Late thrombosis of a thoracic aorta stent graft:
Therapeutic management

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The case of a 17-year-old adolescent boy with severe polytrauma is reported. Among other injuries, he presented with aortic rupture distal to the origin of the subclavian artery with no bleeding into the mediastinum. The lesion was repaired by placement of a Cook TX2 endovascular graft (Cook Incorporated, Bloomington, Ind). One year later, he was hospitalized with acute heart failure. Computed tomography angiography showed nearly complete stent graft occlusion and no evidence of altered integrity of the device. A right axillofemoral bypass was performed, allowing conversion to successful definitive repair consisting of an extra-anatomic bypass from the ascending aorta to the supraceliac abdominal aorta. (J Vasc Surg 2009;49:774–7.)

Endovascular repair of traumatic thoracic aortic rupture is associated with lower morbidity and mortality than open surgery, a fact that has led to increasingly greater use of this technique. Nonetheless, it is not exempt from serious complications, such as stent collapse, which have been related to anatomic variables characteristic of the young subjects in whom this condition often occurs. This study describes a previously unreported complication of this treatment: late, nearly complete stent occlusion. Treatment for this complication by conversion to open surgery is described.

CASE REPORT

A 17-year-old adolescent boy was admitted to our hospital in June 2005 with severe polytrauma sustained in a high-speed motorcycle accident. In keeping with the protocol established in our hospital for major trauma, conventional radiographs of the chest, pelvis, and cervical spine were performed, as well as contrast-enhanced computed tomography angiography (CTA). The images showed a pelvic fracture, multiple fractures in both legs, lung and liver contusions, and an aortic rupture distal to the origin of the subclavian artery with no bleeding into the mediastinum. At 7 weeks after the accident, when the patient had stabilized hemodynamically and the injuries to vital organs had improved, he underwent aortic stent graft placement to treat the aortic rupture.

On preintervention CTA measurement, aortic diameter in the proximal and distal landing zones was 18 mm, and neck length distal to the left subclavian artery was 21 mm. With the patient under general anesthesia, and aided by fluoroscopic and transesophageal echocardiographic (TEE) guidance, a custom-made 24-mm × 6.6-cm (oversizing, 30%) TX2 endovascular graft (Cook Incorporated, Bloomington, Ind) was inserted via a right femoral incision. The TX2 graft is made of polyester fabric attached to a stainless steel stent. The stent has barbs at both the covered proximal part and the bare distal part. The device used in our patient was comprised of six stents. The left subclavian artery was not covered. The endoprosthesis was deployed without balloon dilatation. There were no procedure-related complications and the lesion was excluded. The patient was prescribed antiplatelet treatment with acetylsalicylic acid 100 mg/day, indefinitely.

Follow-up CTA and radiographs at 1 week and 6 months showed no complications (Fig 1). At 11 months after the intervention, the patient presented with abdominal pain and paraparesis of the legs of 1-hour’s duration that remitted spontaneously, and later fever and progressive dyspnea. On hospital admittance, oral intubation was required. The physical examination showed an absence of femoral pulses and severe arterial hypertension. CTA revealed pre-occlusive thrombosis of the distal portion of the stent, without evidence of endoleak, migration, collapse, or structural alterations of the device (Fig 2). Anticoagulant and antihypertensive therapy was started. When hemodynamic stability had been achieved, a decision was made to place a polytetrafluoroethylene axillofemoral bypass graft on the right side to decrease the cardiac post load and improve the patient’s severe heart failure. Following the procedure, the patient’s blood pressure normalized and there was a clear improvement in his condition.

Open surgical repair was then performed, the definitive treatment being placement of an extra-anatomic aortic bypass graft. Through a medial sternotomy and supraumbilical laparotomy, a 20-mm-diameter Dacron graft was implanted from the ascending aorta to the supraceliac abdominal aorta, tunneling over the pericardium and through the right diaphragm (Fig 3). The right axillofemoral bypass graft was removed. There were no postoperative complications, blood pressure values normalized, and follow-up CTA showed patency of the Dacron graft and all visceral branches. In addition, proximal progression of the in-stent thrombus was observed. At the time of writing, 2 years after surgery, the patient is asymptomatic.

DISCUSSION

Endovascular repair of the thoracic aorta is a valid alternative to open surgery for the treatment of thoracic aorta aneurysms, type B aortic dissections, and traumatic aortic rupture. The associated morbidity and mortality rates are lower with these procedures than with open sur-
gery, and in cases of aortic trauma with serious comorbid conditions, endovascular repair is often considered the treatment of choice. Nonetheless, several case studies have reported device-related complications, perhaps the most severe being acute stent collapse. This phenomenon, which has been described in traumatic aortic rupture and dissection, has been related to predisposing anatomic factors, such as a small distal aortic diameter, and minimum

Fig 1. Six-month follow-up of endovascular repair. A, Computed tomography angiography shows proper implantation of the device, with no signs of endoleak or collapse. B, X-ray of the stent graft shows no structural defects.

Fig 2. Computed tomography angiography performed for suspected endograft-related complication at 11 months after the procedure. A, Thrombosis of the segment distal to the endograft. B, Axial view shows nearly complete stent graft occlusion.
We describe another late complication of endovascular treatment for traumatic aortic rupture: stent graft thrombosis. To our knowledge, there are no previous reports of thoracic stent graft thrombosis with the currently available devices.

We analyzed several variables in an attempt to determine the etiology of this serious complication, but were unable to clarify the cause. First, there was no evidence of compromise to the integrity of the device, and intraoperative angiography and follow-up imaging with CTA and chest radiography had shown proper deployment. We considered the possibility that use of a stent with 30% oversizing (outside the manufacturer’s instructions) may have favored development of a kink in the device, making it susceptible to collapse or thrombosis. We could not determine whether oversizing was the cause of stent occlusion; however, we believe that 20% to 30% oversizing is reasonable in cases of traumatic aortic rupture in young patients. The diameter of the aorta will grow somewhat over time, and if oversizing is insufficient, there may be risk of pseudocoarctation syndrome or distal stent migration. In a recent report, Phren et al described variations in aortic diameter measurements in young trauma patients related to blood pressure (BP) variations, a factor that could be relevant for determining stent size. However, comparison of CTA aortic diameter in our patient at hospital admittance (mean BP, 100/50 mm Hg) and 4 days later at hemodynamic stability (mean BP, 120/60 mm Hg) showed no differences. We excluded congenital or acquired thrombophilia as the potential cause of occlusion because laboratory studies for this condition were negative. A final possibility is the existence of a lesion in the aortic wall at the level of the distal anchor that was not visualized on angiography, TEE, or CTA, and that might have led to thrombosis at this site. Examination with intravascular ultrasound scan might have detected this hypothetical lesion.

Open surgery rather than endovascular treatment was chosen for two main reasons: (1) manipulation of the guidewires and passage of the device might have fragmented the thrombus and led to distal embolization of vital organs; and (2), we did not know what had caused thrombosis of the first device. We opted for a right axillofemoral bypass to decrease the cardiac post load and allow definitive surgery. An extra-anatomic bypass was chosen to treat the aortic pseudocoarctation secondary to stent thrombosis, in order to decrease the possibility of severe complications. Mortality is somewhat higher with anatomic repair, mainly because of blood loss, and there is a risk of paraplegia resulting from total aortic clamping. Paraplegia rarely occurs when extra-anatomic techniques are used, and, in agreement with Almeida et al, we believe it is a safe method for such cases. Nonetheless, there are also some potential associated complications, such as graft narrowing with thrombus or neointimal formation, infection, and development of false aneurysms. In contrast to our opinion, Idu et al suggest that conversion to open surgery by

Fig 3. Intraoperative image after extra-anatomic bypass. A, The Dacron bypass originates at the ascending aorta, runs over the pericardium, and penetrates the abdominal cavity through the right hemidiaphragm. B, Detail of the distal area of the bypass after crossing the diaphragm (upper part of the image) toward the supraceliac aorta (distal anastomosis).
thoracotomy should be the standard method for treating stent graft collapse. In a recent study by Langer et al, all corrections of failed endovascular thoracic repair treated by open repair were done with an anatomic technique.

In summary, this report describes a case of thoracic aorta stent graft thrombosis occurring 1 year after implantation, a previously unreported, potentially fatal complication of thoracic endovascular repair that was successfully treated by open surgery and implantation of an extra-anatomic thoracic aorta bypass.

AUTHOR CONTRIBUTIONS
Conception and design: BA, MM
Analysis and interpretation: BA, IC, JM, MM
Data collection: BA, IC, JM, MM
Writing the article: BA, MM
Critical revision of the article: BA, IC, JM, MM
Final approval of the article: BA, IC, JM, MM
Statistical analysis: Not applicable
Obtained funding: Not applicable
Overall responsibility: BA, MM

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Submitted Sep 11, 2008; accepted Nov 7, 2008.