Chronic Aneurysmal Aortic Dissection

A staged hybrid procedure and a fenestrated endograft were used to treat this challenging presentation.

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Endovascular grafting is being increasingly used to treat aortic aneurysms and dissections. However, patients with aneurysmal dissections involving both the thoracic and abdominal aorta are particularly challenging to treat because of the natural communications at the level of the visceral arteries, particularly in the presence of a defined connective tissue disease. Reports of hybrid procedures involving visceral revascularization and subsequent endografting of the whole descending and abdominal aorta are appearing in the literature.[1-3]

CASE REPORT

A 61-year-old man with Marfan syndrome presented with acute chronic back pain. On clinical examination, he was found to have a large abdominal aortic aneurysm. He had undergone previous surgery to the ascending aorta, aortic arch, and the proximal descending thoracic aorta for a large DeBakey type IIIB aortic dissection extending into his left iliac artery.

A CT scan showed replacement of the ascending aorta, arch, and descending aorta with a graft. There was a large residual aneurysmal dissection extending from the lower thoracic aorta into the left iliac artery. The infrarenal aorta had a maximum diameter of 7.7 cm, the majority of which consisted of the false lumen (Figure 1). The celiac, superior mesenteric, and left renal arteries were supplied by the true lumen, and the right renal artery was supplied by the false lumen. The right kidney was small and atrophic. The iliac vessels were also aneurysmal.

Angiography was performed to locate the site of the communications between the true lumen and the false lumen. This showed a large proximal fenestration at the level of the diaphragm and a smaller distal fenestration at the level of the aortic bifurcation. No other fenestrations were visualized.

Figure 1. CT scan shows replacement of the ascending and most of the descending aorta that are of normal caliber (white arrows) (A). Large thoracoabdominal dissection is seen with a large proximal fenestration (solid yellow arrow). The left renal artery is seen to come off the true lumen (dashed yellow arrow) and the right renal artery off the false lumen (white arrow). The right kidney is also seen to be atrophic (B). The infrarenal aorta is seen to be aneurysmal, which consists mainly of the enlarged false lumen (C).

Figure 2. Completion angiography after insertion of the thoracic and infrarenal stent graft. A small leak is visible on the right into the false lumen.

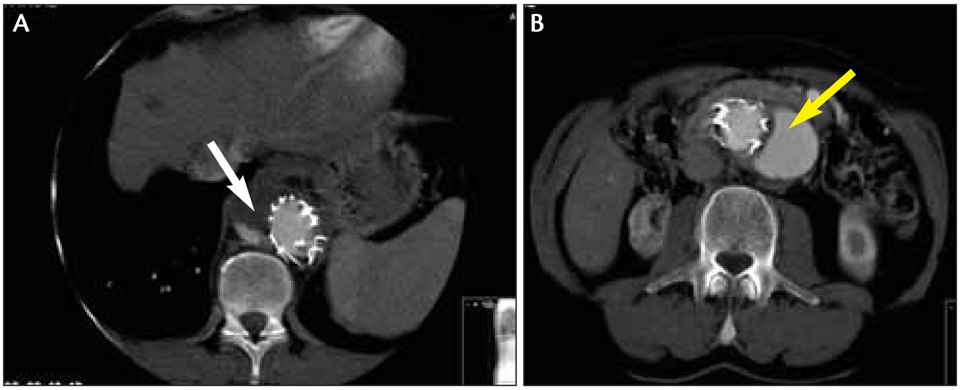

Figure 3. A postprocedure CT scan shows partial thrombosis of the false lumen in the thorax, with some residual perfusion (white arrow) (A) and persistent perfusion of the false lumen in the abdomen (yellow arrow) (B).

A decision was made to treat this patient by endovascular methods. The plan was to close the main proximal and distal communications with the aim of abolishing flow into the false lumen, resulting in thrombosis of the false lumen. In separate procedures, the proximal communication was closed with a Talent thoracic tube graft (Medtronic, Inc., Santa Rosa, CA), and the distal communication was closed with a Talent bifurcated endograft (Medtronic). Angiography performed after insertion of the thoracic and abdominal endografts showed successful closure of the main proximal and distal communications and a small residual leak into the false lumen at the level of the renal arteries (Figure 2).

A CT scan at 1 month showed partial thrombosis of the false lumen in the distal thoracic aorta and persistent perfusion in the upper abdominal aortic false lumen extending to the distal aorta where the false lumen was causing some compression of the infrarenal stent graft (Figure 3). The diameter of the infrarenal aneurysm had decreased by a few millimeters. The persistent false lumen perfusion was thought to be due to remaining natural fenestrations at the level of the visceral vessels. In view of the fact that the aneurysm had decreased in size, it was decided to keep the patient under surveillance rather than to intervene further.

CT scans at 7, 13, and 15 months after the procedure showed persistent filling of the false lumen from the upper abdomen to the bifurcation. The diameter of the infrarenal aneurysm also increased in size from 5 mm to 8.5 cm.

Due to the failure of the false lumen to thrombose and the increased size of the aorta, we decided to close the remaining communications between the false lumen and the true lumen at the level of the visceral vessels by surgical bypass of the celiac, superior mesenteric, and left renal arteries, and placement of an endograft between the thoracic and abdominal aortic endografts.

Hybrid surgery was attempted but was abandoned due to severe coagulopathy before any bypass was performed but after all vessels were dissected. The patient required packing and was managed on the critical care unit. He recovered fully. Hematology review diagnosed a

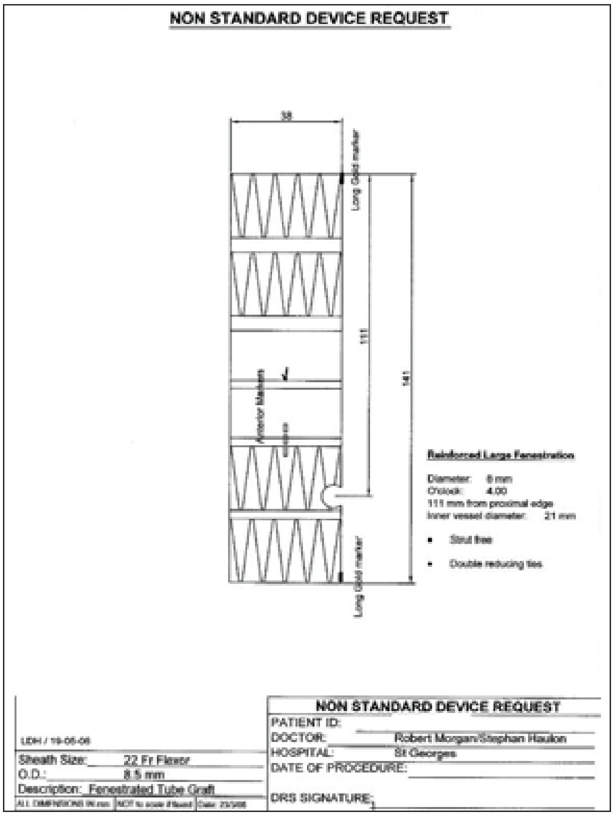

Figure 4. Diagram of the fenestrated device.

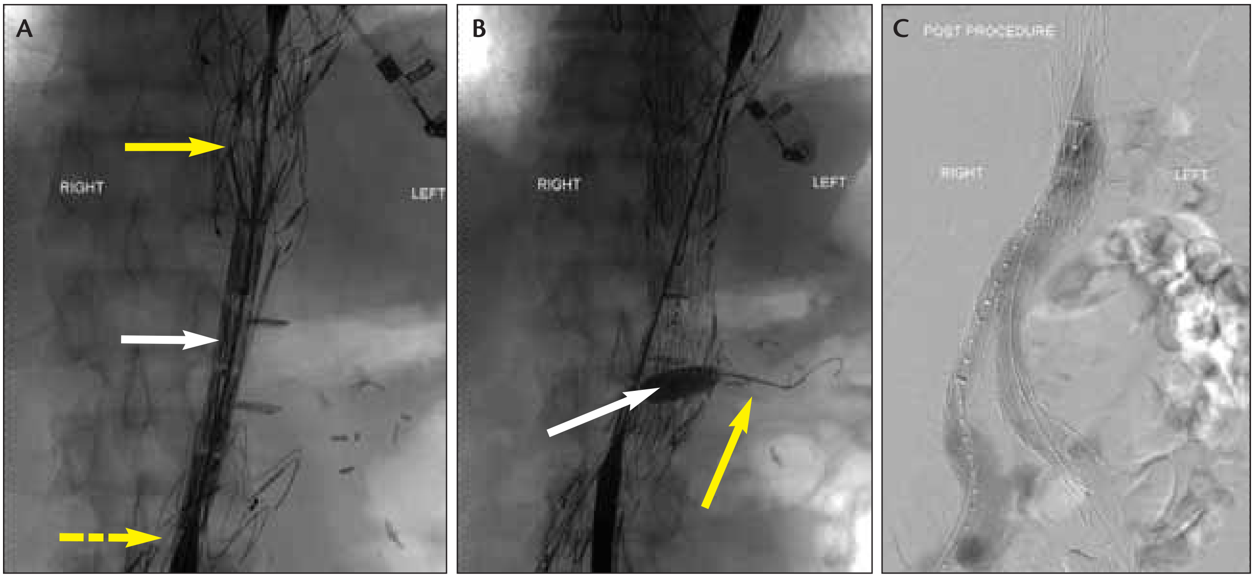

Figure 5. Fenestrated stent graft insertion. The bridging fenestrated stent graft (white arrow) is placed between the infrarenal device (dashed yellow arrow) and thoracic device (solid yellow arrow) (A). An uncovered stent (solid yellow arrow) is placed in the left renal artery, and the proximal end of the stent is flared by a balloon (white arrow) (B). Completion angiography shows no flow into the false lumen (C).

complex hematological disorder characterized by abnormal platelet function. A subsequent attempt at visceral revascularization was scheduled under platelet cover and administration of NovoSeven (Novo Nordisk Inc., Clayton, NC).

> "... patients with the most complex aortic pathology can be treated by a combination of surgical bypass and advanced endograft technology."

At surgery, a 16-mm X 8-mm silver bonded Dacron graft was anastamosed to the right iliac artery and then via an end-to-side anastomosis onto the superior mesenteric artery and the common hepatic artery via a retropancreatic tunnel. The origins of the superior mesenteric artery and coeliac axis were ligated. The left renal artery was unable to be accessed due to excessive scar tissue from the previously attempted bypass.

As the left renal artery could not be bypassed, a tube graft with a fenestration for the left renal artery was designed (William Cook Corporation, Bjaeverskov, Denmark). The tube graft was 38 mm in diameter, 141 mm long, with a single, 8-mm fenestration for the left renal artery 30 mm from the distal end (Figure 4).

Under general anesthesia, the tube graft was deployed in the upper abdominal aorta connecting the thoracic and abdominal endografts. The left renal artery was catheterized successfully through the fenestration, and an 8-mm X 22-mm balloon-expandable stent graft (Atrium Europe, Mijrecht, The Netherlands) was deployed in the left renal artery. Completion angiography showed a good result with no residual leak (Figure 5).

Follow-up CT scans at 2 days and at 2 months showed increased thrombosis of the false lumen, although there was persistent although reduced false lumen perfusion. The persistent false lumen perfusion appeared to be due to a type II leak from at least one large lumbar vessel that communicates with the false lumen (Figure 6). At the current time, as there is increased false lumen thrombosis and no further increase in aortic diameter, no further intervention is planned, and the patient is being followed up by the standard CT protocol.

DISCUSSION

Patients with aneurysmal type B dissections involving the thoracic and abdominal aorta have limited treatment options. Complication rates after surgery are high and, as a result, few patients undergo open surgery and are treated conservatively until they succumb to their aortic disease or other comorbidity. Definitive treatment of these patients requires the cessation of false perfusion by closure of all of the communications between the true lumen and the false lumen.

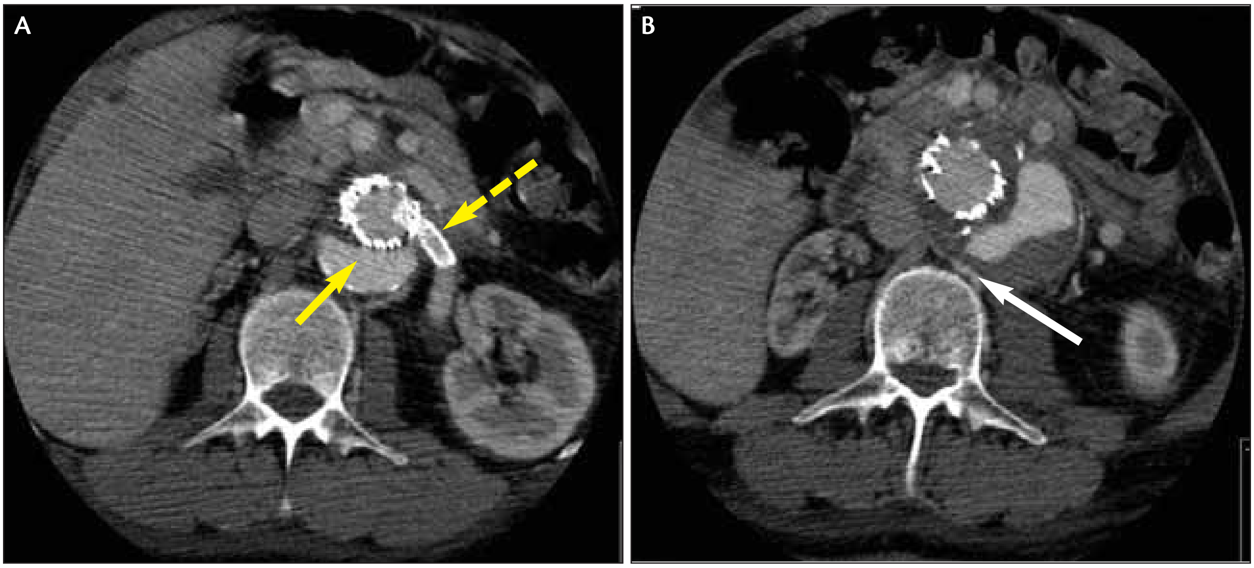

Figure 6. Postprocedure CT shows the renal fenestrated graft *in situ* (dashed yellow arrow) and persistent perfusion of the false lumen (solid yellow arrow) (A). False lumen filling is seen to be via lumbar vessels (white arrow), making this a type II leak (B).

There are increasing reports of the treatment of patients with this type of aortic dissection and of thoracoabdominal aortic aneurysms by hybrid procedures involving surgical bypass followed by the placement of aortic stent grafts.[1-3]

Because there is limited evidence available, hybrid procedures appear to enable many patients with complex aortic pathology to be treated without the need for open aortic surgery. However, a problem arises, as in our patient, when it is not possible to bypass all of the visceral vessels for technical reasons.

On the basis of the success of fenestrated and branched graft technology for the treatment of challenging abdominal aortic aneurysms, we thought that a successful outcome might be achieved by constructing a tube graft with a single fenestration for the left renal artery. Catheterization of the left renal artery and the subsequent placement of a covered renal artery stent were not technically difficult. This procedure is facilitated by previous experience with similar renal artery catheterization in patients undergoing fenestrated abdominal endograft procedures.

CONCLUSION

To our knowledge, this is the first treatment of a patient with Marfan syndrome by both visceral artery revascularization and a fenestrated endograft. In summary, this case illustrates that patients with the most complex aortic pathology can be treated by a combination of surgical bypass and advanced endograft technology. Fenestrated graft technology can be utilized to treat patients with aortic dissection in addition to patients with conventional atherosclerotic abdominal aortic aneurysms. ■

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