Endovascular repair of thoracic aortic pseudoaneurysms and patch aneurysms

Simon Schwill,[a,b] Scott A. LeMaire, MD,[a,b] Susan Y. Green, MPH,[a,b] Faisal G. Bakaeen, MD,[a,b,c] and **Joseph S. Coselli, MD,[a,b]** *Houston, Tex*

Pseudoaneurysms and patch aneurysms are life-threatening late complications after thoracoabdominal aortic aneurysm (TAAA) repair. We treated four patients who presented with a pseudoaneurysm or patch aneurysm involving the descending thoracic portion of a previously implanted TAAA graft. In each patient, stent grafts were placed within the existing graft to cover the aneurysm endoluminally. All patients recovered without major complications, and computed tomography performed after a mean follow-up of 51.5 ± 19.7 months showed that the repairs remained intact. (J Vasc Surg 2010;52:1034-7.)

Thoracic anastomotic pseudoaneurysm and patch aneurysm are life-threatening complications of aortic replacement surgery that may take years to manifest. Anastomotic pseudoaneurysms usually result from tension on suture lines. Patch aneurysms form when residual native aortic tissue dilates where branch arteries have been anastomosed to the prosthetic graft. Because their aortic tissue is unusually fragile, patients with Marfan syndrome (MFS) are at particularly high risk of anastomotic pseudoaneurysms and patch aneurysms.

Although open surgical repair is the traditional treatment for these lesions, such repairs carry substantial mortality and morbidity risks[1-3]; endovascular repairs may be a safer approach. Herein, we report our experience with four patients who underwent endovascular treatment of anastomotic pseudoaneurysms or patch graft aneurysms.

From the Texas Heart Institute at St. Luke's Episcopal Hospital,[a] Division of Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine,[b] and Michael E. DeBakey Veterans Affairs Medical Center.[c]

Competition of interest: Dr Coselli is the Principal Investigator for several thoracic aortic stent graft trials (Cook, Inc, Medtronic, Inc, and W.L. Gore and Associates). Dr Coselli participated as a lecturer at a symposium hosted by W.L. Gore and Associates. Dr Coselli received an educational grant from Vascutek Terumo, served as a consultant for them, and receives royalties for the Coselli Branched Graft for open surgical thoracoabdominal aortic repair.

Reprint requests: Scott A. LeMaire, MD, Division of Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, BCM 390, One Baylor Plaza, Houston, TX 77030 (e-mail: slemaire@bcm.edu).

The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a competition of interest.

0741-5214/$36.00

doi:10.1016/j.jvs.2010.04.078

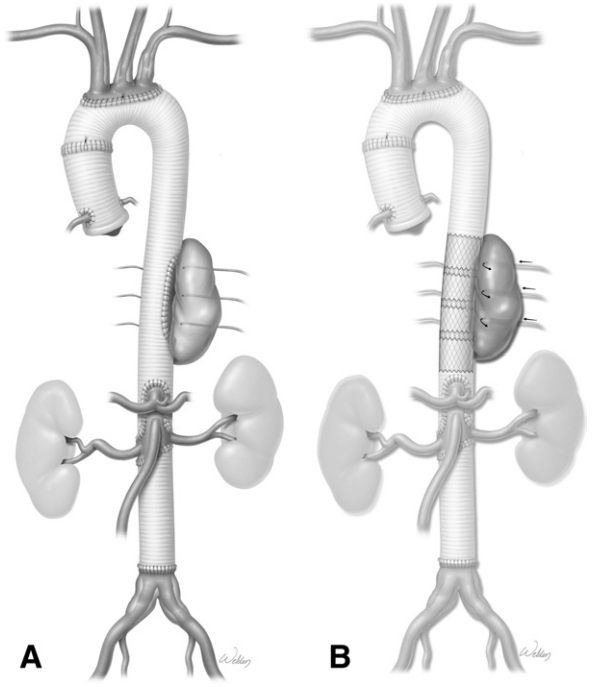

Fig 1. A, A ruptured pseudoaneurysm at the previous site of intercostal artery reattachment. Arteries T8 through T10 were patent. **B,** An endovascular repair performed with four Medtronic AneuRx aortic extender cuff stent grafts.

CASE REPORTS

Patient 1. A 55-year-old man with a history of MFS, chronic obstructive pulmonary disease, and chronic aortic dissection presented with worsening back pain. Previous operations included aortic root replacement with a composite valve graft, extent II thoracoabdominal aortic aneurysm (TAAA) repair by the reverse elephant trunk technique, and total aortic arch replacement.

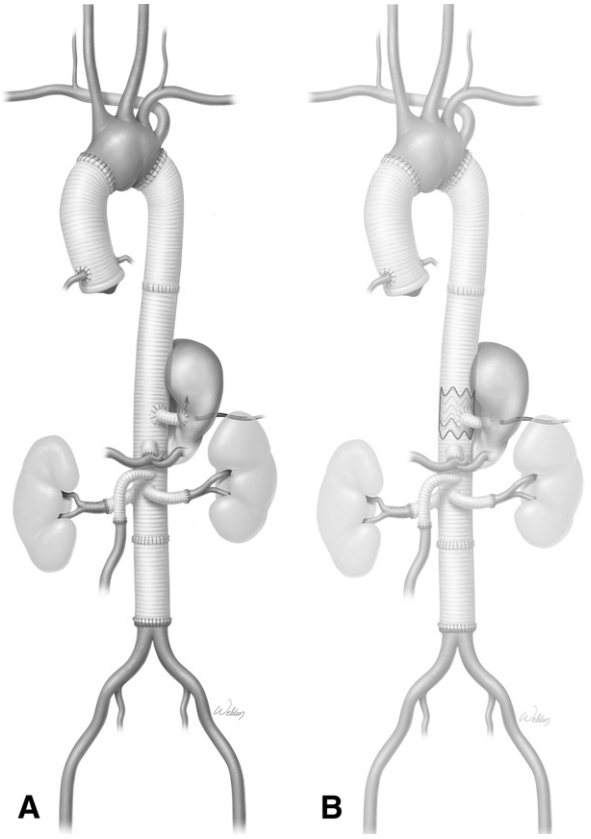

Fig 2. A, A pseudoaneurysm at the previous site of intercostal artery reattachment. Artery T11 was not patent. **B,** An endovascular repair performed with two Gore Excluder aortic extender cuff stent grafts.

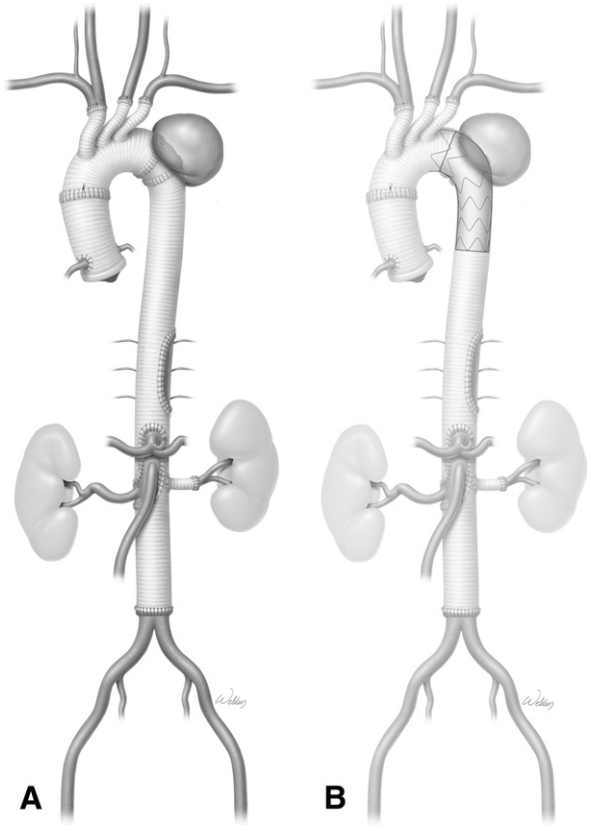

Fig 3. A, A pseudoaneurysm at a graft-to-graft anastomosis in the proximal descending thoracic aorta. **B,** An endovascular repair performed with one Talent stent graft.

Computed tomography (CT) showed a ruptured pseudoaneurysm originating from a leak at the intercostal patch anastomosis (T8-T10) with retroperitoneal bleeding (Fig 1). There was also evidence of an old hemorrhage around the graft. Because all three intercostal arteries (T8-T10) were patent, there was an increased risk of paraplegia; therefore, the patient received adequate analgesia, and a balloon occluder was inflated in the most proximal section of the descending thoracic aorta for 8 minutes. During this period, the patient was awake and could move his legs without difficulty. After the test procedure, the patient received general endotracheal anesthesia, and a cerebrospinal fluid (CSF) drain was placed.

Four 28 × 40-mm AneuRx aortic extender cuff stent grafts (Medtronic, Minneapolis, Minn) were placed within the existing 22-mm polyester descending thoracic aortic graft. The stent grafts were used to extend the overall repair down to just above the celiac axis. Completion aortography revealed a minimal type II endoleak, which was left untreated but kept under observation. The patient recovered without complication and was discharged 7 days after the procedure. Eleven months later, CT showed that the endoleak had resolved. Throughout 56 months of follow-up surveillance, there was no evidence of stent migration or recurrent endoleak.

Patient 2. A 56-year-old man with MFS presented with a large pseudoaneurysm. Comorbidities included congestive heart failure, cardiomyopathy, hepatitis C, and chronic lymphocytic leukemia. Previous operations included aortic root replacement with a composite valve graft, hemiarch replacement, and extent II TAAA repair. Two years before the index admission, the patient underwent reoperation to repair thoracoabdominal patch aneurysms involving the intercostal and visceral reattachment sites; bypasses were performed to the celiac, superior mesenteric, renal, and T11 arteries.

A CT scan showed a 10-cm pseudoaneurysm at the previous intercostal reattachment site (T11 not patent) (Fig 2). Under general anesthesia, an endovascular repair was performed with 2 Gore Excluder aortic extender cuff stent grafts (Gore Medical, Flagstaff, Ariz) placed in the existing 24-mm descending thoracic aortic graft. A 28 × 15-mm secondary stent cuff was deployed toward the distal third of the primary 28 × 37.5-mm stent cuff. Completion angiography showed no evidence of type I endoleak and complete exclusion of the pseudoaneurysm. Forty-one months later, CT revealed no evidence of stent migration or endoleak.

Patient 3. An asymptomatic 39-year-old man with MFS was found to have a pseudoaneurysm at a graft-to-graft anastomosis in the proximal descending thoracic aorta (Fig 3). His surgical history included composite valve graft replacement of the aortic root, transverse aortic arch replacement, extent II TAAA repair, and repair of a recurrent aortic arch aneurysm with bypasses of the brachiocephalic arteries.

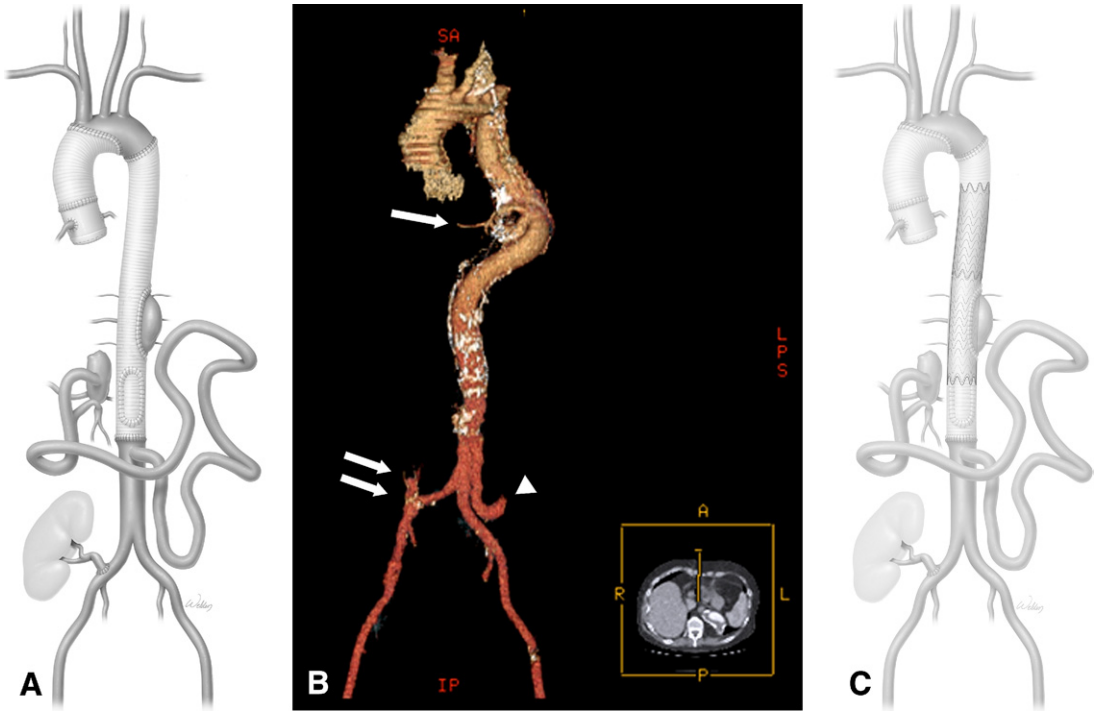

Fig 4. A, A patch aneurysm at the site of a previous intercostal artery reattachment. **B,** Preoperative computed tomographic reconstruction showing a patent intercostal artery (*arrow*) arising from the patch aneurysm, the artery supplying the transplanted kidney (*double arrow*), and the large inferior mesenteric artery (*arrowhead*). **C,** An endovascular repair performed with two GORE TAG stent grafts.

A CT scan showed an 8-cm pseudoaneurysm at the anastomosis between the aortic arch graft and the descending thoracic aortic graft. Under general anesthesia, endovascular repair was accomplished with a 40/42 × 120-mm Talent stent graft (Medtronic). Because of the tortuosity of the thoracoabdominal aortic graft, an Amplatz super-stiff guidewire (Cook Medical, Inc, Bloomington, Ind) was introduced through the right brachial artery, snared, and brought out through the right common femoral artery; the device was then delivered over this wire via a femoral approach. Completion aortography showed no endoleak and patent arch vessels. The patient recovered without complications and was discharged 19 days after the procedure. Follow-up CT performed 77 months later revealed angulation and mild stenosis within the distal aspect of the stent graft. However, no endoleak or other complication was identified, and the patient was asymptomatic.

Patient 4. A 52-year-old man with MFS presented with a patch aneurysm at the site of a previous intercostal reattachment (Fig 4). Comorbidities included left ventricular hypertrophy, left vocal cord paralysis, and chronic renal failure. Previous operations included extent II TAAA repair, kidney transplantation, thoracoabdominal aortic reoperation to repair a visceral patch aneurysm, aortic root replacement with a stentless porcine root bioprosthesis, and graft replacement of the ascending aorta and proximal hemiarch. The patient's entire gastrointestinal circulation was fed through a complex network of collaterals arising from the inferior mesenteric artery.

Computed tomography showed an ectatic aortic graft with a 55-mm patch aneurysm at the T9-11 intercostal reattachment site. The repair was performed under general anesthesia and with CSF drainage. A 31-mm × 15-cm GORE TAG stent graft was placed in the existing graft via the left femoral artery. Although the stent graft covered the patch aneurysm, mild dilatation of the proximal portion of the thoracoabdominal graft raised concern about the proximal seal. Therefore, a 34-mm × 15-cm GORE TAG stent graft was deployed to ensure that an adequate proximal seal was achieved. The completion aortogram showed no endoleak. The patient recovered without complications and was discharged 4 days after the procedure. Thirty-two months later, CT revealed no evidence of endoleak or stent migration.

DISCUSSION

Anastomotic pseudoaneurysms after open aortic replacement surgery are not uncommon, particularly in MFS patients, and are associated with high mortality and morbidity rates.[4-6] Therefore, during initial procedures, it is important to minimize the amount of residual aortic tissue and eliminate anastomotic tension. In addition to causing patch aneurysm formation, dilation of residual aortic tissue leads to pseudoaneurysm formation by exacerbating anastomotic tension. We avoid using the patch technique in MFS patients. Instead, we anastomose separate branch grafts (often a prefabricated multibranched graft) to the individual visceral ostia.[7]

Before the endovascular era, thoracic aortic pseudoaneurysms and patch aneurysms were treated with open re-

pairs with considerable associated morbidity and mortality. All four of our patients presented with severe comorbidities and were considered high-risk candidates for conventional surgical reoperation. Additionally, each patient had undergone multiple previous operations, and no patient had evidence of graft infection. We deemed endovascular repair a particularly attractive approach because, in each case, it appeared possible to place both the proximal and distal ends of the stent graft within the existing graft without covering the visceral branches. The durability of this approach is supported by imaging results obtained after a mean follow-up of 51.5 ± 19.7 months. We conclude that endovascular repair appears to be well suited for treating selected patch aneurysms or pseudoaneurysms.

The authors thank Scott A. Weldon, MA, CMI, for creating illustrations of these complex aortic repairs; Stephen N. Palmer, PhD, ELS, and Rebecca A. Bartow, PhD, of the Texas Heart Institute, for editorial assistance; and Jennifer Parenti, RN, Charlie Cheng, MD, and Karen Amerman, MSN, for assistance in record review and follow-up.

REFERENCES

1. Coselli JS, LeMaire SA, Conklin LD, Koksoy C, Schmittling ZC. Morbidity and mortality after extent II thoracoabdominal aortic aneurysm repair. Ann Thorac Surg 2002;73:1107-16.
2. Villavicencio MA, Orszulak TA, Sundt TM III, Daly RC, Dearani JA, McGregor CG, et al. Thoracic aorta false aneurysm: what surgical strategy should be recommended? Ann Thorac Surg 2006;82:81-9.
3. Tshomba Y, Bertoglio L, Marone EM, Melissano G, Chiesa R. Visceral aortic patch aneurysm after thoracoabdominal aortic repair: conventional vs hybrid treatment. J Vasc Surg 2008;48:1083-91.
4. Carrel T, Beyeler L, Schnyder A, Zurmuhle P, Berdat P, Schmidli J, et al. Reoperations and late adverse outcome in Marfan patients following cardiovascular surgery. Eur J Cardiothorac Surg 2004;25:671-5.
5. Dardik A, Krosnick T, Perler BA, Roseborough GS, Williams GM. Durability of thoracoabdominal aortic aneurysm repair in patients with connective tissue disorders. J Vasc Surg 2002;36:696-703.
6. Gott VL, Cameron DE, Alejo DE, Greene PS, Shake JG, Caparrelli DJ, et al. Aortic root replacement in 271 Marfan patients: a 24-year experience. Ann Thorac Surg 2002;73:438-43.
7. LeMaire SA, Carter SA, Volguina IV, Laux AT, Milewicz DM, Borsato GW, et al. Spectrum of aortic operations in 300 patients with confirmed or suspected Marfan syndrome. Ann Thorac Surg 2006;81:2063-78.

Submitted Mar 8, 2010; accepted Apr 29, 2010.