Proximal thoracic endograft displacement rescued by balloon-assisted pull-back, external shunting, and in situ fenestration of the left carotid artery

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Proximal displacement of thoracic aortic endografts is a catastrophic adverse event, which rarely occurs but is associated with extremely high morbidity and mortality. We describe herein the case of a patient with accidental proximal displacement of a thoracic endograft with occlusion of all supra-aortic branches, successfully rescued by the combination of three advanced endovascular techniques: (1) aggressive pull-back maneuver with a compliant balloon; (2) establishment of an arterio-arterial temporary shunt to the occluded carotid artery over sheaths; and (3) in-situ fenestration of the occluded carotid artery. (J Vasc Surg 2016;63:815-8.)

Thoracic endovascular aortic repair (TEVAR) has become the preferred treatment choice for acute complicated type B aortic dissections, mostly because of the reduced 30-day mortality and morbidity.[1] A devastating complication of TEVAR is the unintentional, intraoperative coverage of the supra-aortic branches, leading to stroke.

In situ fenestration techniques of aortic endografts have been used to facilitate branch vessel perfusion of intentionally covered aortic sidebranches for a decade.[2] Various antegrade and retrograde techniques have been developed for in situ fenestration using needles, laser, and radiofrequency and external shunting techniques to prevent ischemia of the target vessels.[3-6] We describe herein the case of a patient with accidental proximal displacement of a thoracic endograft, rescued by the combination of three endovascular techniques.

CASE REPORT

A 54-year-old male patient presented with acute onset of back pain persisting for several hours, and uncontrolled hypertension.

A thoracoabdominal computed tomography scan confirmed the clinical suspicion of a type B aortic dissection encroaching the left subclavian artery (LSA) and extending to the aortic bifurcation (Fig 1, *a*). The patient had initial false lumen expansion to 42 mm with visceral perfusion from the true lumen for the dissected superior mesenteric artery and the right renal artery. The left renal artery received false lumen and the celiac artery combined true and false lumen perfusion. The true lumen was collapsed at the level of the renal arteries causing dynamic obstruction of the right renal artery (Fig 1, *b*) and markedly reduced perfusion of the right kidney detected using color-coded ultrasound. This finding together with an elevated creatinine level at 1.7 mg/dL despite previously documented normal renal function, refractory hypertension and chest pain, led to the indication of urgent TEVAR.

The procedure was performed in the endovascular suite with a fixed imaging system using general anesthesia and systemic heparinization.

All measurements were performed using the Aquarius Workstation (TeraRecon, San Mateo, Calif). Centerline measurements and measurements using the outer curvature of the aortic arch were used.

After percutaneous right femoral artery access, a 5-French (F) pigtail catheter was advanced within the true lumen into the ascending aorta using repeated angiographies to confirm true lumen position. The pigtail catheter was replaced for a Lunderquist extra stiff wire (Cook Europe, Bjaeverskov, Denmark) that was used to advance and deploy a 36 to 127 mm Zenith TX2 ProForm thoracic endograft (Cook Europe) covering the LSA orifice to cover the large proximal entry tear. The diameter of the thoracic aorta at the level of the LSA was 32 mm resulting in an oversizing of 10% to 15%. The relatively short stent graft was well-positioned at the intended level, but the proximal entry of the dissection membrane tore during deployment leaving only the most distal part of the stent graft in the true lumen, and the middle part extended into the false lumen. Therefore, it was decided to deploy a second endograft to extend distally into the descending aorta securing the stent graft outflow into the true lumen.

Despite gentle advancement of the second endograft, the first one was pushed forward, probably because of engagement of the

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Author conflict of interest: T.K. is a consultant for Cook Medical. This article references off-label or unapproved uses of the Zenith Cook ZTEG Endograft.

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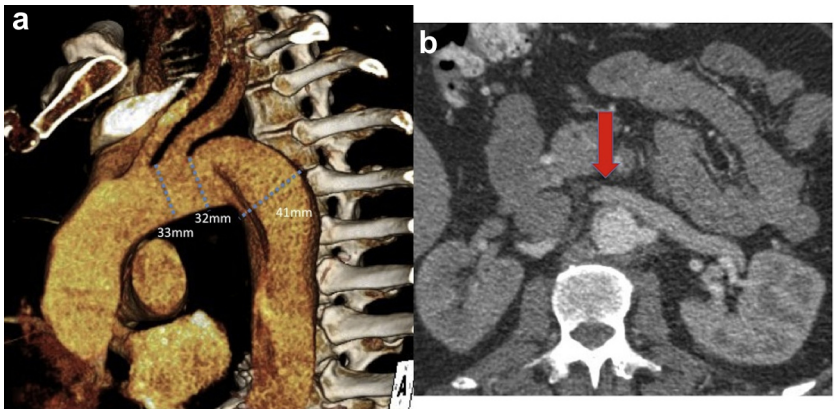

Fig 1. Computed tomography scan demonstrating **(a)** a type B dissection of the thoraco-abdominal aorta encroaching the left subclavian artery (LSA) and **(b)** true lumen collapse at the level of the renal arteries (*arrow*) causing malperfusion of the right renal artery.

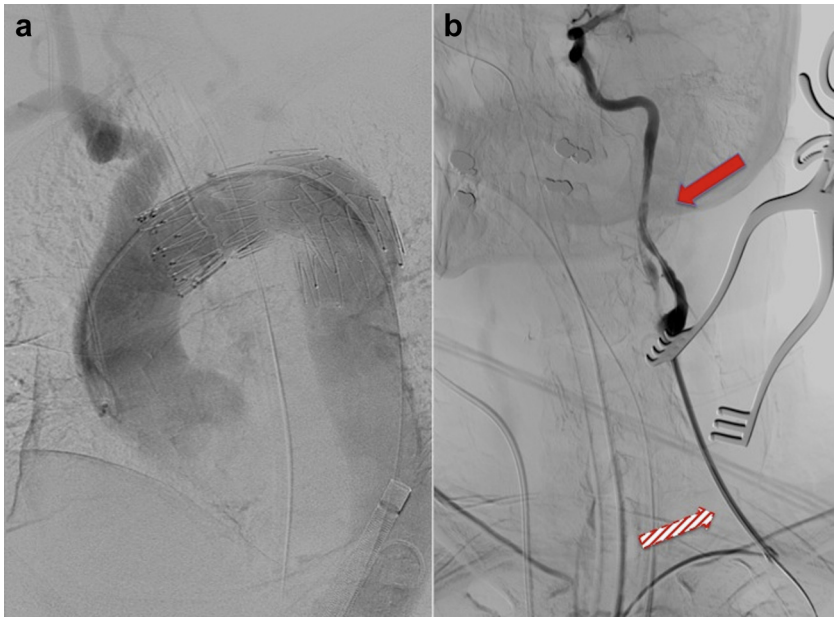

Fig 2. a, Angiography confirmed coverage of the left common carotid artery (LCCA) by the proximally migrated endograft and **(b)** with help of external tubing (*dashed arrow*), the 20-French (F) sheath in the right common femoral artery was connected to the LCCA sheath, thus providing antegrade perfusion to the LCCA (*solid arrow*) during the rest of the procedure.

dilator tip at the distal edge of the previously implanted endograft, thus leading to proximal displacement of the first stent graft into the aortic arch with complete coverage of all supra-aortic branches. To deal with this catastrophic complication, the second endograft was immediately exchanged for a short 20-F Check-Flo-sheath (Cook Europe) and a compliant Coda balloon (Cook Europe) was introduced into the distal part of the migrated first stent graft, inflated and aggressively pulled back. The stent graft moved 3 to 5 cm distally before progress was arrested by engagement of the barbs. A second pull-back maneuver was done with the Coda balloon inflated in the proximal stent graft, but no further distal movement could be accomplished. Angiography thereafter showed the proximally displaced endograft covering the left common carotid artery (LCCA; Fig 2, *a*). At this time, approximately 3 minutes after initial coverage, the patient had an occluded LCCA with perfusion of the innominate artery. With the patient receiving cerebral cooling and mild hypothermia, and ventilation with 100% oxygen, an urgent LCCA cut-down was performed. After proximal and distal control, a 6-F sheath was inserted antegrade in the LCCA. Using external tubing, the 20-F sheath in the right common femoral artery was connected to the LCCA sheath, thus providing antegrade perfusion during the rest of the procedure (Fig 2, *b*). For the external tubing, a 140-cm Heidelberger Extension line with an outer diameter of 4.1 mm (inner, 3 mm) was used.