Total endovascular treatment for extent type 1 and 5 thoracoabdominal aortic aneurysms

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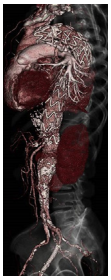
ABSTRACT

Objective: The study objective was to describe the results of thoracic endovascular aortic repair with the intentional coverage of the celiac artery and distal supramesenteric landing zone for extent type 1 and type 5 thoracoabdominal aortic aneurysms.

Methods: Inclusion criteria were thoracic endovascular aortic repair with celiac artery coverage to treat elective or urgent extent type 1 and 5 thoracoabdominal aortic aneurysms. Primary end points were in-hospital and follow-up survival, freedom from aortic-related mortality, and freedom from reintervention.

Results: Thoracoabdominal disease extent was type 1 in 12 patients (71%) and type 5 in 5 patients (29%). Urgent repair was performed in 4 patients (23.5%). Primary technical success was 100%. Early mortality and visceral ischemia did not occur. Permanent spinal cord ischemia rate was 6% (n = 1). Follow-up ranged from 3 to 120 months (interquartile range, 12-36.5). Survival estimate was 85% ± 9% (95% confidence interval, 67-94) at 1 year and 49% ± 17% (95% confidence interval, 21-78) at 5 years. Cumulative freedom from aortic-related mortality was 94%, and estimated freedom from reintervention at 1 and 5 years was 93% ± 7% (95% confidence interval, 68-99). Neither type 1 endoleaks nor distal stent-graft migration causing superior mesenteric artery occlusion was detected.

Conclusions: Thoracic endovascular aortic repair with intentional coverage of celiac artery for extent 1 and 5 thoracoabdominal aortic aneurysms had satisfactory results in selected patients at high risk for open repair. Visceral ischemia did not occur, but spinal cord ischemia is still high at 6%. At midterm follow-up, neither endoleak development nor aortic reintervention was related to the inadequate distal landing zone. Follow-up survival is satisfactory and comparable to open repair. (J Thorac Cardiovasc Surg 2017;154:1487-96)



Total endovascular repair for Crawford extent 1 TAAA.

Central Message

TEVAR with intentional coverage of the CA for extent 1 and 5 TAAAs had results comparable to those for conventional OR.

Perspective

Visceral involvement of the aneurysmal disease often is a prohibitive factor for TEVAR using standard SG because of the proximity of the mesenteric circulation. In selected cases, TEVAR using standard SG with the coverage of the CA may be a viable technique for patients who may not tolerate complex and risky OR.

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Thoracic endovascular aortic repair (TEVAR) has demonstrated better results than open repair (OR) for descending thoracic aortic aneurysms.[1] However, the visceral involvement of the aneurysmal disease often is a prohibitive factor for TEVAR using a standard stent-graft (SG) because of the proximity of the mesenteric circulation and anatomically inadequate distal sealing zone. Only few centers of excellence have published acceptable operative mortality rates less than 10% after OR for thoracoabdominal aortic aneurysms (TAAAs)[2-4]; in the "real world" practice, OR for TAAAs is still plagued by a mortality rate up to 22%.[5]

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Abbreviations and Acronyms

ARM	= aortic-related mortality
CA	= celiac artery
CI	= confidence interval
CSFD	= cerebrospinal fluid drainage
CTA	= computed tomography angiography
IQR	= interquartile range
OR	= open repair
SCI	= spinal cord ischemia
SG	= stent-graft
SMA	= superior mesenteric artery
SVS	= Society for Vascular Surgery
TAAA	= thoracoabdominal aortic aneurysm
TEVAR	= thoracic endovascular aortic repair

Hybrid reconstructions, TEVAR with fenestrations, or parallel-graft techniques have been used as alternative techniques especially for patients at high risk for OR, but even these are physically and technically demanding procedures or still have unproven durable long-term results.[6,7] Total visceral reconstruction (open, hybrid, endovascular with fenestrations) is unavoidable in most TAAAs: however, in extent type 1 and type 5, TEVAR using standard SG with the coverage of the celiac artery (CA) can be a less complex and strenuous procedure.[8-11]

The aim of this article was to report our results with total endovascular repair of extent type 1 and type 5 TAAAs using standard TEVAR with the intentional coverage of the CA and supramesenteric distal landing zone.

MATERIALS AND METHODS

Study Design and Cohort of Patients

This is a single-center, observational descriptive study. Starting in June 2006, all patients treated with TEVAR for TAAA were identified (Figure 1). For the final analysis, the end of the study was December 1, 2016.

The present cohort includes the following:

- TEVAR with coverage of the CA to treat elective (diameter ≥60 mm) or urgent extent type 1 and type 5 TAAAs in patients considered unfit for OR.

The cohort does not include the following:

- TEVAR with CA coverage to treat elective or urgent saccular juxtaceliac aortic lesions;
- distal SG extension with CA coverage to treat elective or urgent type 1b endoleak;
- TAAA treated with OR or hybrid reconstruction (TEVAR with retrograde visceral vessels revascularization); and
- TAAA treated with branched/fenestrated SG, or with ancillary techniques such as chimney/snorkel/periscope.

All clinical and procedural data were prospectively collected and recorded into a computerized database. Information about demographics, comorbidities, medical and surgical history, operative details and postoperative events during the hospital stay, and follow-up was registered. Informed consent was signed by all patients. Approval for this specific study was obtained by the local Institutional Review Board according to the National Policy in the matter of Privacy Act on retrospective analysis of anonymized data.

Aortic Assessment, Treatment Protocol, and Follow-up

This type of TEVAR was performed if the distal SG landing zone was less than 41 mm in diameter and 10 mm at least in length from the origin of the superior mesenteric artery (SMA) (Figure 2, *A-C*). Meticulous attention was paid to evaluate the mesenteric circulation: Both the SMA and the portal vein had to be patent. Thus, exclusion criteria were morphologic and clinic-pathologic:

- aortic disease extent involving both the CA and the SMA;
- larger (>41 mm) aortas;
- SMA occlusion or signs/symptoms of abdominal angina, or portal vein occlusion; and
- chronic dissection with very narrowing true lumen.

For the gastroduodenal collateral network between the SMA and the CA, a preoperative selective arteriogram was eventually performed using the temporary CA balloon occlusion test to further delineate the existence of these collaterals when computed tomography angiography (CTA) did not elucidate them clearly.[12,13] Triple-phase CTA follow-up was performed at 1, 6, and 12 months, and on an annually basis thereafter (Figure 3, *A*, *B*, *C1-2*). Maximum aortic diameter was measured on preoperative CTA and on the most recent postoperative CTA.

Operative Technical Details

All operations were performed in the operating room, using general anesthesia in all patients. According to the cardiovascular risk of the patient, general anesthesia was performed using midazolam 0.01 to 0.1 mg/kg, propofol 1 to 2 mg/kg or thiopental sodium 2 to 4 mg/kg, fentanyl 1 to 2 γ/kg, and rocuronium 0.6 to 1.2 mg/kg. General anesthesia was maintained using halogenated gases. The management of spinal cord ischemia (SCI) prevention involved different aspects, which are in agreement with the most recent position statement of the European Association for Cardio-Thoracic Surgery vascular domain.[14] Briefly, in elective cases, antiplatelets and anticoagulants were suspended appropriately to limit the bleeding risk for cerebrospinal fluid drainage (CSFD) positioning. The CSFD catheter was inserted intraoperatively and maintained for at least 72 hours. Left subclavian artery revascularization was performed in the presence of a stable clinical condition, when the dominant left vertebral artery had been confirmed, or in the presence of previous abdominal aortoiliac surgery, patent arteriovenous access for hemodialysis, patent left internal thoracic artery in patients already submitted to coronary artery bypass grafting, and left arm ischemia/impotence. A combination of vasoactive agents infusion (dopamine, 3-5 γ/kg/min, noradrenaline 0.01-0.1 γ/kg/min, nitroglycerin 0.5-5 γ/kg/min), fluid intake, and diuretics (bolus of furosemide 10-20 mg or 50-150 mg/die of mannitol 5% infusion) was used to maintain a stable hemodynamic condition throughout the entire procedure, and the postoperative course: Mean arterial pressure was maintained at 80 mm Hg or greater, central venous pressure was maintained at less than 12 mm Hg, and transfusions were used to preserve hemoglobin level 10 g/dL or greater. Generally, SGs were deployed sequentially: the longest possible SG proximally and the shorter one distally, to have the best deployment control as possible at the SMA border. CA occlusion was always performed before the deployment of the distal SG. In all patients, we used an endovascular plug that was delivered through the transfemoral approach. Both the SG and the endovascular plug were oversized by 20%, according to the diameter of the normal