Masters of Cardiothoracic Surgery

A new hybrid graft for open thoracoabdominal aortic aneurysm repair

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Introduction

The Thoracoflo® graft was developed as a new hybrid device for thoracoabdominal aortic aneurysm (TAAA) repair. The aim was to offer strategies to mitigate perioperative mortality/morbidity through a combined endovascular thoracic and open abdominal aortic single-stage operation. The SPIDER technique for graft implantation allows temporary, pulsatile distal perfusion of visceral, renal, and iliac arteries via a side-branch attached to the common iliac artery following the deployment of the stent-supported part of the device. Thoracotomy, radiation, and extracorporeal circulation (ECC) can be avoided, while enabling reimplantation of visceral, renal, and lumbar arteries (1-5).

Clinical vignette

A 30-year-old female patient with Loeys-Dietz syndrome type I developed acute type A dissection. She was treated with David repair, including aortic arch repair using a frozen elephant trunk (FET) technique. Thoracic endovascular aortic repair (TEVAR) was performed in the descending thoracic aorta, but she developed a rapid, progressive dissecting TAAA type II false lumen aneurysm. Due to her pretreatment, she was selected for TEVAR elongation of the FET and thoracoabdominal hybrid repair using the Thoracoflo® graft.

Surgical technique

After general anesthesia, transesophageal echocardiography (TEE) was established for controlled stent graft implantation. Femoral and radial arterial blood pressure monitoring lines were inserted to verify pulsatile distal blood flow after deployment. A femoral 14-F sheath for inflow balloon occlusion was established to reduce blood flow during deployment. Motor-evoked potentials (MEP) were measured throughout the procedure. The patient was placed in a supine position and median laparotomy was performed. The abdominal aorta, including the celiac trunk, superior mesenteric artery, left renal and both iliac arteries, were exposed via right visceral rotation in a secondary retroperitoneal approach.

Device description

The Thoracoflo® graft consists of a proximal stent graft with ring stents and a distal gelatin-sealed polyester, multibranched graft: a long, Y-shaped arm (11-mm each side) for bi-iliac reattachment and four prosthetic arms (8 mm for visceral, 6 mm for renal arteries). A 14-mm access branch carries the handle with the delivery system and can be used for reattachment of the lumbar arteries after graft deployment. A Siena collar between the stent-grafted and the multi-branched, gelatin-sealed, unstented polyester prosthesis for suture fixation to the native aortic

vessel prevents backbleeding from the intercostal arteries, as well as stent graft migration. The stent graft section is loaded into a 30-F, peel-away sheath, and can be customized to the landing zone in the descending aorta (28–38 mm in diameter and 90 or 140 mm in length). Longitudinal stiffness and stability of the stent graft is achieved by special orientation and formation of the ring stents. The tip at the top of the delivery system is equipped with a side hole, enabling over-the-wire implantation of the device via direct puncture of the access site in the abdominal aorta.

The handle with the delivery system is externalized via the 14-mm access branch on the dorsal side of the main body of the multi-branched graft and equipped with a splitter for sheath removal during deployment. The elongated design of the splitter prevents the amount of blood loss during extraction of the delivery system through the access branch. The release wire for fixation of the proximal stent graft component on the introducer tip is inserted through the delivery system and fixed on a release clip at the end of the handle.

Operation

Before implantation, all side branches to the left iliac sidebranches were distally equipped with a 2-way stopcock and flushed with heparinized saline solution. The left iliac branch was temporarily anastomosed end-to-side to one common iliac artery and clamped until the stent graft was deployed and the graft was deaired. The access point for the stent graft (visceral artery ostium or aorta) was secured with a purse string prolene suture. The stent-grafted section of the Thoracoflo® graft was introduced over the guidewire after direct puncture of the aorta. The guidewire was established into the true lumen of the descending thoracic aorta under TEE control. The needle was retracted and the puncture hole was stepwise dilated using 16- and 20-F dilator sheaths. The guidewire was externalized through the sidehole in the nose cone of the introducer tip and the stent graft component of the hybrid graft was introduced whilst the cardiac output was reduced by in-flow occlusion under TEE control to reduce the risk for severe access-site bleeding. The guidewire was extracted before the peelaway sheath was retracted to deploy the stent graft. The proximal fixation wire was released.

The delivery system was retracted until the nose cone was in the access branch. The access branch was clamped and the proximal part of the extended splitter was opened, allowing retraction of the delivery system with minimized blood loss. The graft was deaired via the access branch and the 2-way stopcock of the side branches. Cardiac output reduction was released and the clamp of the iliac side branch was removed. The visceral arteries and the left renal artery were reattached end-to-end to the corresponding branches. After infrarenal crossclamping, the suprarenal aorta was opened until the access side of the stent graft. The right renal artery was temporarily perfused via a perfusion catheter attached to the right iliac side branch and the collar was attached to the native aorta (3-0 Prolene) to prevent backbleeding and distal graft migration. Finally, the right renal artery was attached and the temporary iliac anastomosis was replaced by end-to-end anastomosis to both iliac arteries.

Postoperative course

The procedure was successfully performed and MEP monitoring showed no sign of spinal cord injury. The patient was extubated during the night and released from the intensive care unit on post-operative day (POD) 3 without events. She was released home on POD 15. During follow-up transposition of the left vertebral artery to the left carotid artery, vascular plug occlusion of the subclavian artery was performed due to a progressive dissecting aneurysm of the left subclavian artery.

Comments

The Thoracoflo® graft can avoid thoracotomy and ECC, with reduced blood loss and distal pulsatile blood flow allowing for short ischemic times, which might decrease the risk of spinal cord ischemia.

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Footnote

Conflicts of Interest: The graft development was supported by Terumo Aortic. ALE is a consultant for WL Gore, CryoLife, Edwards Lifesciences, and Terumo Aortic. The authors have no other conflicts of interest to declare.

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