Retrograde Recanalization of the Celiac Trunk

Treatment of a type A aortic dissection and a discussion of the available options.

BY RAFAEL TRUNFIO, MD; FRANCESCO SICLARI, MD; AND JOS C. VAN DEN BERG, MD, PhD

Arterial obstruction in patients with aortic dissection can be caused by the dissection flap itself (either dynamic or static), distal embolization, occlusion of a vessel arising from the false lumen, thrombosis in a region of stasis, or problems caused by a pre-existing arterial stenosis.

Treatment options consist of surgical repair and endovascular repair. Stent graft placement is indicated in cases of malperfusion of the true lumen and its branches. In some cases, however, the extension of the dissection does not permit safe stent graft placement. This article describes a case of extension of the intimal flap in a patient with a type A dissection into the celiac trunk, leading to occlusion.

CASE REPORT

A 44-year-old man was referred to our center with a type A dissection extending from the aortic valve to the aortic bifurcation. Emergent surgical repair consisting of aortic valve and ascending thoracic aorta replacement was performed. The distal part of the dissection was not treated surgically, and medical therapy was started in order to lower blood pressure. In the immediate postoperative period, the patient developed a compartment syndrome caused by transient hypoperfusion of the right lower leg, necessitating a fasciotomy. At postoperative day 12, the patient developed clinical signs of gastric ischemia (laboratory findings: ASAT/GOT, 217 u/L; ALAT/GPT, 432 u/L; G-GT, 234 u/L; LDH, 1,976 u/L; CK, 1,272 u/L). Computed tomographic (CT) angiography was performed, which revealed occlusion of the celiac trunk, probably with thrombus in the main stem of the celiac axis; the celiac axis was originating from the true lumen (Figure 1A).

Because of thrombus, treatment with (percutaneous) fenestration was not considered as a viable treatment option, and the patient was scheduled for percutaneous revascularization. After right common femoral artery access (4-F sheath) was achieved, the celiac trunk was cannulated selectively, confirming an occlusion (Figure 1B). Several attempts to cross the occlusion in an antegrade fashion were unsuccessful. Selective catheterization of the superior mesenteric artery with a Cobra-type catheter demonstrated retrograde filling of the celiac trunk through pancreaticoduodenal and gastroduodenal collaterals (Figure 1C). Therefore, we decided to attempt a retrograde recanalization.

An exchange was made for a Simmons I-type diagnostic catheter. With the use of a Y-connector (to allow for continuous flushing) and a microcatheter (Progreat 2.7 F, 130 cm, Terumo Interventional Systems, Somerset, NJ), a coaxial catheter system was created. The microcatheter and its guidewire were subsequently advanced until the tip of the microcatheter could not be advanced anymore because of the lack of length (Figure 1D, E). An exchange of the Progreat guidewire for a longer guidewire (0.014-inch, 300-cm ATW, Cordis Corporation, Warren, NJ) was made, and this wire was advanced across the origin of the celiac trunk into the aorta (Figure 1F). At this point, a second arterial access of the ipsilateral common femoral artery was obtained (6-F sheath). A 4-F loop snare catheter (Amplatzer

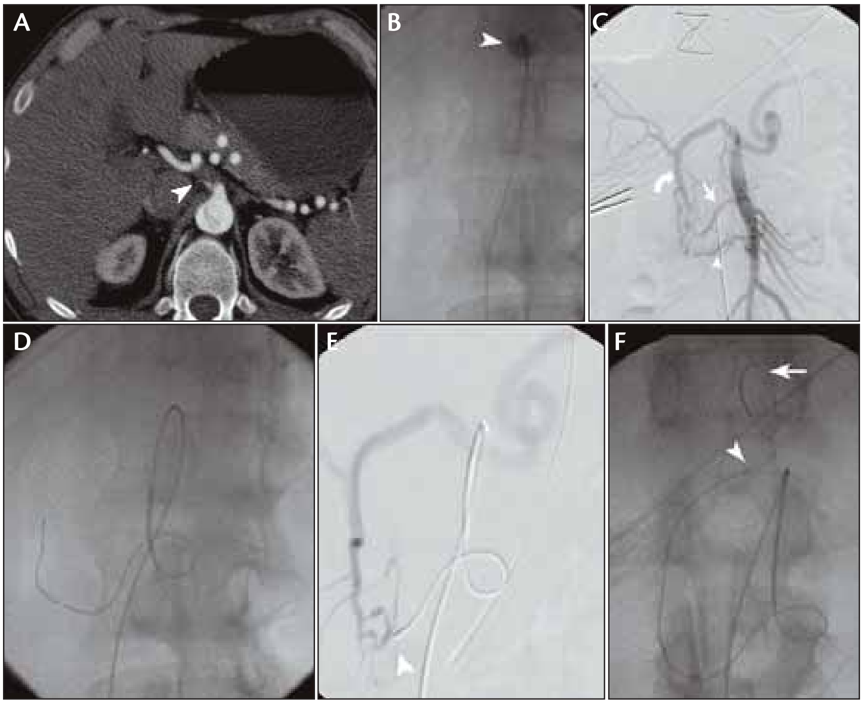

Figure 1. An axial CT image demonstrating occlusion of the celiac trunk (arrowhead), probably with thrombus; the patient was suffering from gastric ischemia (A). A fluoroscopic image of selective injection of contrast into the celiac trunk, confirming occlusion (arrowhead); antegrade recanalization was not possible (B). Selective digital subtraction angiography (DSA) of the superior mesenteric artery demonstrating retrograde filling of the inferior pancreaticoduodenal artery (arrowhead), superior pancreaticoduodenal artery (arrow), and gastroduodenal artery (curved arrow); there was also filling of hepatic and splenic artery (C). A fluoroscopic image of a microcatheter and guidewire passing across the inferior pancreaticoduodenal artery (D). An angiographic image demonstrating flow from the inferior pancreaticoduodenal artery (arrowhead) toward celiac trunk (E). A fluoroscopic image of a microcatheter (arrowhead) and guidewire passing across the inferior pancreaticoduodenal artery, gastroduodenal artery, and hepatic artery; the tip of the guidewire at the level of the aorta (arrow) is shown (F).

Goose Neck snare kit, 4 F, 120 cm, ev3 Inc., Plymouth, MN) was advanced over a guidewire to the level of the celiac trunk, and after removal of the guidewire, the snare was advanced. The 0.014-inch guidewire protruding from the celiac axis was snared (Figure 2A), and the snare and its catheter were pulled into the celiac axis by traction on the 0.014-inch guidewire (Figure 2B). The snare and its catheter were advanced into the inferior pancreaticoduodenal artery and subsequently into the aorta, and at that point, the snare and the 0.014-inch guidewire were disengaged (Figure 2C through E). The snare was removed and replaced for a 0.018-inch guidewire (SV-5, 180 cm, Cordis Corporation).

After removing the snare kit catheter, a 6-F guiding catheter (RDC, Cordis Corporation) was advanced over the 0.018-inch guidewire, and subsequently, a balloon-expandable stent (Palmaz Blue, 7 X 12 mm, Cordis Corporation) was placed (Figure 3A). Stent placement was uneventful, but control angiography revealed propagation of the thrombus distally into the celiac axis (Figure 3B). Additional balloon angioplasty (Savvy 6 X 40 mm, Cordis Corporation) at the level of the thrombus was performed, and control angiography demonstrated optimal reconstitution of flow (Figure 3C).

The clinical course was complicated by rhabdomyolysis (as a sequelae of the compartment syndrome), necessitating temporary hemofiltration. The signs of gastric ischemia disappeared, and the patient demonstrated normal intestinal peristalsis. The patient was dismissed in good clinical condition on day 56.

DISCUSSION

Aortic dissection is a life-threatening disease with a high mortality rate and an elevated incidence of early and long-term complications.[1] Most cases of acute type A dissection are managed surgically.

Most cases of acute type B dissection are managed medically, although open surgery or stent graft placement is sometimes performed. Patients with type B or surgically treated type A dissection may develop vascular complications, such as mesenteric or peripheral ischemia, which cannot be managed medically. In these cases, arterial obstruction can be caused by the dissection flap itself (either dynamic or static), distal embolization, occlusion of a vessel arising from the false lumen, thrombosis in a region of stasis, and problems caused by a pre-existing arterial stenosis.[2,3]

Treatment options consist of surgical repair and endovascular repair. Stent graft placement is indicated in cases of malperfusion of the true lumen and its branches. In some cases, however, the extension of the dissection does not permit safe stent graft placement. The con-

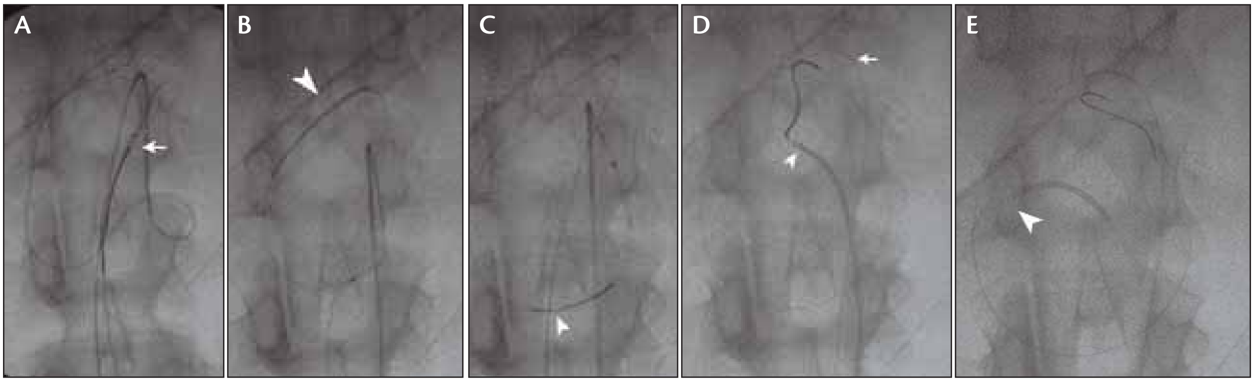

Figure 2. A fluoroscopic image of a snare loop (arrow) grasping the guidewire (A); pull-back of the snare (arrowhead) into the hepatic artery (B); advancement of the snare into the inferior pancreaticoduodenal artery (arrow) (C). The snare at the level of the tip of the diagnostic catheter (now pulled back into the aorta [arrowhead]); the arrow indicates the entry of the 0.018-inch guidewire at the level of the celiac trunk (D). The snare and guidewire are disengaged (arrowhead indicates the position of the tip of the diagnostic catheter) (E).

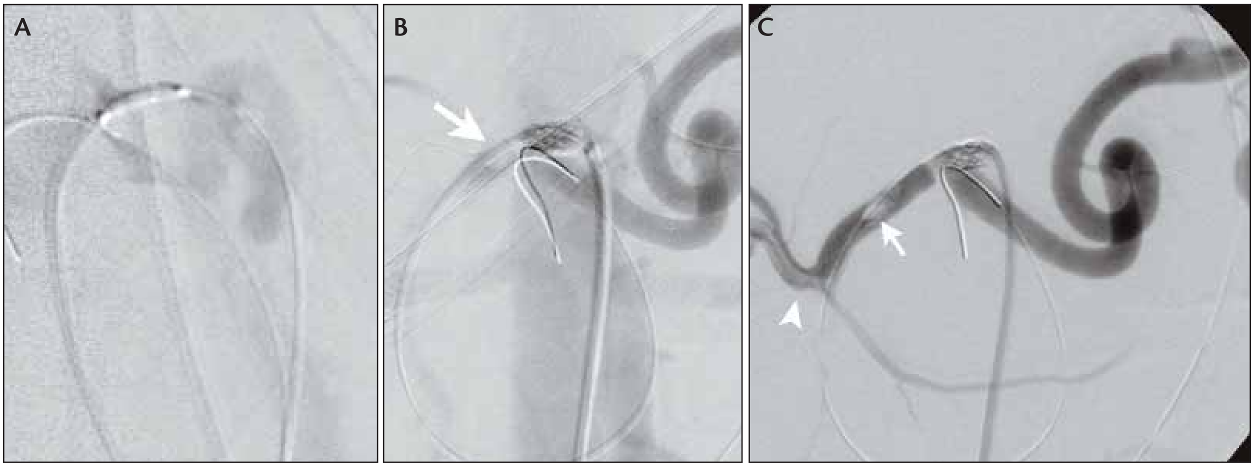

Figure 3. A DSA image of the stent in place (undeployed) at the origin of the celiac trunk (A). A DSA image after stent deployment, demonstrating propagation of thrombus (arrow) into the common hepatic artery; note patency and antegrade flow into the splenic artery (B). Control angiography demonstrating antegrade flow into the celiac trunk; note the thrombus (arrowhead) in the hepatic artery (this was left in place, and the patient was administered heparin); also note the inflow phenomenon from the gastroduodenal artery (arrow) (C).

traindications for endovascular treatment using a stent graft are most often related to anatomic considerations. Stent graft placement requires adequate vascular access (sufficient diameter of the iliac artery and abdominal aorta without severe tortuosity), an aortic lesion without excessive tortuosity, a neck that extends more than 15 mm above the celiac artery and is more than 5 mm distal to the left subclavian artery without mural thrombus (more than 50% of patients present with thrombosis of the false lumen), and dilatation.[4] Other contraindications include a tear too proximal to crucial branch vessels, inadequate seal of the stent graft, or unavailability of an adequate size stent graft. In cases of ischemic complications related to aortic dissection in which contraindications for stent graft placement exist, alternative treatment options such as fenestration and stent placement should be employed.[5] The goal of these therapies is to allow outflow from the false lumen, to relieve branch vessel obstruction, to reduce intraluminal pressure, and to reduce the risk of extension of the dissection.

TREATMENT OPTIONS

Fenestration

Fenestration is a method to decompress the hypertensive false lumen by creating a hole in the distal part of the dissection flap, thus augmenting flow in the true lumen (and its branches that are at risk).[6] Fenestration is the first choice treatment option.

Two different techniques to create and enhance communication between the true and false lumen exist:

Balloon technique. With this technique, a guidewire is placed across an existing communication between the false and true lumen (either going from true to false or vice versa); a large size balloon (> 15 mm) is used to enlarge the pre-existing hole.

Creation of a novel communication by puncturing the intimal flap using the back end of a guidewire or needle systems as used in TIPS procedures (transjugular intrahepatic portosystemic shunt). Puncture guidance can be performed using a loop snare in the false lumen as a target, with multiplanar or three-dimensional rotational angiography, or transesophageal echocardiogram or intravenous ultrasound; subsequently, the puncture hole is enlarged, as described above.

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Scissor technique. With this technique, the arterial system is accessed at a point beyond the dissection with a 6- or 7-F introduction sheath. Selective cannulation of the true and false lumen is performed, and guidewires are left in place. A guiding catheter is then advanced over both guidewires and will tear the intimal flap in a longitudinal fashion.[5]

It is of utmost importance to measure intra-arterial pressure within the true and false lumen. The aim is to reduce the pressure gradient to less than 5 mm Hg. If this objective cannot be reached, a second angioplasty with a larger balloon or a second fenestration can be performed.

Complications of fenestration procedures include dehiscence of intimal flap (on CT angiography presenting as a tube-in-tube sign), aneurysm formation, transmural perforation, and propagation of dissection.[7,8]

Stent Placement

Indications for stent placement are the presence of static dissection (ie, extension of dissection up to and/or into the aortic side branch in the absence of a re-entry tear, resulting in constriction of lumen) into a branch vessel only. This can be performed by direct access, in a way similar to stent placement in cases of atherosclerotic stenotic disease. If the occlusion cannot be recanalized in an antegrade fashion, collaterals can be used to perform a retrograde recanalization.

Other indications for stent placement are persisting pressure gradient after fenestration, the presence of significant thrombus in the false lumen (this increases the risk of embolization during fenestration procedures), and failure to perform a fenestration.

It must be kept in mind that stent placement (especially in the false lumen) might compromise future thoracic surgery. Technical success can be achieved in up to 90% of cases, with a clinical success rate of 43% to 91%.[6,9] About one-third of patients die in cases of visceral artery involvement.

CONCLUSION

Aortic dissection can be complicated by occlusion of visceral side branches, which may lead to life-threatening visceral ischemia. Several surgical and endovascular treatment options are available. Retrograde recanalization is one of the treatment options that should be kept in mind when treating this category of patients. ■

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1. Beregi JP, Haulon S, Otal P, et al. Endovascular treatment of acute complications associated with aortic dissection: midterm results from a multicenter study. J Endovasc Ther. 2003;10:486-493.
2. Williams DM, Lee DY, Hamilton BH, et al. The dissected aorta: percutaneous treatment of ischemic complications—principles and results. J Vasc Interv Radiol. 1997;8:605-625.
3. Gaxotte V, Cocheteux B, Haulon S, et al. Relationship of intimal flap position to endovascular treatment of malperfusion syndromes in aortic dissection. J Endovasc Ther. 2003;10:719-727.
4. Gaxotte V, Thony F, Rousseau H, et al. Midterm results of aortic diameter outcomes after thoracic stent-graft implantation for aortic dissection: a multicenter study. J Endovasc Ther. 2006;13:127-138.
5. Beregi JP, Prat A, Gaxotte V, et al. Endovascular treatment for dissection of the descending aorta. 2000;356:482-483.
6. Hartnell GG, Gates J. Aortic fenestration: a why, when, and how-to guide. Radiographics. 2005;25:175-189.
7. Maynar M, Rostagno R, Zander T, et al. Intimal dehiscence in the abdominal aorta following balloon fenestration for type B dissection. J Endovasc Ther. 2005;12:103-109.
8. Lookstein RA, Mitty H, Falk A, et al. Aortic intimal dehiscence: a complication of percutaneous balloon fenestration for aortic dissection. J Vasc Interv Radiol. 2001;12:1347-1350.
9. Vedantham S, Picus D, Sanchez LA, et al. Percutaneous management of ischemic complications in patients with type-B aortic dissection. J Vasc Interv Radiol. 2003;14(2 Pt 1):181-194.