

# Hybrid Repair of Thoracoabdominal Aortic Aneurysms

Emergent thrombectomy, percutaneous transluminal angioplasty, and stenting of an acute occlusion of the superior mesenteric artery.

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**A**cute mesenteric vascular ischemia (AMVI) after open or endovascular aneurysm repair is a disastrous complication that is associated with significant morbidity and mortality.<sup>1,2</sup> AMVI, caused by atherosclerotic occlusive disease, is traditionally treated with emergent bypass and bowel resection. Mortality rates after this are reported to be as high as 75% to 100%.<sup>3,4</sup> This article describes a patient with extensive aortic disease who developed AMVI during endovascular aneurysm exclusion with visceral debranching; she was successfully treated with an extraction catheter followed by balloon angioplasty and stent implantation.

## HISTORY

A 66-year-old woman presented with an 8-cm descending thoracic aneurysm. Pertinent medical history included surgical repair of an abdominal aortic aneurysm in 1999. In addition, she continued to smoke and had severe chronic obstructive pulmonary disease, dyslipidemia, hypertension, and transient ischemic attacks. The 1999 abdominal aortic aneurysm repair was performed at an outside hospital and consisted of a tube graft from the infrarenal portion of the aorta to the aortic bifurcation. She did well initially, but a follow-up CT scan in 2001 showed the progression of aneurysm formation in the suprarenal portion of the aorta measuring 4.3 cm. She was treated medically and followed with an annual CT scan.



Figure 1. The maximum thoracic aneurysm diameter increased from 5.2 cm in 2006 to 8 cm in 2007.

In August 2006, the suprarenal aorta had increased to 5.2 cm, and by April 2007, the maximum thoracic aortic diameter was 8 cm (Figure 1). The suprarenal aortic diameters at the level of the celiac access and superior mesenteric artery (SMA) were 5 and 4 cm, respectively. At the level of the renal arteries, the maximum diameter was 2.5 cm.



**Figure 2.** A 10-mm Hemashield Gold graft (Boston Scientific Corporation, Natick, MA) was used to construct the chimney conduit from the middle of the old aortic tube graft. The two side branches for the SMA and celiac artery were constructed from an 8-mm Hemashield Gold graft.

Because of the rapid increase in the size of the aneurysm, medical therapy alone was not believed to be a good option. Therefore, we consulted the cardiothoracic surgery team, and a hybrid approach was thought to be the best option. The procedure involved retrograde debranching of the celiac artery and SMA using a direct conduit sewn to the pre-existing aortic tube graft. The debranching would create a landing zone just above the renal arteries, which would be the appropriate diameter for placement of a Gore TAG Thoracic Endoprosthesis (Gore & Associates, Flagstaff, AZ).

## SURGICAL PROCEDURE

The procedure was performed in the hybrid suite in the operating room using general endotracheal anesthesia. The patient was prepared and draped in a sterile fashion from the neck down to the knees. A 6-F sheath was inserted percutaneously in the right femoral artery using the standard Seldinger technique. A 5-F marker pigtail catheter was then introduced under fluoroscopic guidance into the descending aorta. Digital contrast angiography was performed first to further assess the relationship of the great vessels to the origin of the descending thoracic aortic aneurysm, as well as the origin of the SMA and celiac artery. A retroperitoneal approach was then used to access the aortic tube graft via an oblique left laparotomy, and the left kidney, spleen, and intestines were mobilized medially. The aortic tube graft, SMA, and celiac artery were exposed, and 1 mg/kg heparin was administered. A 10-mm Hemashield Gold graft was used to construct a chimney conduit starting at the middle of the old aortic tube graft to be used for introduction of the thoracic endograft. The two side branches for the SMA and celiac artery were constructed from an 8-mm



**Figure 3.** An angiogram of the SMA and the celiac artery shows the celiac artery is patent, and the SMA is occluded just beyond the anastomosis with bypass graft (arrow).



**Figure 4.** Angiogram after balloon angioplasty shows little improvement of the flow to the distal SMA branches.

Hemashield Gold graft (Figure 2).

After completion of the SMA and celiac artery bypass, the surgeon noticed that the color of the bowel remained cyanotic. Emergent SMA and celiac artery bypass angiography was performed. A 5-F Cobra catheter was inserted through the chimney conduit and used to selectively engage first the celiac artery bypass (Figure 3)



Figure 5. Improved distal filling of the intestinal branches of the SMA after several passes of the Pronto extraction catheter.



Figure 6. Final angiogram of the SMA after placement of a 6-mm X 18-mm balloon-expandable stent.

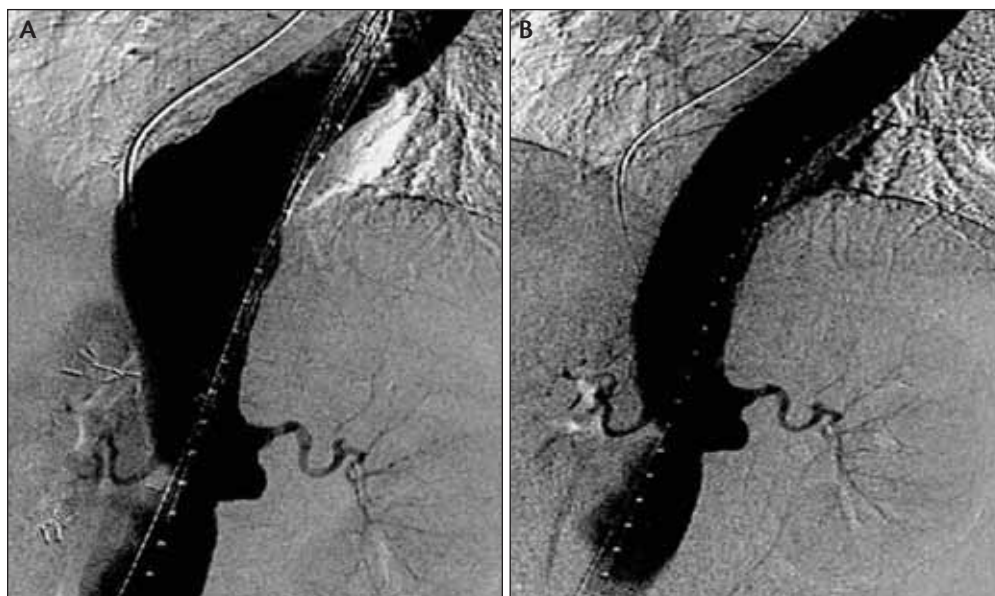


Figure 7. Descending thoracic aortography performed before deployment of the stent graft system (A). Follow-up aortogram after placement of the Gore TAG Endoprosthesis (B).

and then the SMA bypass. The celiac artery bypass was widely patent; however, the SMA bypass was completely occluded just distal to the anastomosis of the graft (Figure 3).

Thrombolysis was not considered because of the open abdominal incision. Therefore, balloon angioplasty was attempted first. A 7-F renal double-curve guide catheter was used to deliver a 3.5-mm coronary balloon followed by a 4-mm coronary balloon over a .014-inch guidewire.

Sequential balloon inflations were performed. Follow-up angiography after the balloon inflations showed little improvement (Figure 4). A Pronto extraction catheter (Vascular Solutions, Inc., Minneapolis, MN) was then passed down the SMA over the same .014-inch guidewire. Multiple passes were made before the .014-inch guidewire was redirected to the other distal branches, and several more passes were accomplished. Repeat angiography revealed marked improvement in the filling of the distal arteries (Figure 5). A 6-mm X 18-mm balloon-expandable stent was then deployed at the anastomotic site to resolve the residual stenosis (Figure 6). Finally, a 22-F sheath was passed through the aortic chimney conduit and positioned in the aortic tube graft. A .035-inch Lunderquist extra-stiff double-curved guidewire (Cook Medical, Bloomington, IN) was placed under fluoroscopic guidance in the

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ascending aorta, and a 34-mm X 15-cm-long Gore TAG Endoprosthesis was advanced and positioned using contrast injections in the descending thoracic aorta where the distal end was just above the renal arteries. After deployment of the endoprosthesis, the seal zones were ballooned using the stent graft proprietary balloon. Balloon inflations were performed in the distal, proximal, and midsections of the graft.

Repeat contrast angiography revealed satisfactory opacification of the graft with no evidence of endoleak (Figure 7). The chimney conduit was tied off, and the laparotomy was closed in a multilayer fashion. The 6-F right femoral access site was closed with a StarClose device (Abbott Vascular, Santa Clara, CA) without complications.

## IN-HOSPITAL STAY

After the operation, the patient remained stable, and there were no clinical signs of spinal cord or bowel ischemia. Her severe respiratory insufficiency, however, required 7 days of mechanical support. A CT scan of the abdomen before discharge failed to reveal any evidence of bowel ischemia. The stent graft was well positioned, and the SMA, celiac, and renal arteries were patent.

## DISCUSSION

Conventional repair of aneurysms of the descending thoracic aorta entails thoracotomy and graft interposition. Comorbid conditions, such as advanced age, severe respiratory insufficiency, previous surgeries, or obesity, are still associated with major complications, including death, cardiac, renal, and neurologic complications.<sup>1-4</sup> Hybrid strategies incorporating surgical and endovascular approaches can be used successfully in treating patients with complex thoracic aortic aneurysms. This consists of visceral aortic debranching with retrograde revascularization of the splanchnic and renal arteries, coupled with aneurysm exclusion using stent grafts, and is a more elegant approach to treating high-risk patients with compromised cardiopulmonary reserves.<sup>5-10</sup>

Complications of such complex procedures, even in high-expertise facilities, are inevitable; therefore, constant attention to detail is a necessity for the surgeon and interventionist. AMVI due to SMA occlusion carries with it a high mortality rate.<sup>4</sup> The use of direct aspiration techniques using rapid-exchange aspiration catheters for SMA rescue has been described previously,<sup>11</sup> but to our knowledge, this is the first report of aspiration thrombectomy with percutaneous transluminal angioplasty with stenting of the SMA in the setting of a hybrid thoracoabdominal aortic

aneurysm procedure. Despite the technical challenges, endovascular stent grafting of thoracic aortic disease continues to evolve and is feasible and relatively safe.<sup>12</sup> Careful planning, attention to anatomic detail and device specifications, as well as good judgment and experience coupled with high-quality imaging, will help ensure encouraging results. ■

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