was grossly distended and tender to palpation with a pulsatile abdominal aorta. Also, his bowel sounds were normal on auscultation. Laboratory tests revealed a hemoglobin level of 8.2 g, a white blood cell count of 10,000, and a serum creatinine level of 1.7 mg/dL. The noncontrast computed tomography (CT) of the abdomen and pelvis revealed an RAAA with a large retroperitoneal hematoma.

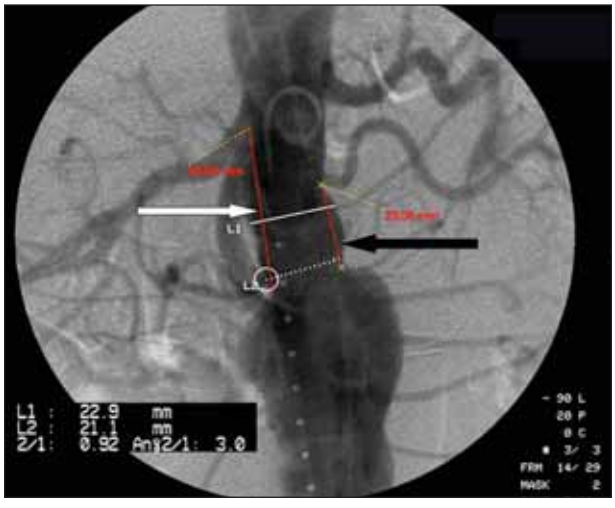

Figure 1. The abdominal aortic angiogram reveals a 46-mm-long infrarenal neck (white arrow). The distance from the left lower pole renal artery to the AAA was 23 mm (black arrow).

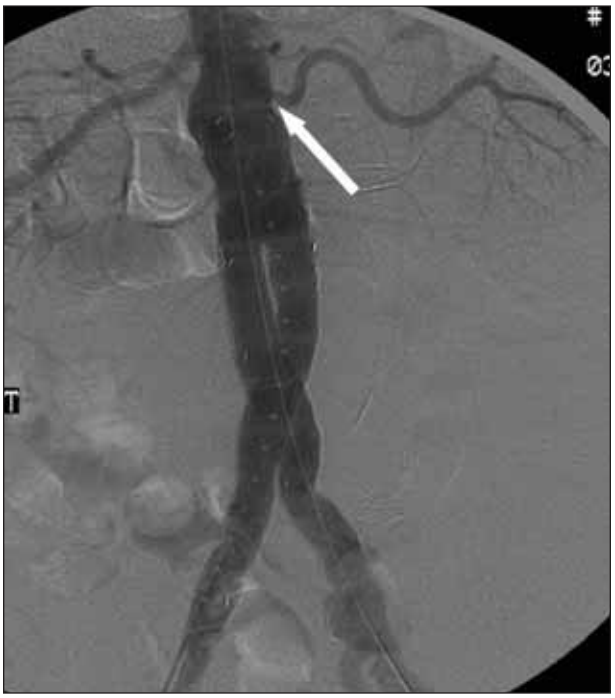

Figure 2. The abdominal aortic angiogram after the Excluder stent graft (W. L. Gore & Associates, Flagstaff, AZ) was deployed just below the accessory left renal artery (white arrow). There is no evidence of endoleak.

ORIGINAL PROCEDURE

The CT measurements before the original EVAR revealed an infrarenal aortic neck diameter of 25 mm, a neck length of 40 mm, and a maximal abdominal aortic aneurysm (AAA) diameter of 61 mm. There was no evidence of thrombus or circumferential calcification of the infrarenal aortic neck. An abdominal angiogram revealed the presence of dual left renal arteries, with the left lower pole artery supplying approximately 40% of the renal parenchyma. The left lower pole renal artery originated approximately 2 cm above the AAA (Figure 1).

Because the patient had impaired renal function, we decided to preserve the left lower pole renal artery (the 28.5-mm bifurcated Excluder stent graft was positioned just below it). In order to expand the stent graft, balloon angioplasty of the infrarenal segment of the device was performed with a 32- X 20-mm Coda balloon catheter (Cook Medical, Bloomington, IN). The postprocedural abdominal aortogram revealed satisfactory results without any evidence of endoleak (Figure 2). The patient had an uneventful recovery and was discharged from the hospital the next day. Despite several notifications, the patient never returned for routine follow-up.

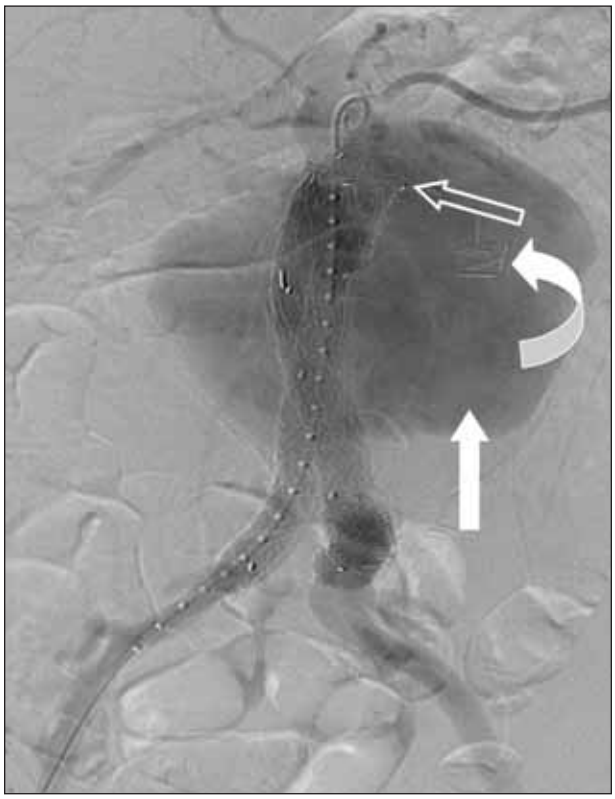

Figure 3. An abdominal aortogram revealing distal migration of the stent graft (open white arrow), RAAA (closed white arrow), and metallic clips from a previous procedure unrelated to AAA surgery (curved white arrow).

MANAGEMENT OF DISTAL ENDOGRAFT MIGRATION AND RAAA

The patient was transferred from our emergency department to the endovascular suite with the diagnosis of an acute RAAA 3 years after his original EVAR procedure. His CT angiograms and the abdominal angiogram from the original EVAR procedure were reviewed for possible causes of endograft migration and RAAA. No apparent cause for endograft migration was identified. Because of his severe comorbid conditions, we decided to perform the abdominal angiogram, and if possible, we would perform EVAR with the use of local anesthesia and a percutaneous femoral artery approach. The abdominal aortic angiogram with a marker pigtail catheter (with 1-cm markers) (Cook Medical) revealed distal migration of the Excluder stent graft into the AAA. It also showed a type I endoleak and an RAAA (Figure 3). The distance from the main left renal artery to the septation of the endograft was measured at 70 mm. The left lower pole renal artery was thought to be too close to the AAA to avoid type II endoleak, which in the setting of RAAA would have devastating conse-

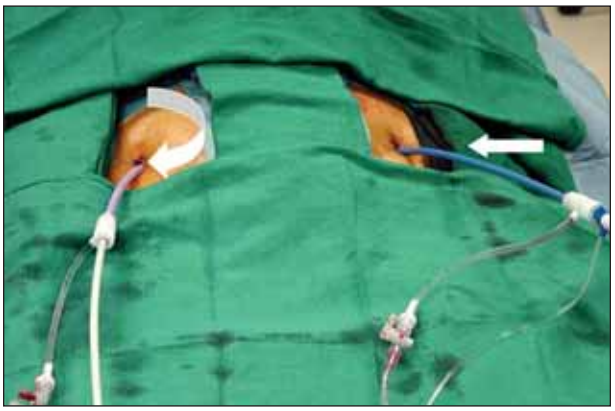

Figure 4. An image of the percutaneous right femoral artery approach with an 18-F sheath (Cook Medical) (white curved arrow) and a 12-F sheath (Cook Medical) (straight white arrow).

quences. Occlusion of this branch was then performed with three Tornado endovascular coils (Cook Medical) (each measuring 3 mm in diameter and 3 cm in length) through a 5-F C1 diagnostic catheter (Boston Scientific Corporation, Natick, MA).

The patient underwent a redo EVAR with an Excluder stent graft that was 140 mm long, 28.5 mm in aortic diameter, and 14.5 mm in right iliac diameter. This device was delivered via the right femoral artery with a percutaneous approach through an 18-F sheath, advanced through the existing stent graft, and deployed just below the origin of the more cranial left renal artery and above the left lower pole renal artery. The left iliac limb measured 14.5 mm in distal diameter and 100 mm in length and was delivered through a 12-F sheath with a percutaneous approach via the left femoral artery (Figure 4). Balloon angioplasty of the endograft was performed with a 25- X 20-mm Impact balloon catheter (B. Braun Interventional Systems Inc., Bethlehem, PA) and a 14- X 40-mm XXL balloon catheter (Boston Scientific Corporation). The abdominal aortogram revealed satisfactory results and no evidence of endoleak (Figure 5).

Bilateral common femoral artery repair was achieved percutaneously with the use of a 10-F Prostar XL device (Abbott Vascular, Santa Clara, CA) and the previously described "preclose technique" (Figure 6).[6] At the end of the procedure, the patient received a blood transfusion of 2 U of packed red blood cells to treat anemia. His postprocedural course was uncomplicated. The patient's serum creatinine level the following day was 1.7 mg/dL, and his hemoglobin was 10.4 g. He was discharged from the hospital 48 hours after the procedure. The patient continues to do well, and his CT scan after 1 year of follow-up revealed no evidence of endoleak or any other complications.

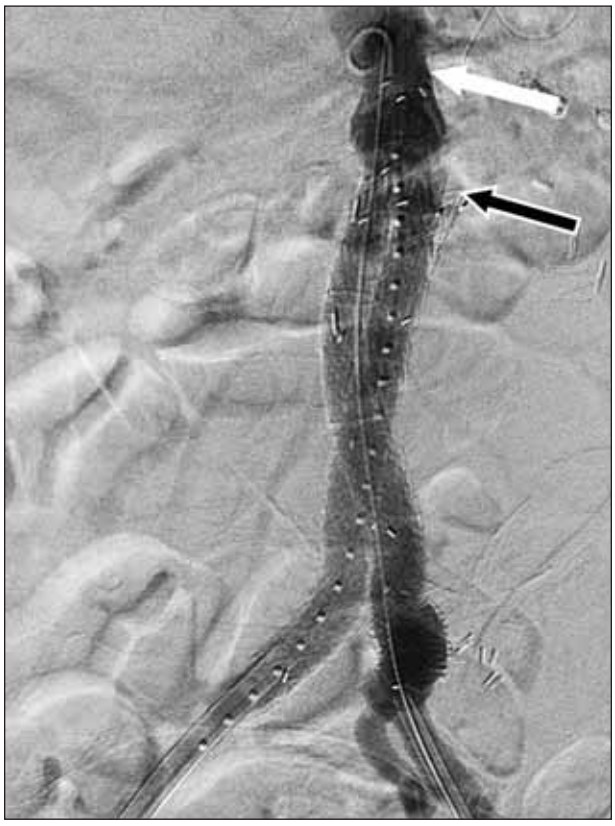

Figure 5. An abdominal aortogram after deployment of a new stent graft (white arrow) within the migrated endograft (black arrow) reveals a satisfactory result and resolution of the endoleak.

DISCUSSION

The EUROSTAR registry collaborators have reported that angulated and short infrarenal necks, large neck diameters, and neck thrombus are some of the most common predictors of endograft failure, resulting in type I endoleak and stent graft migration.[2,7] The incidence of endograft migration has been reported to be between 9% and 45%.[2,7-9] The cause and nature of the endograft migration with subsequent type I endoleak is not exactly clear in our patient. The CT measurements before the original procedure revealed 2 cm of infrarenal neck below the left accessory renal artery, which should have been sufficient to achieve a reliable and permanent seal. However, without surveillance, it is difficult to know the exact mechanism of failure in this case. It is possible that the aneurysm neck degenerated and that this is not truly a case of a device-related endograft migration.

The Excluder endograft has seven double anchors in the proximal segment that are designed to prevent distal migration. In the Excluder pivotal trial, there was no

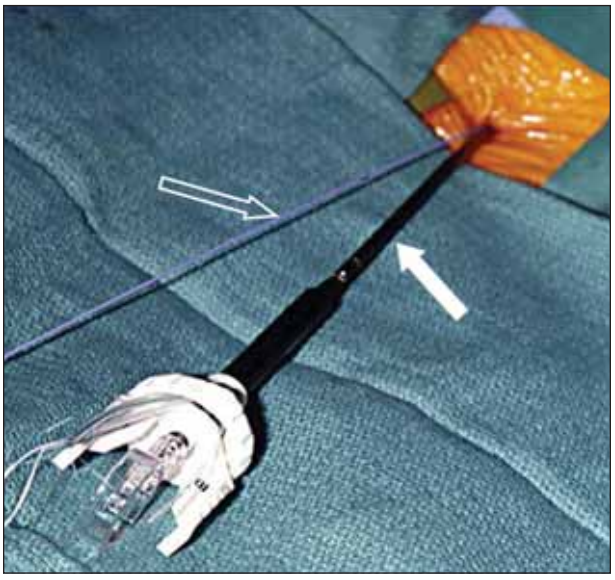

Figure 6. The 10-F Prostar XL device (closed white arrow) and a 0.035-inch Amplatz Super Stiff guidewire (Boston Scientific Corporation) (open white arrow) that was used for percutaneous repair of the left and right femoral arteries.

evidence of distal migration and type I endoleak. The manufacturer of this device recommends routinely performing balloon angioplasty of the proximal segment of the endograft to embed the anchors in the aortic neck; this was done in our patient. The manufacturer also cautions that in patients with circumferential aortic neck calcifications, the anchors might not be able to adequately penetrate the aortic tissue, which could result in distal endograft migration. However, we did not see any evidence of severe aortic neck calcification in our patient.

Another possibility is that the infrarenal aortic neck tissue was of suboptimal quality and could not hold the endograft in place. Because the Excluder is not a fully supported device and depends solely on proximal anchors to hold it in place, it is possible that a suboptimal attachment of the anchors caused endograft migration in our patient. The breakage of the aortic tissue or endograft anchors could have resulted in distal endograft migration and type I endoleak. However, it should be emphasized that in the absence of follow-up evaluations, it is not possible to determine the mechanism or nature of the procedural failure in the original case presented. Undetected and untreated distal endograft migration and type I endoleak invariably leads to AAA enlargement and eventual rupture. Therefore, it is mandatory for all patients after EVAR to undergo routine surveillance studies, which was not done in our patient due to his lack of compliance to the follow-up protocol.

An RAAA is a surgical emergency that carries significant mortality and morbidity.[4,5] We elected to perform percutaneous EVAR in our patient due to his comorbid conditions and favorable anatomical findings, which helped us achieve this goal. It is important to mention that it is necessary to have at least a 7-cm distance from the lowest renal artery to the original endograft septation to be able to fully open the contralateral limb. If this distance is shorter, one could convert the endograft using the Excluder to aortomonoiliac configuration by deploying the contralateral limb in the ipsilateral side. Another option is to use other commercially available endografts that offer aortomonoiliac configuration and then perform a femorofemoral bypass to provide blood flow to the contralateral leg.

CONCLUSION

The key factors that influence EVAR success are preprocedural planning, operator experience, the technique employed, and the type and the generation of the endograft.[1,2,7-9] In order to prevent serious complications and RAAA after EVAR, regular follow-up of patients with complex infrarenal neck anatomy is essential. Percutaneous EVAR should be considered whenever possible to avoid consequences and delay of general anesthesia for RAAA. However, further improvements in endograft attachment are needed to simplify and improve the results of EVAR. ■

Zvonimir Krajcer, MD, FACC, is Codirector of Peripheral Vascular Intervention with St. Luke's Episcopal Hospital and the Texas Heart Institute in Houston, Texas. He has disclosed that he holds no financial interest in any product or manufacturer mentioned herein. Dr. Krajcer may be reached at (713) 790-9401; zvonkomd@aol.com.

1. Terramani TT, Chaikof EL, Rayan SS, et al. Secondary conversion due to failed endovascular abdominal aortic aneurysm repair. J Vasc Surg. 2003;38:473-477; discussion 477-478.
2. Leurs LJ, Kievit J, Dagnelie PC, et al. Influence of infrarenal neck length on outcome of endovascular abdominal aortic aneurysm repair. J Endovasc Ther. 2006;13:640-648.
3. Resch T, Ivancev K, Brunkwall J, et al. Distal migration of stent-grafts after endovascular repair of abdominal aortic aneurysms. J Vasc Interv Radiol. 1999;10:257-264; discussion 265-256.
4. Yusuf SW, Whitaker SC, Chuter TA, et al. Emergency endovascular repair of leaking aortic aneurysm. Lancet 1994;344:1645.
5. Bown MJ, Sutton AJ, Bell PR, et al. A meta-analysis of 50 years of ruptured abdominal aortic aneurysm repair. Br J Surg 2002;89:714-730.
6. Krajcer Z, Strickman N, Mortazavi A. AAA repair using local anesthesia and conscious sedation. Endovascular Today. 2004;7:48-54.
7. Harris PL, Vallabhaneni SR, Desgranges P, et al. Incidence and risk factors of late rupture, conversion, and death after endovascular repair of infrarenal aortic aneurysms: the EUROSTAR experience. European collaborators on stent/graft techniques for aortic aneurysm repair. J Vasc Surg. 2000;32:739-749.
8. Albertini J, Kalliafas S, Travis S, et al. Anatomical risk factors for proximal perigraft endoleak and graft migration following endovascular repair of abdominal aortic aneurysms. Eur J Vasc Endovasc Surg. 2000;19:308-312.
9. Fulton JJ, Farber MA, Sanchez LA, et al. Effect of challenging neck anatomy on mid-term migration rates in AneuRx endografts. J Vasc Surg. 2006;44:932-937; discussion 937.